ECE 35, Fall 2017

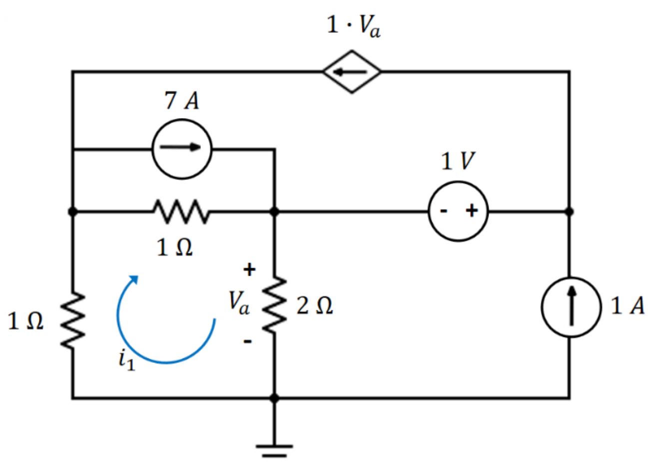
Quiz 1- Section A

Last name	
First + middle name(s)	
PID	

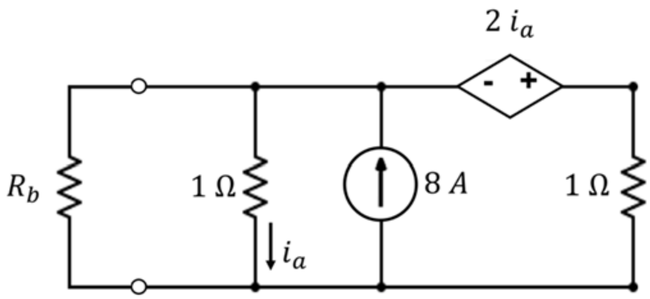
Instructions:

- 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) In the circuit below, find mesh current i_1. You can use any analysis method you like to solve this problem. Do not forget the units in your final answer.



(2) In the following circuit, find the value of R_b such that the power received by R_b is maximized. Do not forget the units in your final answer.



ECE 35, Fall 2017

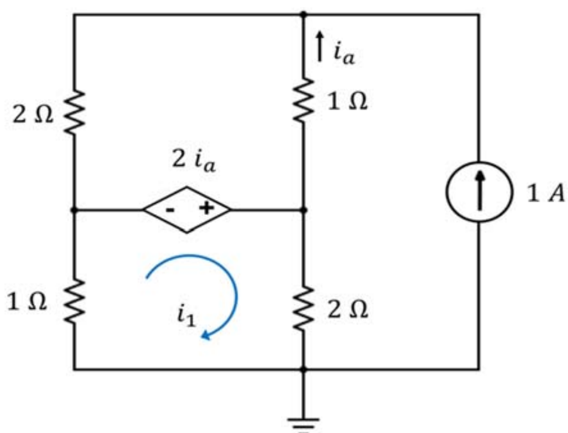
Quiz 1- Section B

Last name	
First + middle name(s)	
PID	

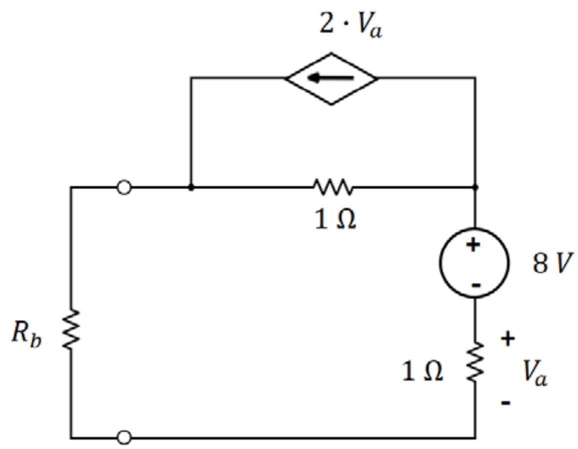
Instructions:

- 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) In the circuit below, find mesh current i_1. You can use any analysis method you like to solve this problem. Do not forget the units in your final answer.



(2) In the following circuit, find the value of R_b such that the power received by R_b is maximized. Do not forget the units in your final answer.



ECE 35, Fall 2017

Quiz 3 - Section A

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) Consider the system below (it is repeated on the next page). For $t < 0$, the switch is closed. At $t = 0$, the switch is opened and it remains open. At time $t = 0^-$, just before the switch was opened, the system was not in steady state, but it is given that $\boldsymbol{v_C(0^-) = 1V}$ and $\boldsymbol{i_L(0^-) = 2A}$.

(a) What is the energy in the capacitor at time $\boldsymbol{t = 0^+}$, (right after the switch is opened)?

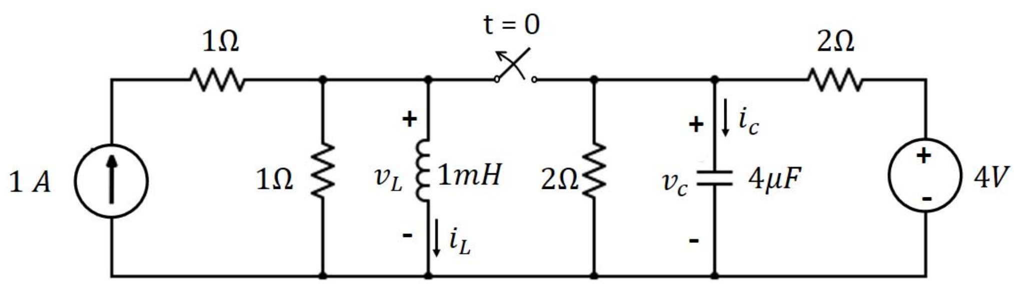
(b) Find the expression for the inductor voltage $\boldsymbol{v_L(t)}$, for $t > 0$.

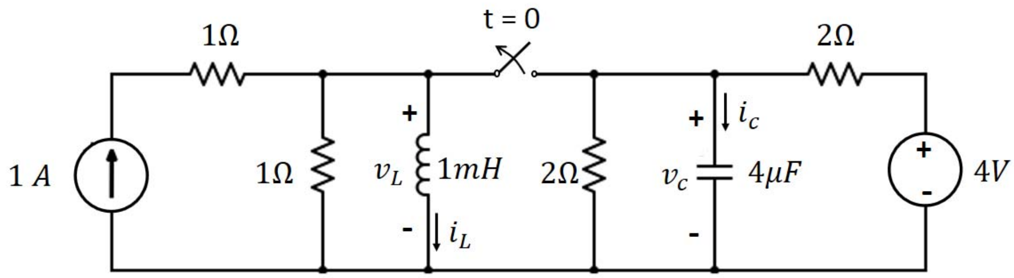
$\boldsymbol{v_L(t)}$ ***in V =***

(c) At time $t = 1000$, the switch is closed again. Find the capacitor voltage $\boldsymbol{v_C}$ and the inductor current $\boldsymbol{i_L}$ at time $\boldsymbol{t = \infty}$.

$\boldsymbol{v_C}$

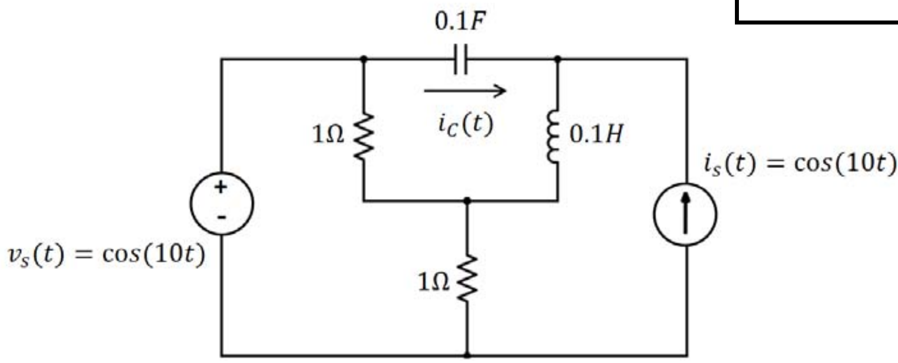
$\boldsymbol{i_L}$





t = 0
1Ω
2Ω
1 A
1Ω
+
v_L
1mH
-
i_L
2Ω
+
i_c
v_c
4μF
-
+
-
4V

(2) Find $i_C(t)$. (Hint: you can use nodal analysis)



ECE 35, Fall 2017

Quiz 3 - Section B

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) Consider the system below (it is repeated on the next page). For $t < 0$, the switch is closed. At $t = 0$, the switch is opened and it remains open. At time $t = 0^-$, just before the switch was opened, the system was not in steady state, but it is given that $\boldsymbol{v_C(0^-) = 8V}$ and $\boldsymbol{i_L(0^-) = -2A}$.

(a) What is the energy in the inductor at time $t = 0^+$, (right after the switch is opened)?

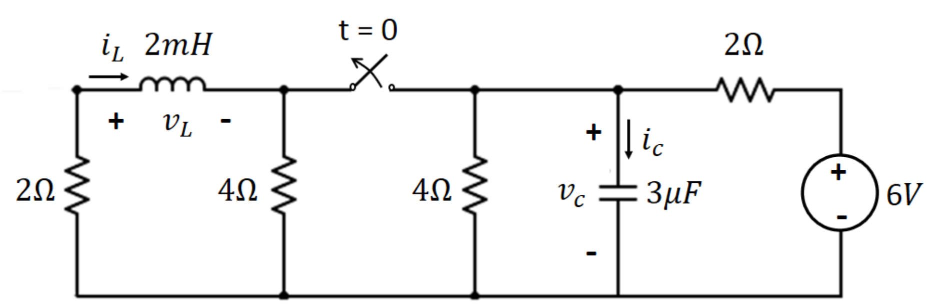
(b) Find the expression for the capacitor current $\boldsymbol{i_C(t)}$, for $t > 0$.

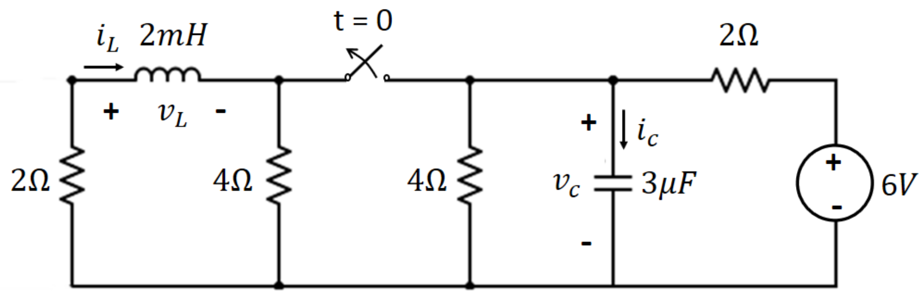
$i_C(t)$ in A =

(c) At time $t = 1000$, the switch is closed again. Find the capacitor voltage $\boldsymbol{v_C}$ and the inductor current $\boldsymbol{i_L}$ at time $\boldsymbol{t = \infty}$.

$\boldsymbol{v_C}$

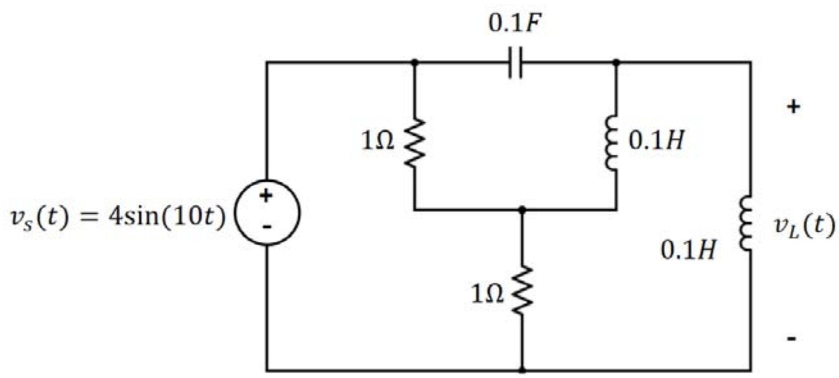
$\boldsymbol{i_L}$





i_L
$2mH$
$t = 0$
2Ω
+
v_L
-
2Ω
4Ω
4Ω
+
i_c
v_c
$3\mu F$
-
+
-
$6V$

(2) Find $v_L(t)$. (Hint: you can use nodal analysis)



ECE 35, Fall 2018
Quiz 2

/ 20

Last name

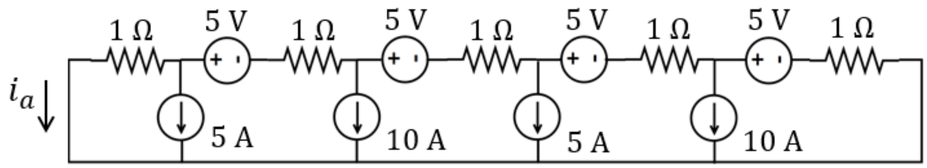
First + middle name(s)

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) Find i_a. *(4 points)*

i_a

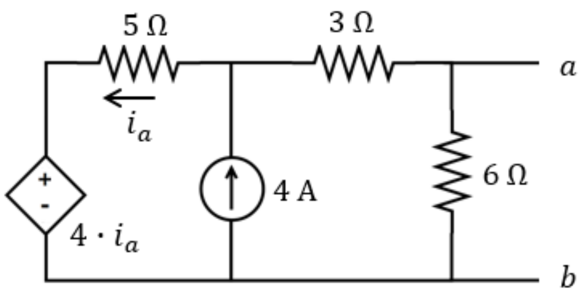


(2) (a) Find the load resistor R_L that needs to be attached between a and b to maximize the power in R_L. *(4 points)*

(b) Assume that with the R_L you found in part (a), the power received by R_L is P_1. When you change the independent current source to 8 A, this power changes to $k \cdot P_1$. What is the value of k? *(1 point)*

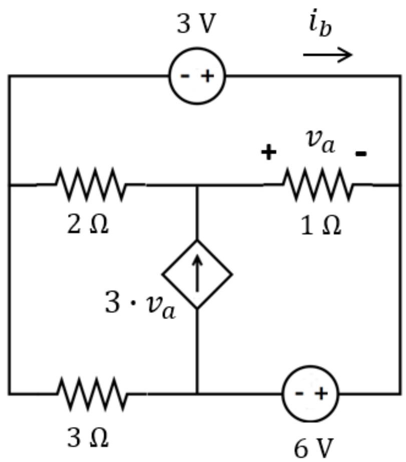
R_L $\boxed{}$

k $\boxed{}$



(3) Find i_b. You must use MESH analysis. First write all your equations; then solve. *(6 points)*

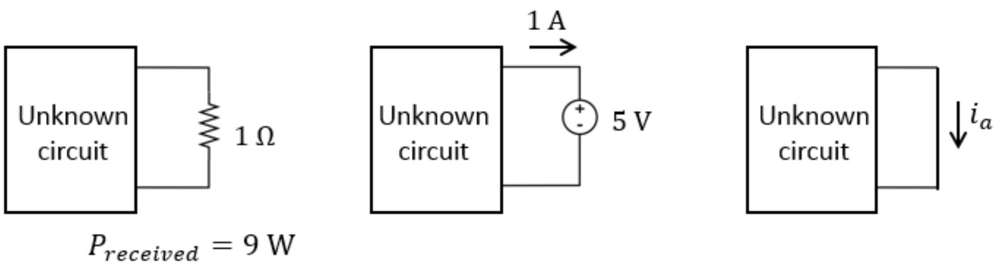
i_b $\boxed{}$



(4) Below you see three configurations with the same unknown circuit. When a 1 Ω resistor is attached, the power received by that resistor is 9 W. When a voltage source of 5 V is attached, the current is 1 A.

What is the current i_a when the two terminals are shorted together? *(5 points)*

i_a



ECE 35, Fall 2018

Quiz 3

/ 20

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

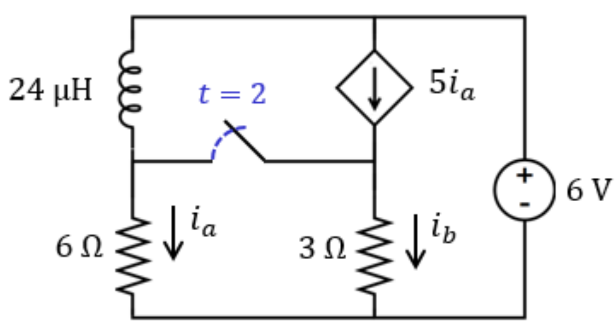
(1) For $t < 2$ s, the switch is closed and you may assume the system has reached steady state. The switch opens at time $t = 2$ s.

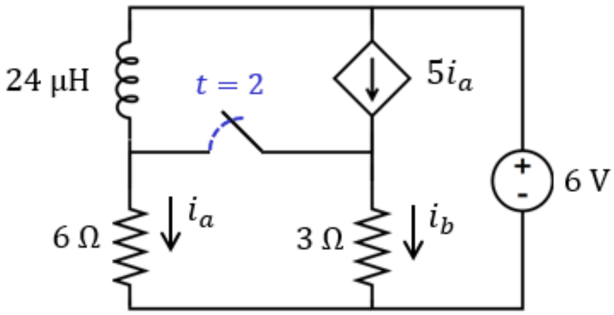
(a) Find $i_b(2^-)$. *(1 point)*

$i_b(2^-)$

(b) Find $i_b(t)$ for $t > 2$ s. *(6 points)*

$i_b(t)$

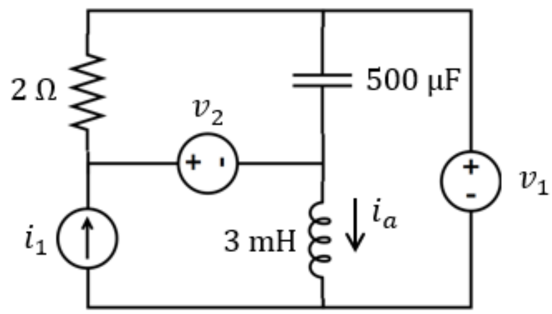




(2) For an RC system, we found $i_1(t) = -4 \cdot e^{-t/4\,s} + 1$ A. Draw this waveform. Indicate where you can find the time constant on the graph. *(2 points)*

(3) The system is in steady state. Find $i_a(t)$. (In your answer, combine cosines/sines with the same frequency. So for each frequency, there should be only one cosine wave.) *(6 points)*

$i_a(t)$	



$i_1(t) = \sin(1000t)$ A

$v_1(t) = 2 \cdot \cos(1000t + \pi)$ V

$v_2(t) = 4$ V

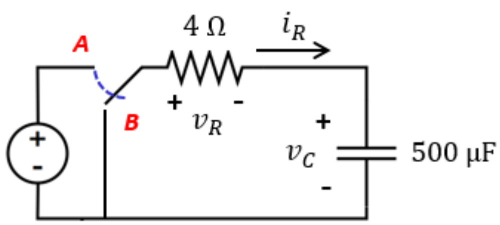
(4) In the circuit below, the switch moves from position A to position B at time t = 0 s. For *t* < 0 s (switch in position *A*), you may assume the system is in steady state. The voltage source is sinusoidal with $\omega = 1000$. The diagram shows two phasors, **A** and **B** (not to scale). One of them represents the capacitor voltage and the other the resistor voltage (but you are not told which one is which). *(5 points)*

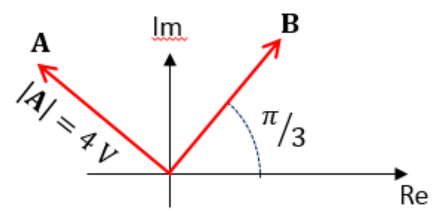
$i_R(0^-)$ ☐

$i_R(0^+)$ ☐

(a) Find i_R at time $t = 0^-$ (i.e. just before the switch moves to *B*).

(b) Find i_R at time $t = 0^+$ (i.e. immediately after the switch moves to *B*).





ECE 35, Fall 2019

Quiz 2

Sequence number	

Last name	
First + middle name(s)	
PID	

Grade

/ 10

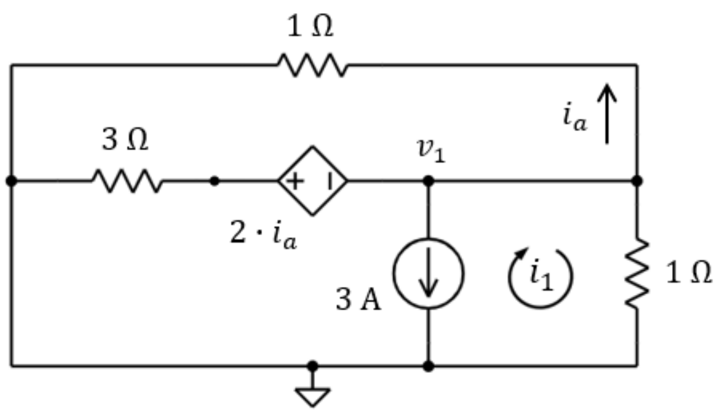
Instructions:

- 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) Find the value of **node voltage v_1** and of **mesh current i_1**.
You can use any analysis technique you want. *(5 points)*

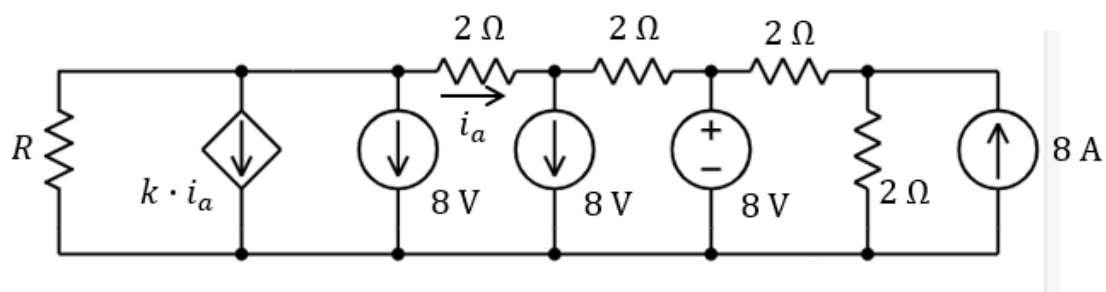
v_1 [   ]

i_1 [   ]



(2) *(5 points)* In the circuit below, someone tweaked resistor R until the power received by it is maximum. This resulted in R = 1 Ω. What is the value of k in the circuit?

k



ECE 35, Fall 2019

Quiz 2

Sequence number

Grade

/ 10

Last name

First + middle name(s)

PID

Instructions:

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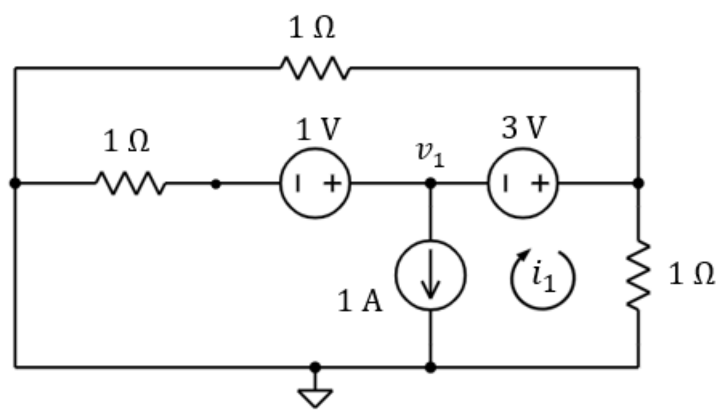
- Write your answers in the answer boxes for each question. Make sure you list units!
- Answers without supporting calculations will receive zero credit.

(1) Find the value of **node voltage v_1** and of **mesh current i_1**.
You can use any analysis technique you want. *(5 points)*

v_1 [ ]

i_1 [ ]



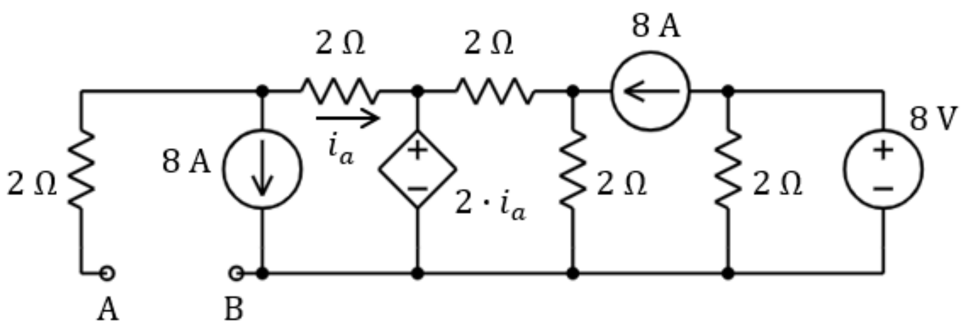
(2) *(5 points)*

(a) In circuit (a) below, find the Thevenin equivalent resistance as seen between A and B.

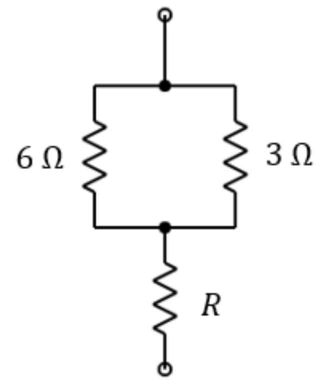
R_{Th} ☐

(b) I attach the load shown in (b) between A and B in the circuit of part (a). What value of R will result in the maximum power being received by this load (i.e., all the resistors of the load combined)?

R ☐



(a)



(b)

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Quiz 3 – Section A

Sequence number

Grade

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Last name

First + middle name(s)

PID

Instructions:
- Read each problem completely and thoroughly before beginning.
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- Write your answers in the answer boxes for each question. Make sure you list units!
- Answers without supporting calculations will receive zero credit.

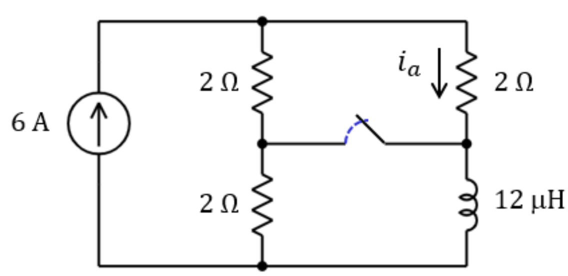
(1) *(5 points)* For $t < 2$ s, the switch is closed, and you may assume the system has reached steady state. The switch opens at time t = 2 s.

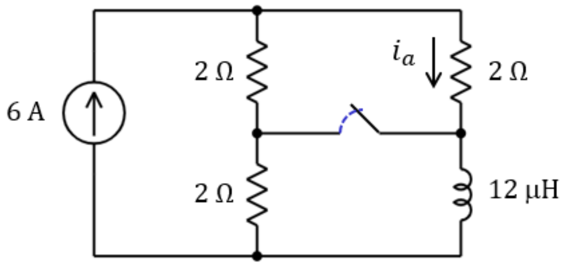
(a) Find $i_a(2^- \text{ s})$.

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

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

$i_a(t)$

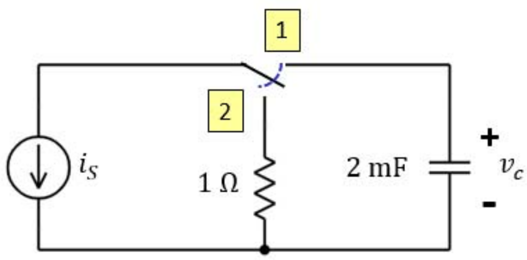


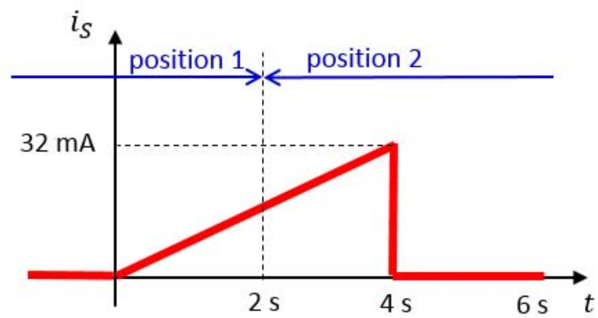

6 A
2 Ω
2 Ω
i_a
2 Ω
12 μH

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

(a) Find v_c at time t = 1 s. $v_c(1)$ [ ]

(b) Find v_c at time t = 6 s. $v_c(6)$ [ ]





(3) *(3 points)* For $t < 0$ s, the switch is open, and you may assume the system has reached steady state. <u>The switch closes at time $t = 0$ s</u>. You are given the curve of the voltage v_c over the capacitor for $t > 0$ s.

(a) On the curve, we see that $v_c = 1.5$ V at time t_1. What is the current i_a at that same time t_1?

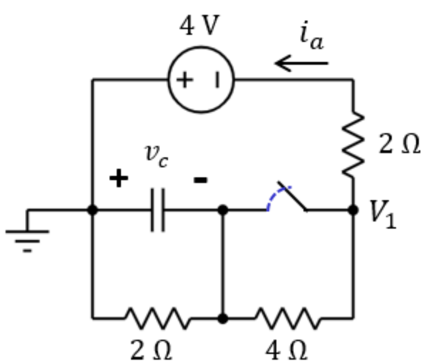
$i_a(t_1)$ ☐

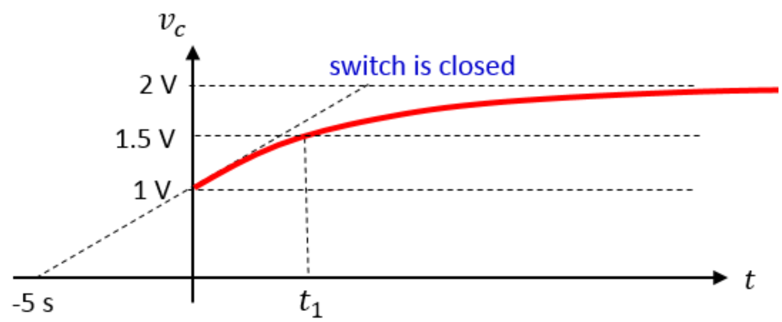
(b) What is the time constant τ of $v_c(t)$ for $t > 0$ s?

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	$\sqrt{3}$	∞

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Quiz 3 – Section B

Sequence number

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Last name

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PID

Instructions:

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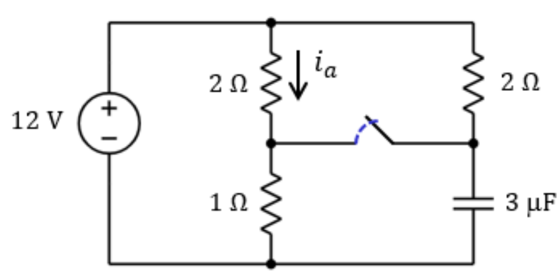
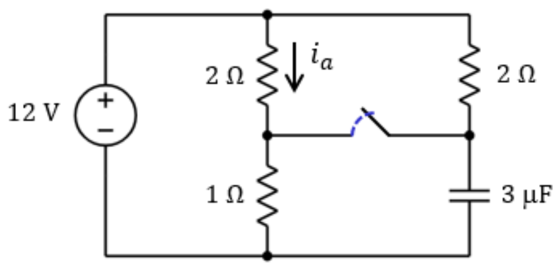
- Write your answers in the answer boxes for each question. Make sure you list units!
- Answers without supporting calculations will receive zero credit.

(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 $i_a(2^- \text{ s})$. $i_a(2^- \text{ s})$

(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

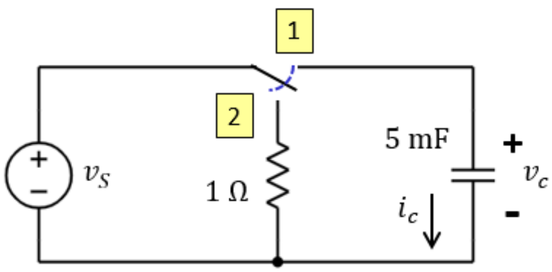
(2) *(2 points)* The capacitor is fully discharged at t = 0 s. For t < 3 s, the switch is in position 1. <u>The switch moves from position 1 to position 2 at time t = 3 s</u>. You are given the curve of the voltage source v_S.

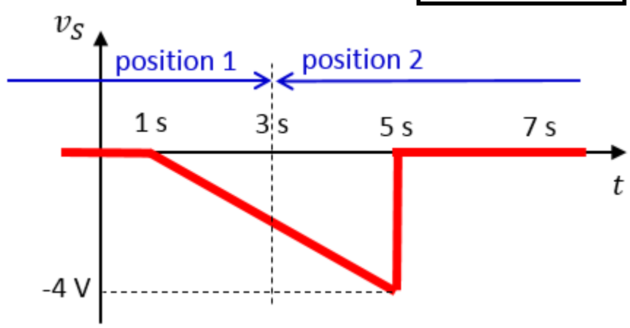
(a) Find v_c at time t = 4 s.

$v_c(4)$ $\boxed{}$

(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?

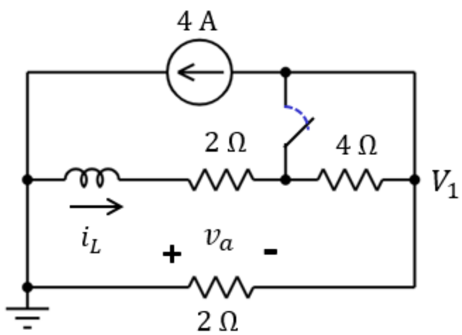
$v_a(t_1)$ $\boxed{}$

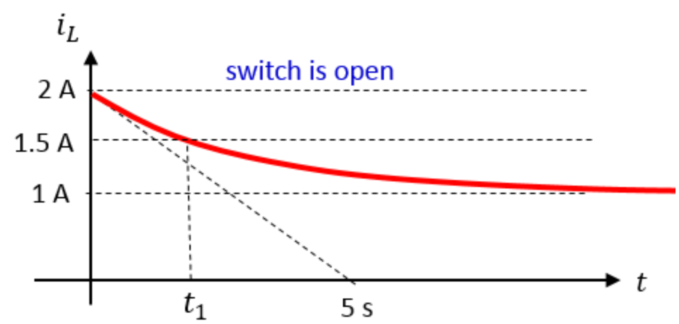
(b) What is the time constant τ of $i_L(t)$ for $t > 0$ s?

τ $\boxed{}$

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

τ $\boxed{}$





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

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

Trigonometry:

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

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

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

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

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

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

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

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

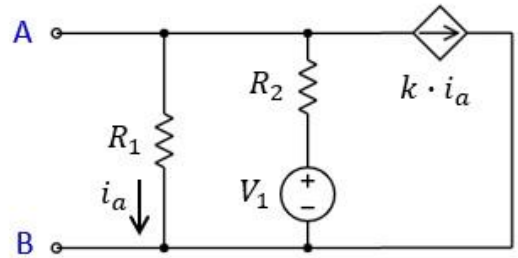
$\cos(\alpha)\cos(\beta) = 0.5 \cdot (\cos(\alpha - \beta) + \cos(\alpha + \beta))$

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

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	$\sqrt{3}$	∞

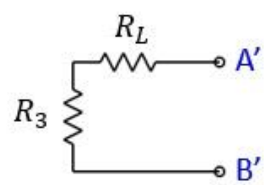
Q1

(a) Consider the circuit below. Find the Thevenin equivalent resistance R_{Th} between A and B.



R1:	3 Ω
R2:	1 Ω
V1:	6 V
k:	2 A/A
R3:	1 Ω

(b) Attach the circuit on the right to the circuit above (A′ connected to A and B′ connected to B). What is the value of R_L such that the power received by R_L is maximized?

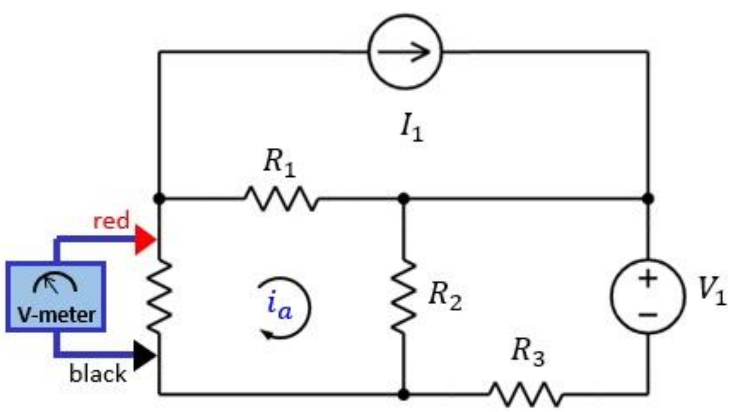


Q2

Consider the circuit below. For one of the resistors, you are not given its value. The volt-meter is ideal.

(a) The volt-meter reading is X. Find the mesh current i_a.

(b) We double both I_1 and V_1 and keep all the other circuit elements the same. What is i_a now?



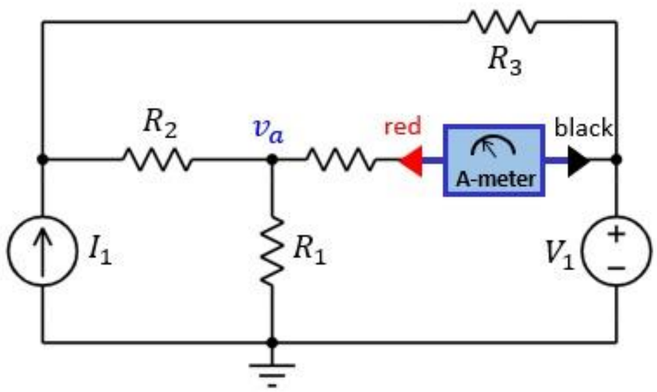
R1:	2 Ω
R2:	2 Ω
R3:	1 Ω
I1:	3 A
V1:	-5 V
X:	-4 V

Q1

Consider the circuit below. For one of the resistors, you are not given its value. The ammeter is ideal.

(a) The ammeter reading is X. Find the node voltage v_a.

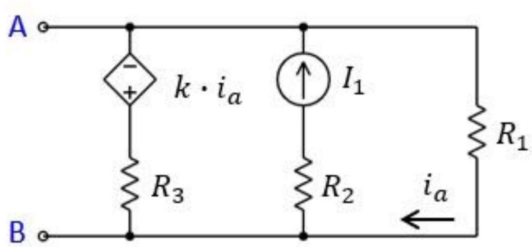
(b) We flip the direction of both I_1 and V_1 and keep all the other circuit elements the same. What is v_a now?



R1:	2 Ω
R2:	1 Ω
R3:	2 Ω
V1:	6 V
I1:	1 A
X:	1 A

Q2

(a) Consider the circuit below. Find the Thevenin equivalent resistance R_{Th} between A and B.

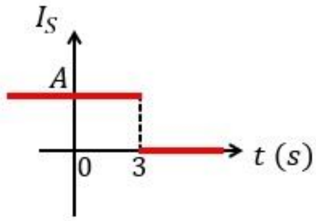


R1:	3 Ω
R2:	2 Ω
R3:	6 Ω
I1:	5 A
k:	3 V/A

(b) We double the value of I_1 and all other circuit elements remain the same. Find the value of R_L to be connected between A and B such that the power received by R_L is maximized.

Q1

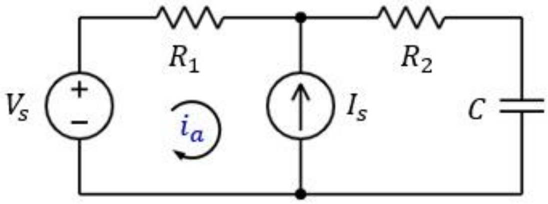
The current source I_s changes from A to 0 at t = 3 s, as shown on the right. For t < 3 s, you may assume the system has reached steady state. The current i_a is a mesh current.



(a) Find $i_a(3^-\ \text{s})$.

(b) Find $i_a(t)$ for $t > 3$ s. Write the equation.

R1:	1 Ω
R2:	2 Ω
Vs:	2 V
A:	6 A
C:	2 pF



Q2

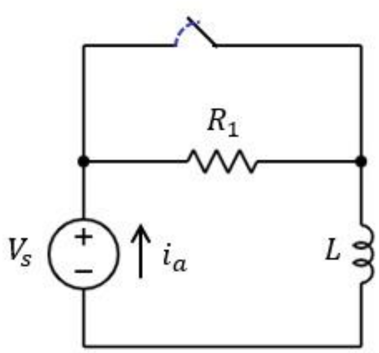
For t < 0 s, the switch is open, and you may assume the system has reached steady state. <u>The switch closes at time t = 0 s and opens again at time t = 4 s.</u>

(You can leave your answer written as a function of e)

(a) Find $i_a(2\ \text{s})$.

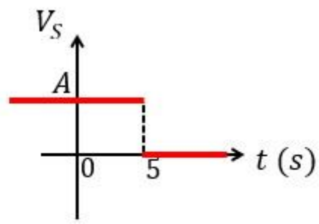
(b) Find $i_a(7\ \text{s})$.

Vs:	4 V
R1:	2 Ω
L:	4 H



Q1

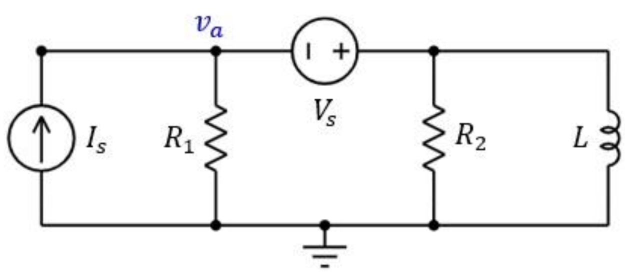
The voltage source V_s changes from A to 0 at $t = 5$ s, as shown on the right. For $t < 5$ s, you may assume the system has reached steady state. The voltage v_a is a node voltage.



(a) Find $v_a(5^-\ \text{s})$.

(b) Find $v_a(t)$ for $t > 5$ s. Write the equation.

R1:	1 Ω
R2:	2 Ω
Is:	2 A
A:	6 V
L:	2 nH



Q2

For $t < 0$ s, the switch has been opening and closing (and the capacitor may not have reached steady state).

<u>The switch closes at time $t = 0$ s.</u>

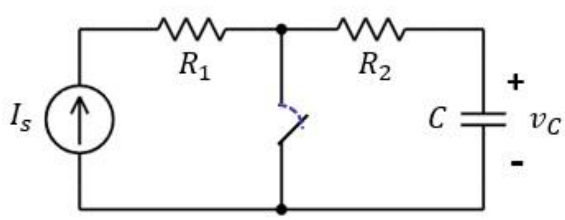
You are given the capacitor voltage at time $t = 4^-$ s:

$$v_C(4^-) = \text{X}$$

(a) Find $v_C(0^+\text{s})$. (You can leave your answer written as a function of *e*)

(b) The switch opens again at time $t = 4$ s. Find $v_C(6\ \text{s})$.

R1:	1 Ω
R2:	4 Ω
X:	3 V
Is:	1 A
C:	2 F



ECE 35, Fall 2021

Quiz 2

/ 12

Your sequence number

Last name

First + middle name(s)

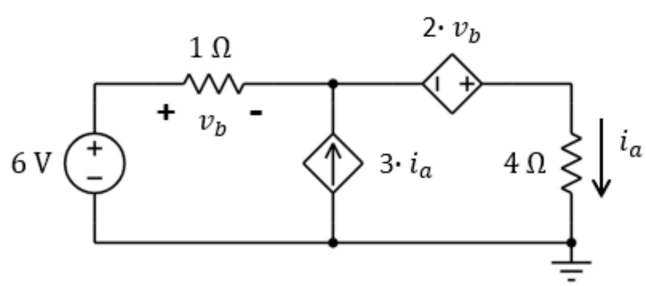
PID

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) (a) *(4 points)* Find the current i_a. You can use any analysis method. (Hint: we recommend mesh analysis.)

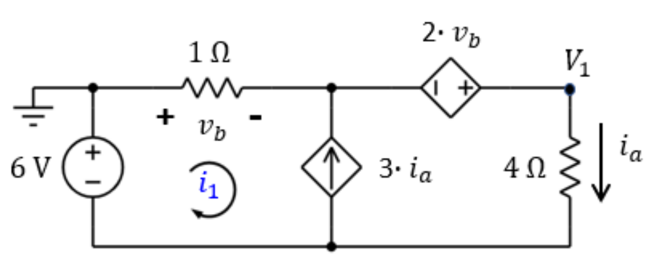
i_a



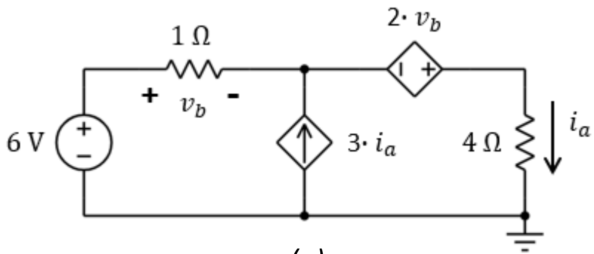
(b) *(2 points)* We keep the circuit the same but move the ground to a new location as shown below. Find the mesh current i_1 and the node voltage V_1.

i_1

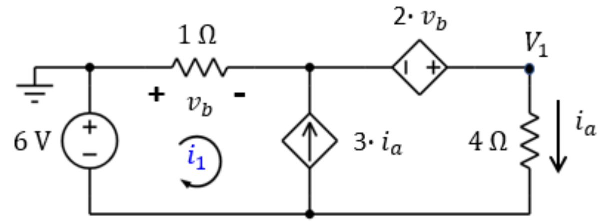
V_1



The circuits are copied on the next page for your convenience.



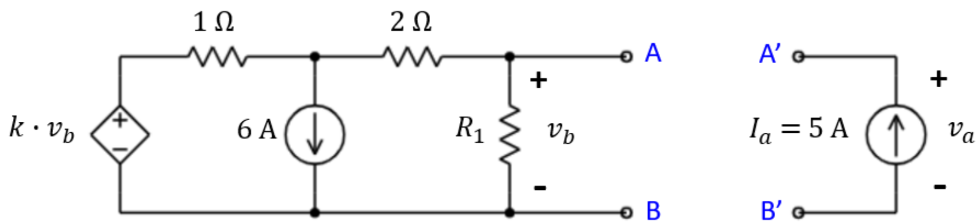
(a)



(b)

(2) (a) *(4 points)* You are asked to find the Norton equivalent model of the circuit below on the left. You are not given the values of R_1 and k in this circuit. However, you are told that if you connect the circuit on the right to it (A' connected to A and B' connected to B), a voltage v_a of **12 V** will appear across current source I_a (as indicated).

Draw the Norton equivalent model between A and B of the circuit on the left (i.e., without the circuit on the right attached to it). Make sure you label A and B in your model. (Hint: find the Norton equivalent current source I_N first.)



(b) *(2 points)* In the scenario above, we double the 6 A independent current source to **12 A** and change I_a to **1 A**. All other circuit elements remain the same. What is the new value of v_a when the two circuits are connected?

v_a $\boxed{}$

ECE35 Equation Sheet

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

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

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

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

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

Trigonometry:

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

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

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

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

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

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

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

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

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

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

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	$\sqrt{3}$	∞

ECE 35, Fall 2021

Quiz 3

/ 12

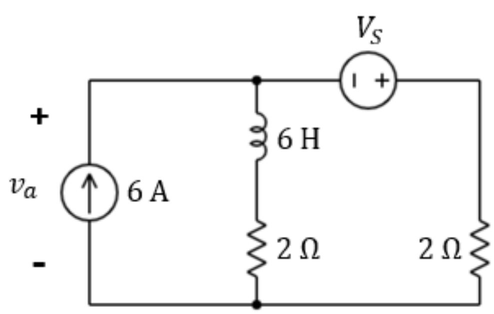
Your sequence number	
Last name	
First + middle name(s)	
PID	

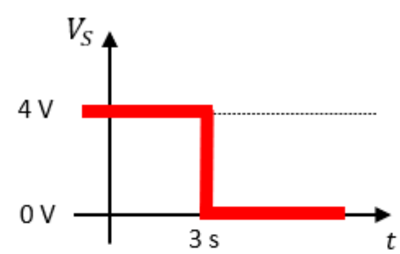
Instructions:
- Read each problem completely and thoroughly before beginning
- All calculations need to be done on these sheets
- Write your answers in the answer boxes for each question. Make sure you list units!
- Answers without supporting calculations will receive zero credit

(1) The voltage source V_S changes as shown in the figure. For t < 3 s, you may assume the system has reached steady state. *(7 points)*

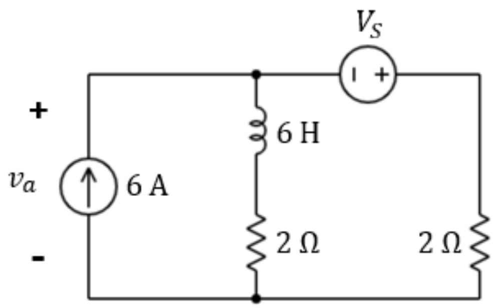
(a) Find $v_a(3^- \text{ s})$ (just before V_S changes) $v_a(3^- \text{ s})$ $\boxed{}$

(b) Find $v_a(t)$ for t > 3 s.
Write the equation. $v_a(t)$ $\boxed{}$

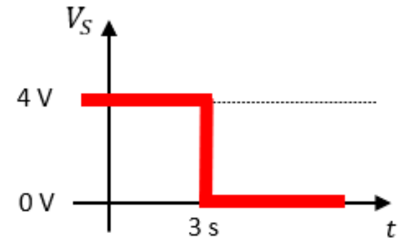




The circuit is copied on the next page for your convenience.



V_S
+
v_a
6 A
-
6 H
2 Ω
2 Ω

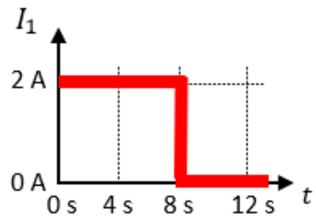


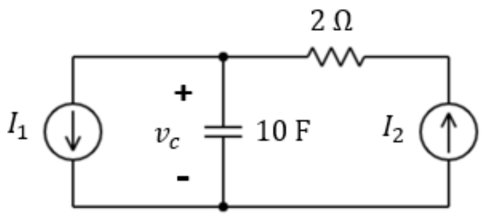
V_S
4 V
0 V
3 s
t

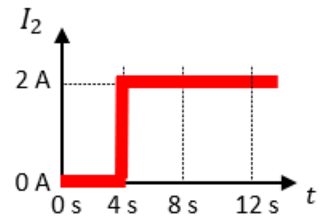
(2) The capacitor is fully discharged at t = 0 s. The two current sources change as indicated in the figures. *(5 points)*

(a) Find $v_c(4^- \text{ s})$ (just before I_2 changes) $v_c(4^- \text{ s})$ $\boxed{}$

(b) Find $v_c(9 \text{ s})$ (at time t = 9 s) $v_c(9 \text{ s})$ $\boxed{}$







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:

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

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

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

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

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

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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	$\sqrt{3}$	∞

ECE 35, Fall 2022

Your sequence number

Last name

First + middle name(s)

PID

Quiz 2

/ 12

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) (a) *(3 points)* Draw the Thevenin model for the circuit in figure 1 below, between A and B (make sure you label A and B in your drawing).

You are not given the values of V_1, I_1 or R_1. However, you are told that if you attach an ammeter as shown in figure 2, the ammeter reading is **2A**. Also, if you attach a voltage source as shown in figure 3, the current i_a is **2A**.

Drawing of the Thevenin model

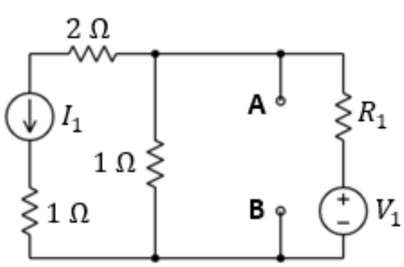


Figure 1

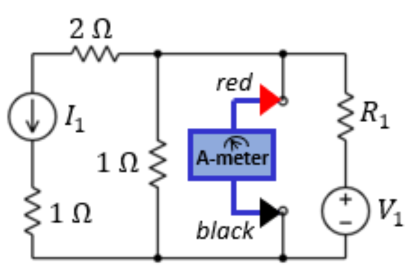


Figure 2

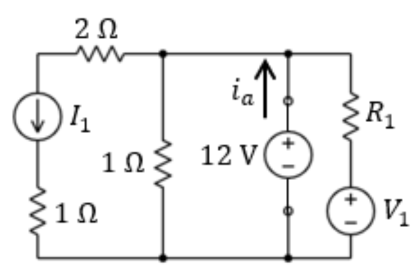


Figure 3

(b) *(3 points)* We attach the circuit from figure 4 to the one from figure 1 above (with A' connected to A and B' connected to B).
Find the value of k such that the power received by the two elements in figure 4 combined is maximized (i.e, the power received by the dependent source and the resistor combined).

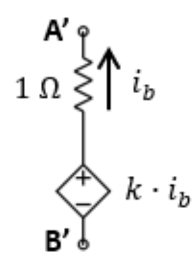


Figure 4

k

Copies of the circuits from the previous page …

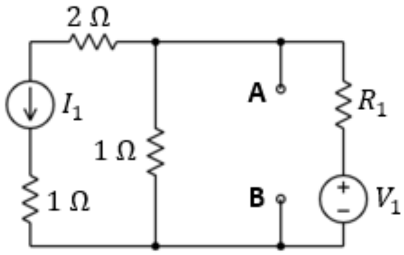


Figure 1

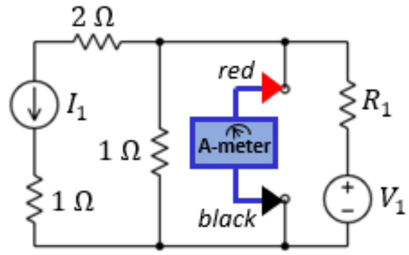


Figure 2

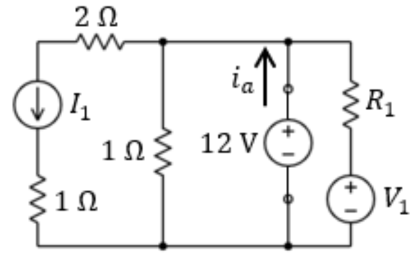


Figure 3

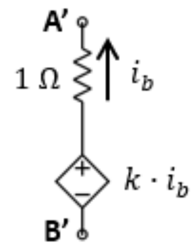


Figure 4

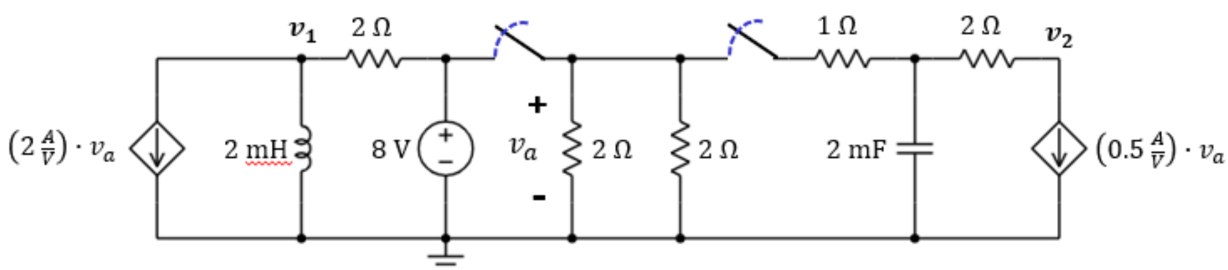
(2) *(6 points)* For $t < 2$ s, both switches are closed, and you may assume that the system has reached steady state. Both switches open at time $t = 2$ s.

(a) Find $v_1(2^-\ \mathrm{s})$. (i.e., the left node voltage just before the event) $v_1(2^-\ \mathrm{s})$

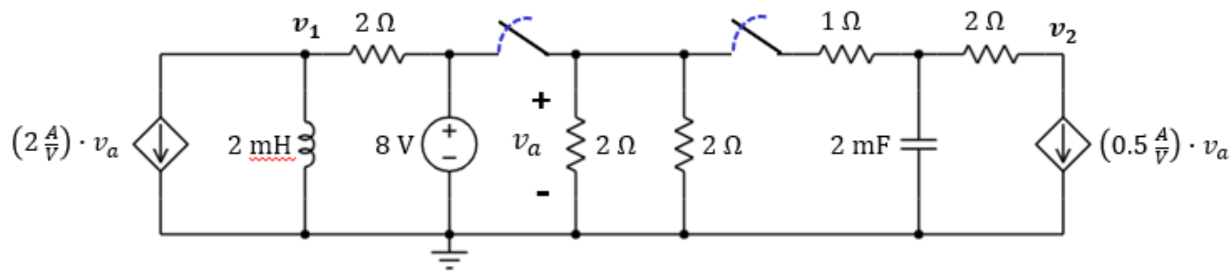
(b) Find $v_2(2^-\ \mathrm{s})$. (i.e., the right node voltage just before the event) $v_2(2^-\ \mathrm{s})$

(c) Find $v_1(2^+\ \mathrm{s})$. (i.e., the left node voltage just after the event) $v_1(2^+\ \mathrm{s})$

(d) Find $v_2(t)$ for $t > 2$ s.
Write the equation. $v_2(t)$
(i.e., for the right node voltage)



Copy of the circuit from the previous page …



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

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

Trigonometry:

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

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

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

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

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

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

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

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

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

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

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	$\sqrt{3}$	∞

ECE 35, Fall 2022

Quiz 3

/ 12

Your sequence number

Last name

First + middle name(s)

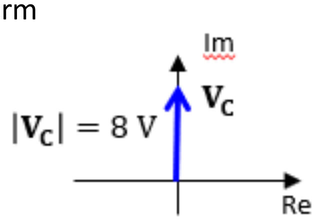
PID

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. <u>Make sure you list units!</u>
- Answers without supporting calculations will receive zero credit

(1) *(6 points)*

(a) Consider the circuit in Figure 1. It is in steady-state. The current source i_S is an AC source with $\omega = 5$ rad/s. In the diagram, we give you the phasor of $\boldsymbol{v_c}$. Find the current waveform $i_S(t)$.

$i_S(t)$



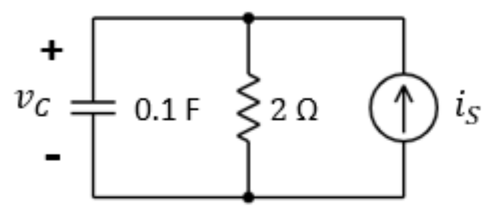


Figure 1

(b) Consider the circuit in Figure 2. It has the exact same components as the circuit in Figure 1 (including the same AC current source i_S). The only difference is that it contains two additional DC voltage sources. The circuit is in steady state. What is the value of v_x at time $t = \frac{\pi}{20}$ s?

$v_x(\frac{\pi}{20}$ s)

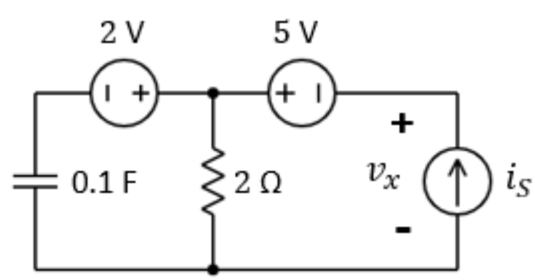
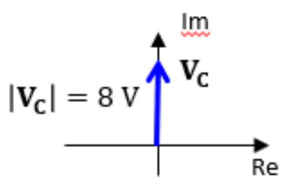


Figure 2

Copy of the circuits from the previous page …



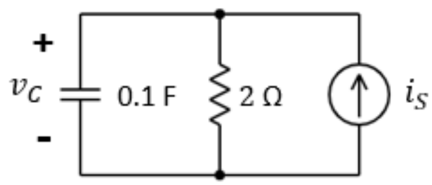


Figure 1

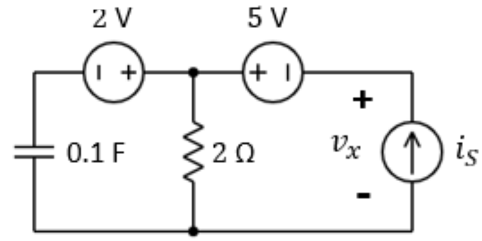


Figure 2

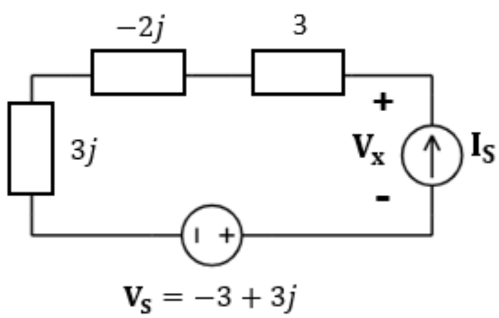
(2) *(6 points)* The circuit below represents an AC circuit in steady-state in the phasor domain (for the complex numbers, you may assume units are V, A, Ω, etc. as appropriate). Both sources in the circuit have the same ω, but you are not told the value of ω. Each box represents the impedance of a single circuit element (a resistor, capacitor or inductor).

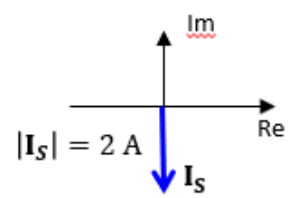
(a) Find the phasor $\mathbf{V_x}$. Your answer should be a complex number (can be in cartesian or polar form).

V_x

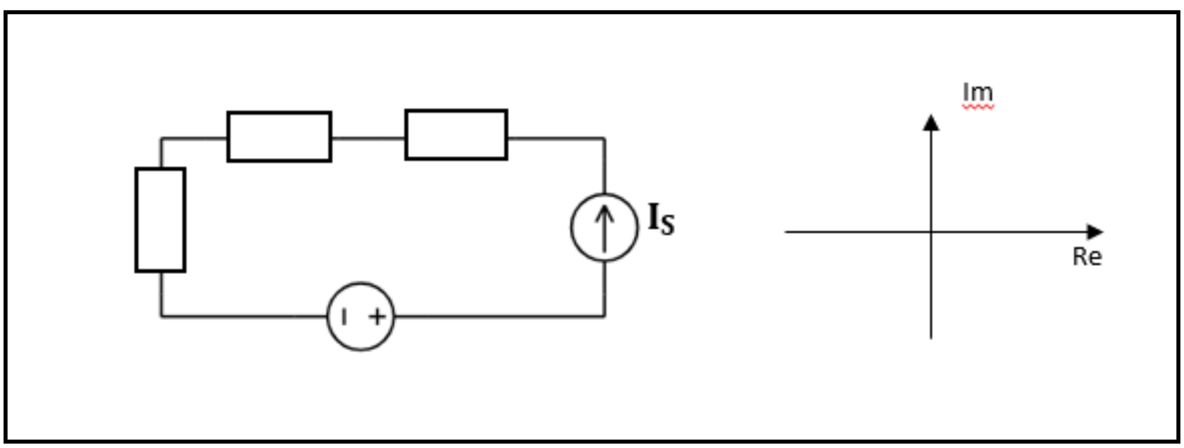
(b) What is the maximum value of the voltage waveform v_S(t)?

$v_{s\,max}$

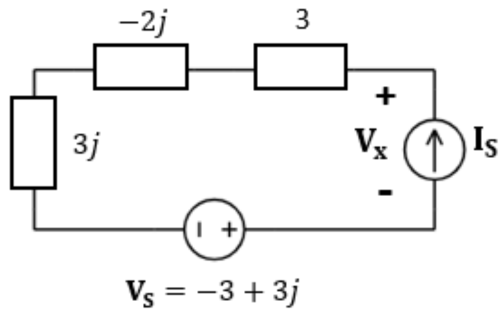


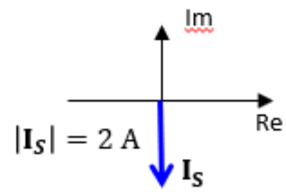


(c) We now double ω of both sources but keep everything else the same (such as the capacitor, inductor and resistor values; the amplitude and phase of the sources, etc.). In the drawing below, complete the circuit diagram for this new situation. I.e., add the new values of all the complex numbers and draw the new $\mathbf{I_S}$ vector (also label the angle and magnitude).



Copy of the circuit from the previous page …





ECE35 Equation Sheet

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

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:

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

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

Trigonometry:

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

ECE 35, Fall 2024

Your sequence number

Last name

Quiz 2

First + middle name(s)

/ 12

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. <u>Make sure you list units!</u>
- Answers without supporting calculations will receive zero credit.

(1) *(6 points)* Consider the circuit below. At time t = 1 s, the current source changes as shown in the figure, and will not change after that. Immediately before the current source changes, the system is <u>not</u> guaranteed to have reached steady-state.

However, you are told that immediately after the change, i.e., at time $t = 1^+$, the node voltage v_a = 2 V. In other words: $v_a(1^+\ \mathrm{s})$ = 2 V.

(a) Find $i_x(1^+\ \mathrm{s})$. (i.e., the current just <u>after</u> the current source changes)

$i_x(1^+\ \mathrm{s})$

(b) Find $v_a(1^-\ \mathrm{s})$. (i.e., the node voltage just <u>before</u> the current source changes)

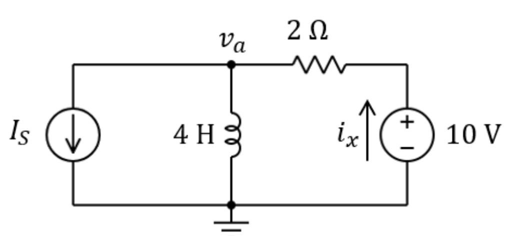
$v_a(1^-\ \mathrm{s})$

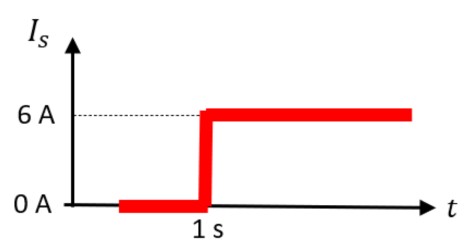
(c) Find $i_x(\infty)$.

$i_x(\infty)$

(d) Find $i_x(6\ \mathrm{s})$. (i.e., the current at time t = 6 s). You can leave your answer as a function of e.

$i_x(6\ \mathrm{s})$





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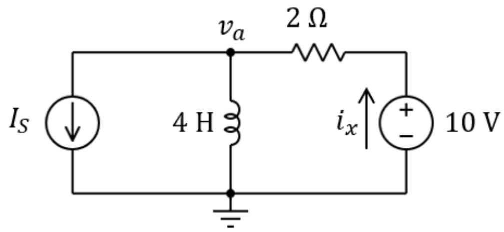

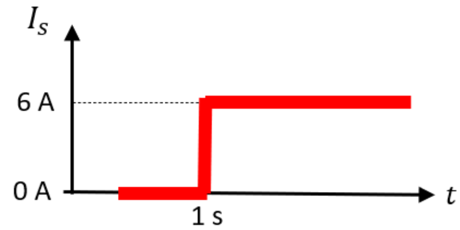

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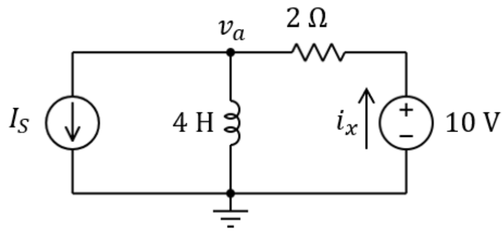

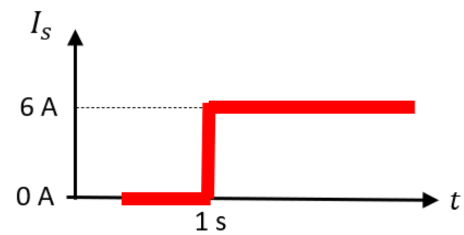

(2) *(6 points)* Consider the circuit below in Figure 1. You are not told the values of I_1 and V_1. However, you are told that if you attach the circuit from Figure 2 to the one from Figure 1 (with A' connected to A and B' connected to B), the value of $i_a = 3$ A.

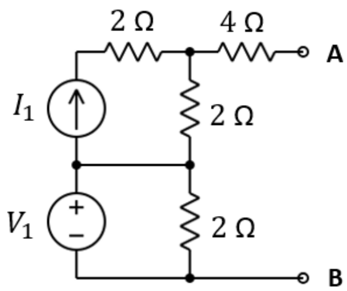

Figure 1

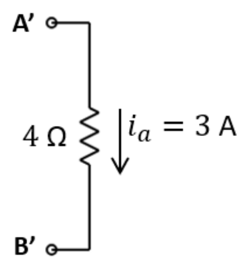

Figure 2

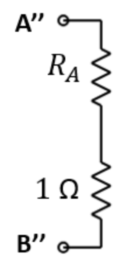

Figure 3

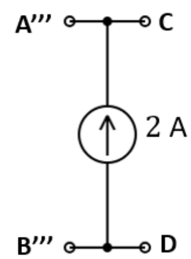

Figure 4

(a) <u>Draw</u> the <u>Thevenin</u> model between A and B for the circuit in Figure 1 (make sure you label A and B in your drawing).

(b) The circuit from Figure 3 is attached to the one from Figure 1 (with A'' connected to A and B'' connected to B). What should be the value of R_A to maximize the power received by R_A?

R_A

(c) The circuit from Figure 4 is attached to the one from Figure 1 (with A''' connected to A and B''' connected to B). For this new combined circuit, <u>draw</u> the <u>Norton</u> model between C and D (make sure you label C and D in your drawing).

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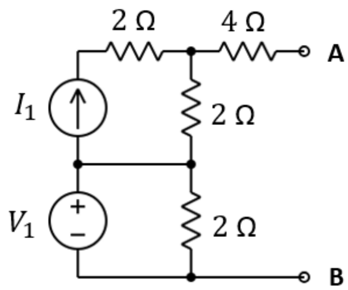

Figure 1

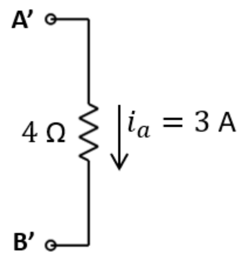

Figure 2

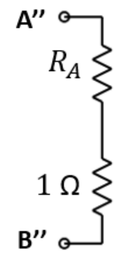

Figure 3

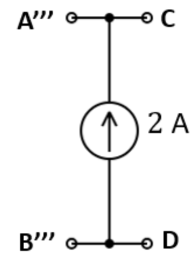

Figure 4

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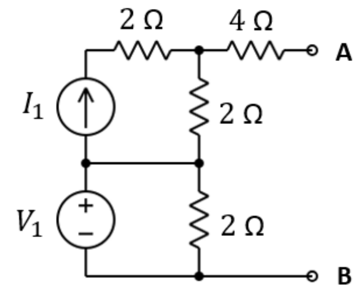

Figure 1

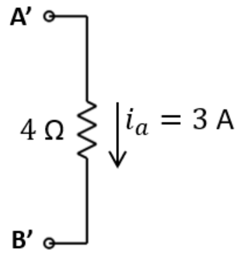

Figure 2

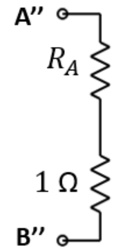

Figure 3

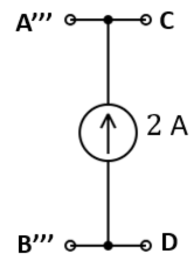

Figure 4

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

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

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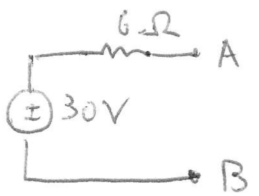
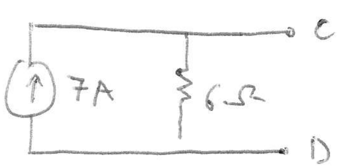
sin(α):	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1
tan(α):	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	∞

▽

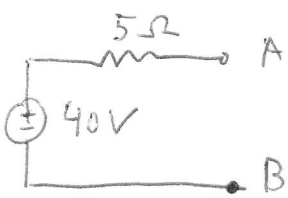
1.
   a. 4A
   b. 14V
   c. 5A
   d. $(-e^{-5/2}+5)$ A

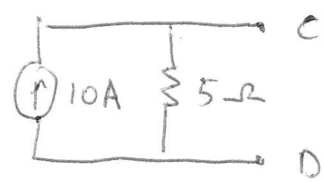
2.
   a. 

   b. 7 Ω
   c. 

△

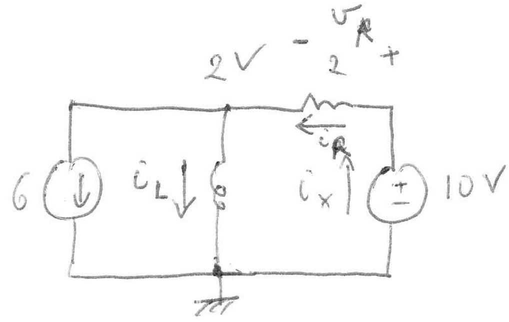
1.
   a. 5 A
   b. 16 V
   c. 6 A
   d. $(-e^{-3/2}+6)$ A

2.
   a. 

   b. 6 Ω
   c. 

1

(a) $t = 1^+$:

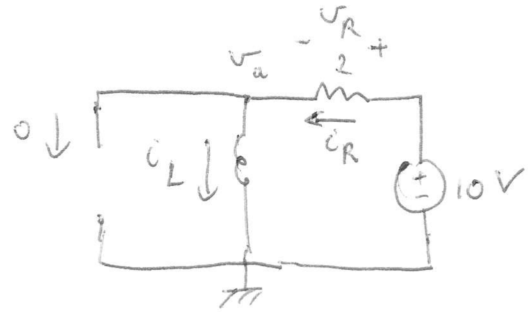


$v_R = 10 - 2 = 8$

$i_R = \frac{8}{2} = 4 \Rightarrow \boxed{i_x = 4A}$

KCL: $i_L + 6 = i_R \Rightarrow i_L = i_R - 6 = -2\,A$

(b) $t = 1^-$:



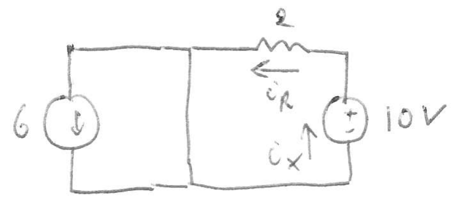
$i_L(1^-) = i_L(1^+) = -2\,A$

$i_R = i_L = -2\,A$

$v_R = 2 \cdot i_R = -4\,V$

$v_a = 10 - v_R = 14$ $\boxed{v_a = 14\,V}$

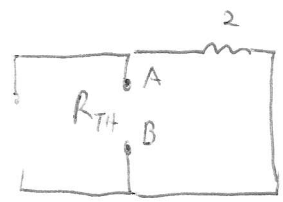
(c) $t = \infty$:



$i_x = i_R = \frac{10}{2} = 5\,A$

$\boxed{i_x(\infty) = 5\,A}$

(d) τ:



$R_{TH} = 2$ $\tau = \frac{L}{R_{TH}} = \frac{4}{2} = 2s$

$$i_x(t) = A e^{-\frac{(t-1)}{\tau}} + B$$

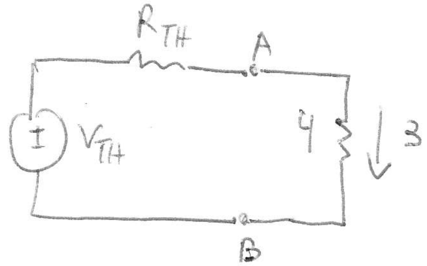
$$\begin{cases} i_x(\infty) = A \cdot 0 + B = 5 \Rightarrow B = 5 \\ i_x(1^+) = A \cdot 1 + B = 4 \Rightarrow A = -1 \end{cases}$$

$$i_x(t) = -e^{-\frac{(t-1)}{2}} + 5$$

$$\boxed{i_x(6) = (-e^{-5/2} + 5)\ A}$$

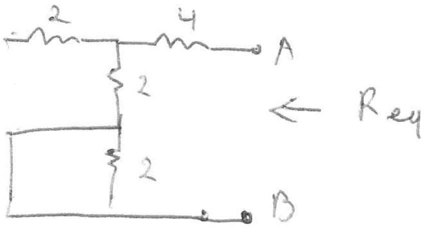
2

(a)



$$\frac{V_{TH}}{R_{TH}+4} = 3 \qquad (1)$$

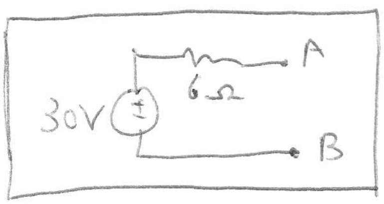
SET INDEP. SOURCES TO ZERO



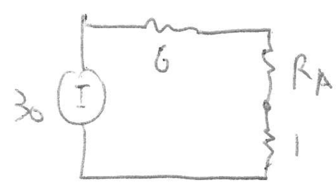
$$R_{eq} = 2+4 = R_{TH} \qquad (2)$$

(2) $R_{TH} = 6\,\Omega$

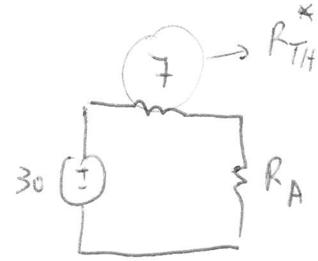
(1) $V_{TH} = 3(R_{TH}+4) = 30V$



(b)



NEW THEV. MODEL

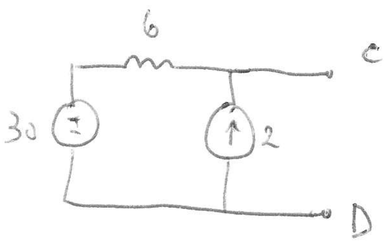


MAX POWER

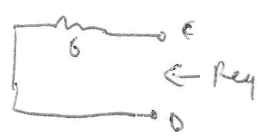
$R_A = R_{TH}^*$

$\boxed{R_A = 7\,\Omega}$

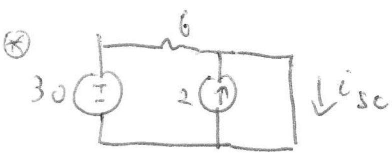
(c)



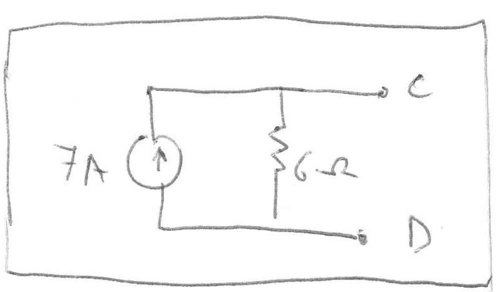
SET INDEP. SOURCES TO ZERO



$R_{eq} = 6 = R_N$



$$i_{sc} = \frac{30}{6} + 2 = 7$$



ECE 35, Fall 2024

Your sequence number

Last name

First + middle name(s)

PID

Quiz 2

/ 12

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. <u>Make sure you list units!</u>
- Answers without supporting calculations will receive zero credit.

(1) *(6 points)* Consider the circuit below. At time *t* = 1 s, the current source changes as shown in the figure, and will not change after that. Immediately before the current source changes, the system is <u>not</u> guaranteed to have reached steady-state.

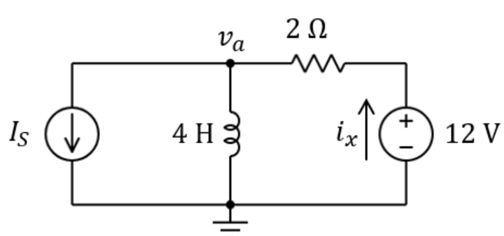
However, you are told that immediately after the change, i.e., at time $t = 1^+$, the node voltage v_a = 2 V. In other words: $v_a(1^+\text{ s})$ = 2 V.

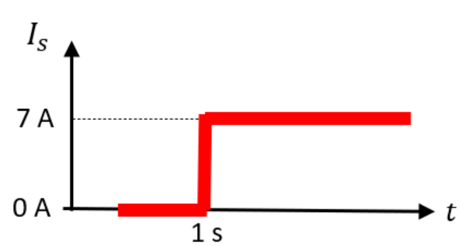
(a) Find $i_x(1^+\text{ s})$. (i.e., the current just <u>after</u> the current source changes) $i_x(1^+\text{ s})$

(b) Find $v_a(1^-\text{ s})$. (i.e., the node voltage just <u>before</u> the current source changes) $v_a(1^-\text{ s})$

(c) Find $i_x(\infty)$. $i_x(\infty)$

(d) Find $i_x(4\text{ s})$. (i.e., the current at time *t* = 4 s). You can leave your answer as a function of e. $i_x(4\text{ s})$





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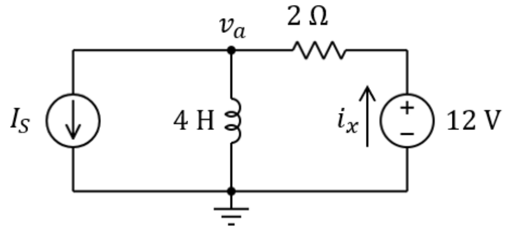

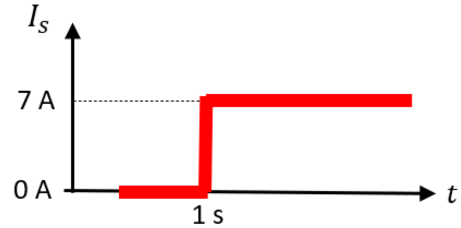

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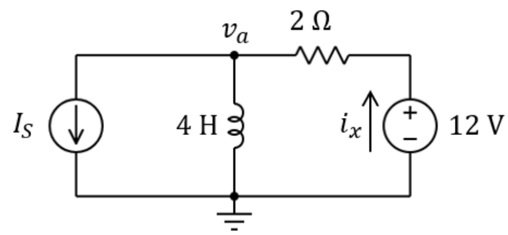

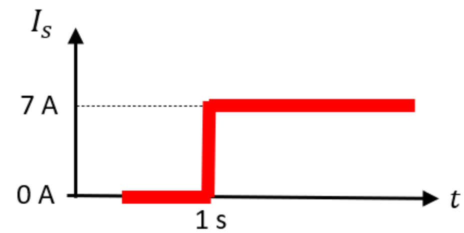

(2) *(6 points)* Consider the circuit below in Figure 1. You are not told the values of I_1 and V_1. However, you are told that if you attach the circuit from Figure 2 to the one from Figure 1 (with A’ connected to A and B’ connected to B), the value of $i_a = 5$ A.

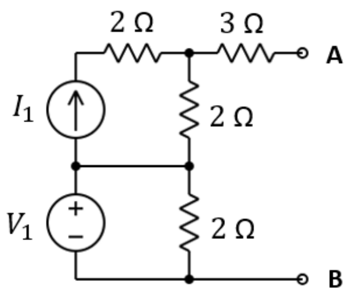

Figure 1

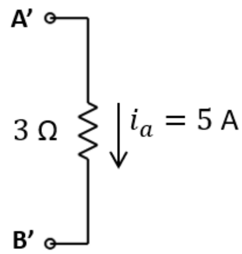

Figure 2

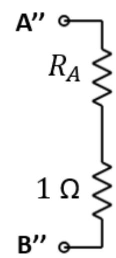

Figure 3

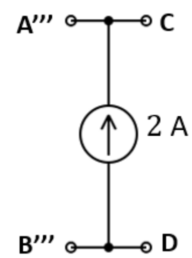

Figure 4

(a) Draw the Thevenin model between A and B for the circuit in Figure 1 (make sure you label A and B in your drawing).

(b) The circuit from Figure 3 is attached to the one from Figure 1 (with A’’ connected to A and B’’ connected to B). What should be the value of R_A to maximize the power received by R_A?

R_A

(c) The circuit from Figure 4 is attached to the one from Figure 1 (with A’’’ connected to A and B’’’ connected to B). For this new combined circuit, draw the Norton model between C and D (make sure you label C and D in your drawing).

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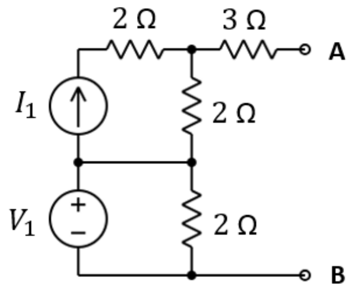

Figure 1

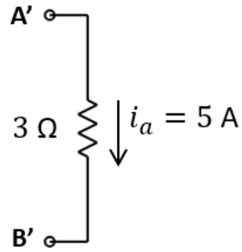

Figure 2

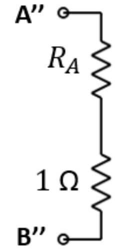

Figure 3

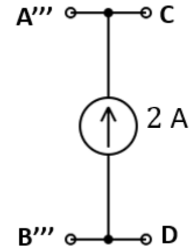

Figure 4

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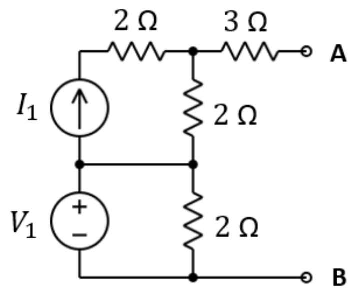

Figure 1

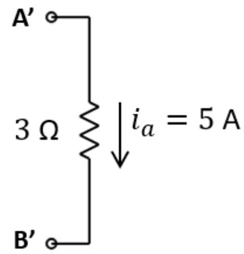

Figure 2

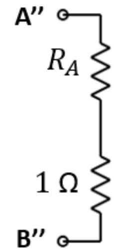

Figure 3

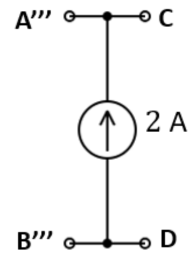

Figure 4

ECE35 Equation Sheet

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

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

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

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

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

Trigonometry:

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

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

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

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

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

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

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

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

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

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

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	$\sqrt{3}$	∞

ECE 35, Spring 2020

Quiz 2

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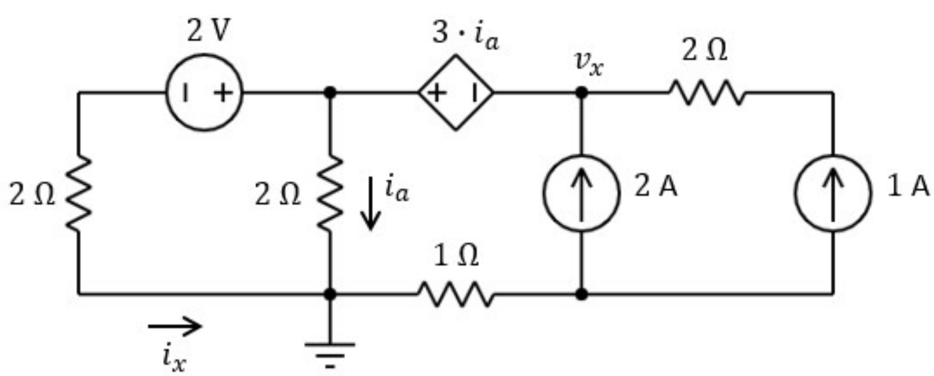
PID

(1) *(5 points)*

Consider the circuit below. You must use mesh analysis.

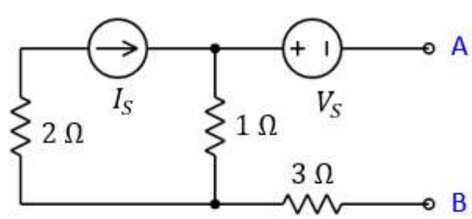
(a) Find i_x.

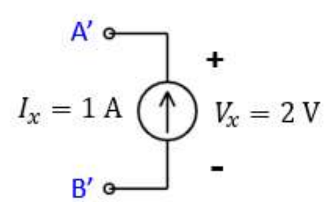
(b) Find the node voltage v_x.



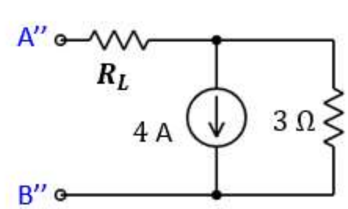
(2) *(5 points)*

(a) Consider the circuit below on the left. **Find the Thevenin model for the circuit between A and B**. You are not given the values of I_S and V_S. However, you are told that if you connect current source I_x to the circuit (A′ connected to A and B′ connected to B) the voltage V_x appears across the current source.





(b) Now connect the circuit on the right to the original one (A″ connected to A and B″ connected to B). **Find R_L such that the power received by R_L is maximized.**



ECE 35, Spring 2020

Quiz 3

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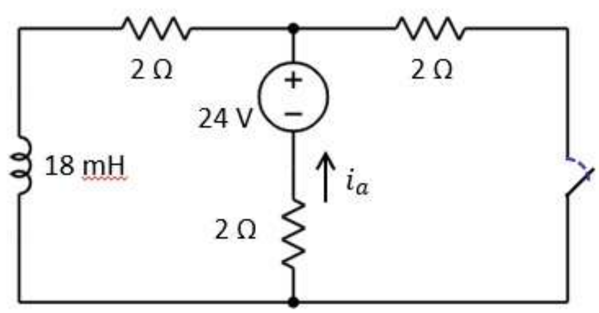
Last name	
First + middle name(s)	
PID	

(1) *(5 points)*

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

(a) Find $i_a(5^-\ \mathrm{s})$.

(b) Find $i_a(t)$ for $t > 5$ s. Write the equation.

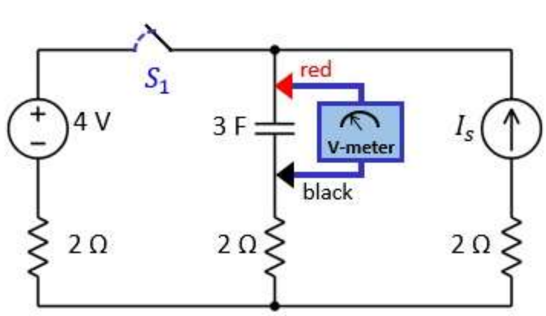


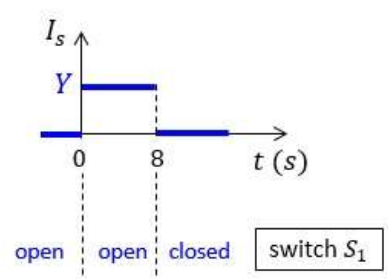
(2) *(5 points)*

- For time $t < 0$s, switch S1 is open and current source I_s is zero. The voltmeter reading is 1V.
- At time $t = 0$s, switch S1 remains open and the current source I_s jumps to Y (an unknown DC value).
- The moment the voltmeter reading becomes 9V, which happens at time $t = 8$s, switch S1 closes and the current source I_s becomes zero again.

(a) Find the voltmeter reading X at time $t = 5$s.

(b) Find the voltmeter reading X at time $t = 11$s.





ECE 35, Winter 2019

Quiz 2

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Last name

First + middle name(s)

PID

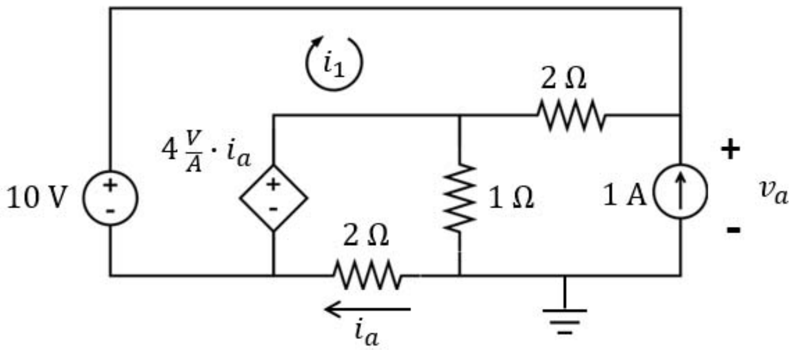
Instructions:

- 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) You <u>must use nodal analysis</u> to solve this problem. Find the value of voltage $\boldsymbol{v_a}$ and of mesh current $\boldsymbol{i_1}$. *(6 points)*

v_a ☐

i_1 ☐

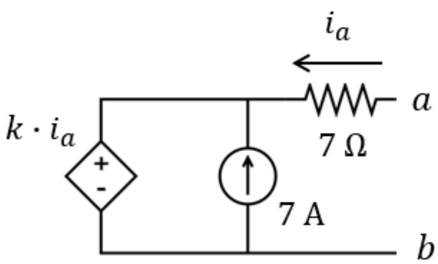


(2) (a) For figure (a) below, find the value of k such that the Thevenin equivalent resistance between a and b is equal to 2 Ω. *(3 points)*

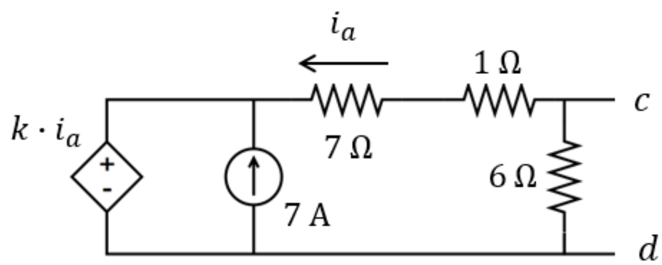
k [ ]

(b) Someone chose a value of k that resulted in a Thevenin equivalent resistance of 1 Ω between a and b for part (a). With this same value of k, what load resistance R_L should be attached between c and d, in figure (b), to get the maximum power dissipated in this R_L? *(3 points)*

R_L [ ]



(a)



(b)

ECE 35, Winter 2019

Quiz 3

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Last name	
First + middle name(s)	
PID	

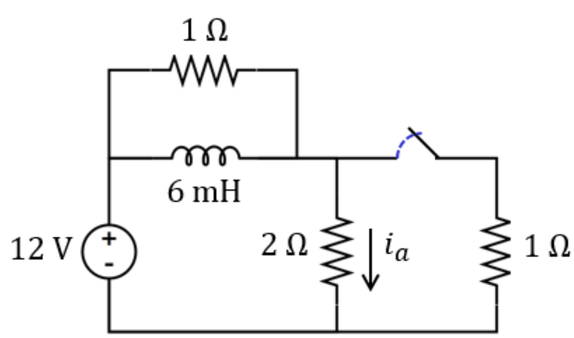
Instructions:

- 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) For $t < 2$ s, the switch is closed, and you may assume the system has reached steady state. The switch opens at time $t = 2$ s.

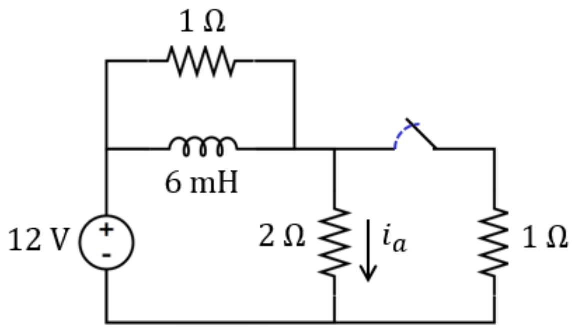
(a) Find $i_a(2^- \text{ s})$. *(1 point)*

$i_a(2^- \text{ s})$ [ ]



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

$i_a(t)$ $\boxed{}$



(2) For $t < 3$ s, the switch is open. <u>The switch closes at time t = **3 s**</u>. <u>The switch opens again at time t = 5 s.</u>
At $t = 0$, the capacitor is charged to **1 V**.

(a) Find $v_a(2\text{ s})$. *(2 points)*

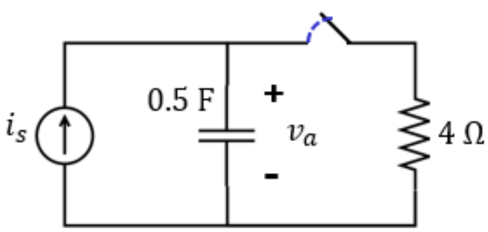
(b) Find $v_a(3^+\text{ s})$. *(1 point)*

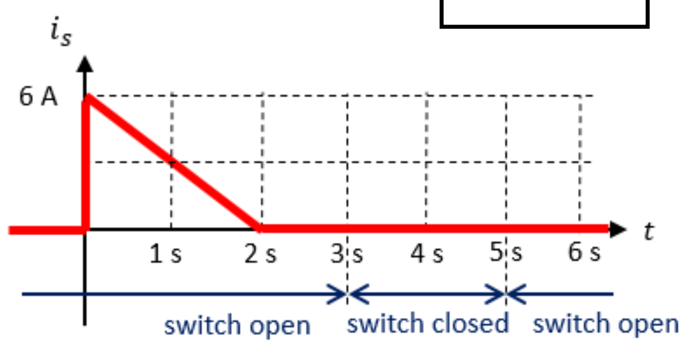
(c) Find $v_a(\infty)$. *(2 points)*

$v_a(2\text{ s})$

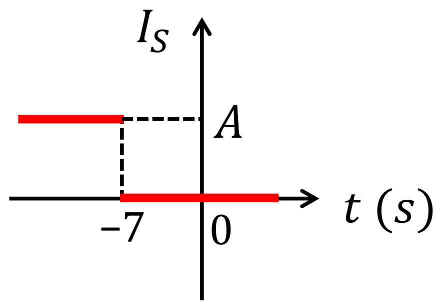
$v_a(3^+\text{ s})$

$v_a(\infty)$





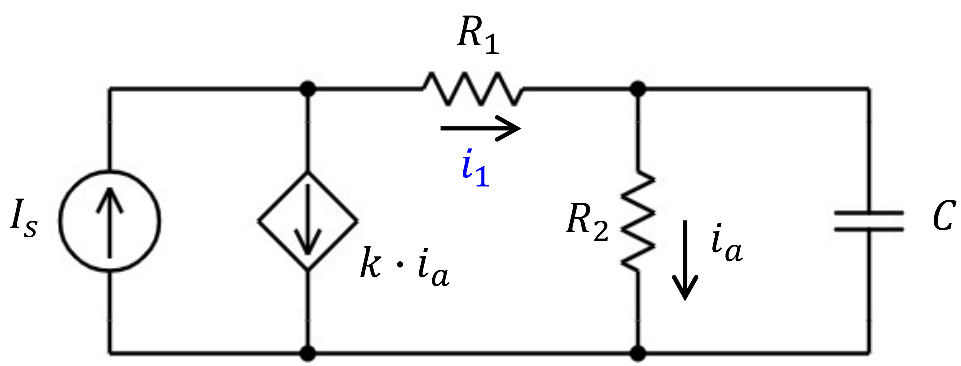
The current source I_s changes from *A* to 0 at *t* = -7 s, as shown on the right. For *t* < -7 s, you may assume the system has reached steady state.



(a) Find $i_1(-7^-\ s)$. (Note: we are asking for i_1, not i_a)

(b) Find $i_1(t)$ for *t* > -7 s. Write the equation.

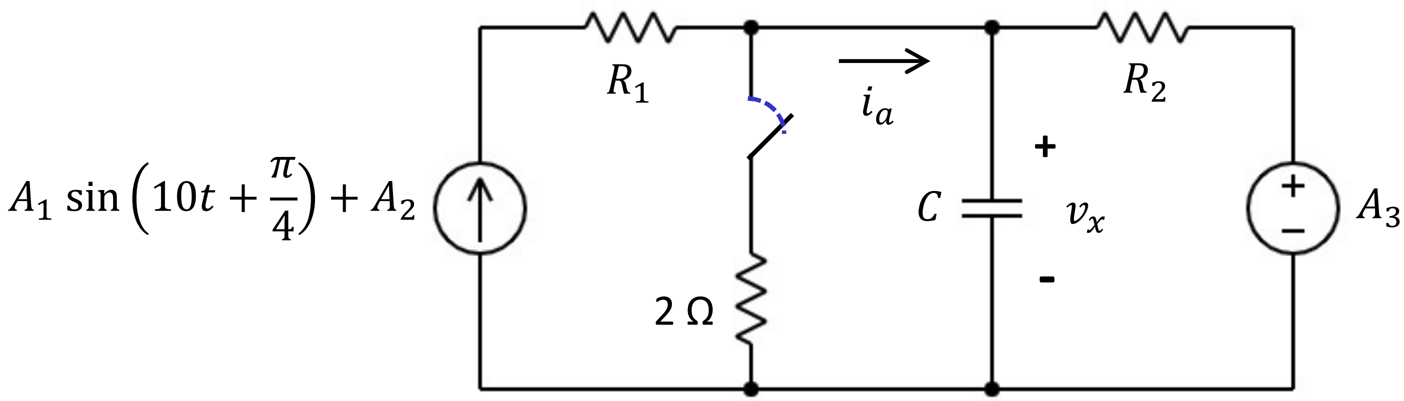
R1:	2 Ω
R2:	3 Ω
A:	6 A
k:	2 A/A
C:	2 nF



For $t < \frac{\pi}{40}$ s, the switch is open and you may assume the system has reached steady state. The switch closes at $t = \frac{\pi}{40}$ s and remains closed.

(a) Find $v_x\left(\frac{\pi}{40}^- \text{ s}\right)$ (i.e., just before the switch closes)

(b) Find $i_a\left(\frac{\pi}{40}^+ \text{ s}\right)$ (i.e., right after the switch closes)



R1:	1 Ω
R2:	2 Ω
C:	50 mF
A1:	2 A
A2:	2 A
A3:	1 V

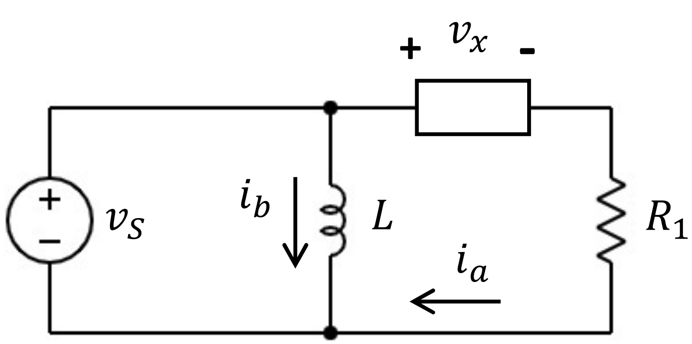
The AC circuit below has ω = 10 rad/s and is in steady state. The phasor diagram shows the phasors of v_x and i_a. You are given the angle α and $|\mathbf{V}_x|$. The element represented by the rectangular box is either an inductor or a capacitor but you are not told which.

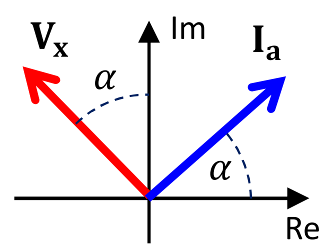
You are also told this piece of information: $v_S = A\ sin(\omega t)$ with some unknown value of *A* (positive or negative).

(a) At what time t_0 does the waveform of v_x reach its maximum value? (if there are multiple such times, giving one of them is sufficient).

(b) What is the mystery element (capacitor or inductor) and <u>why</u>?

(c) What is the value of i_b at time *T*/8 (with *T* the period)?

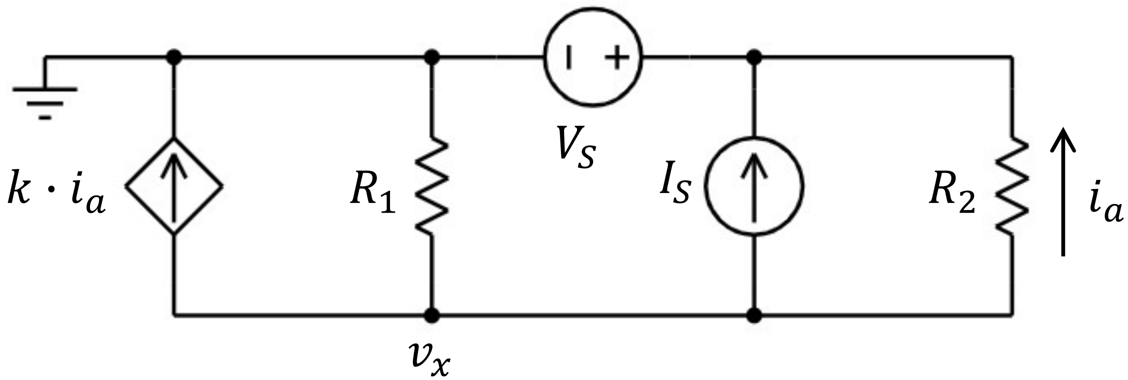




|Vx|:	3 V
alpha:	60 degrees
R1:	3 Ω
L:	2 H

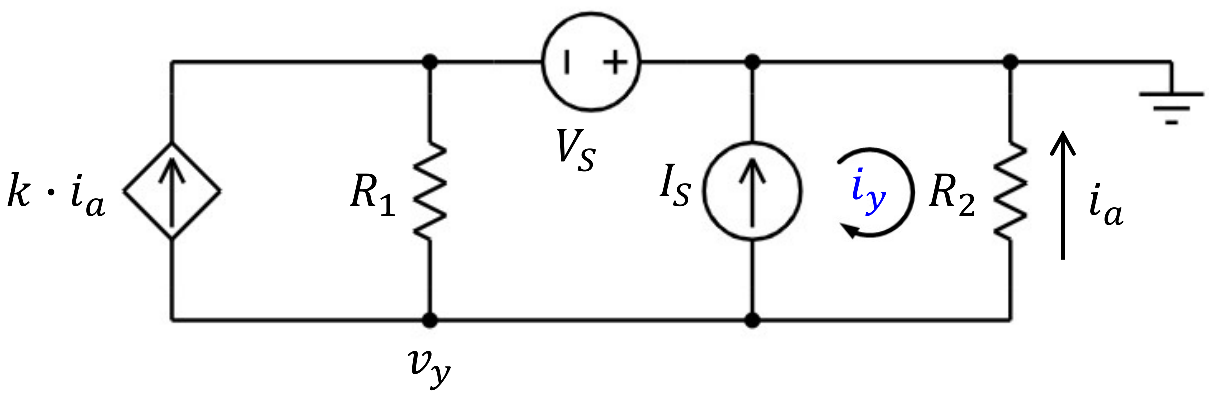
Q1

a. For the circuit below, find the node voltage v_x. You can use any technique. Write your equations symbolically first and only then plug in numbers.



b. For the circuit below (which is identical to the one above, but with the ground moved to a new location), find the node voltage v_y.

c. For the circuit below, find the mesh current i_y.

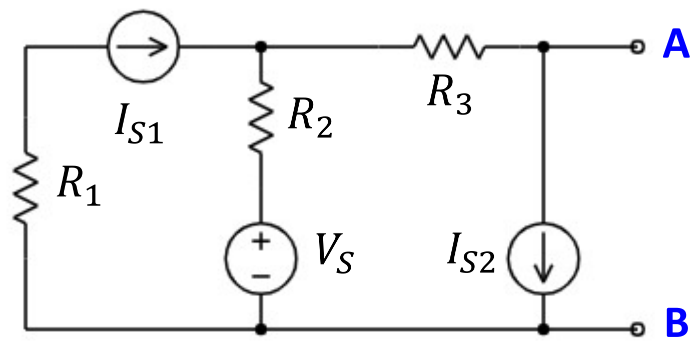


R1:	2 Ω
R2:	2 Ω
k:	2
Vs:	2 V
Is:	1 A

Q2

a. Consider the circuit on the right. The independent sources have the following values: $V_S = X$, $I_{S1} = Y$ and $I_{S2} = Z$, but you are not told what X, Y and Z are.

Find the Thevenin equivalent resistance between A and B.



R1:	1 Ω
R2:	1 Ω
R3:	2 Ω
I1:	2 A
I2:	2 A

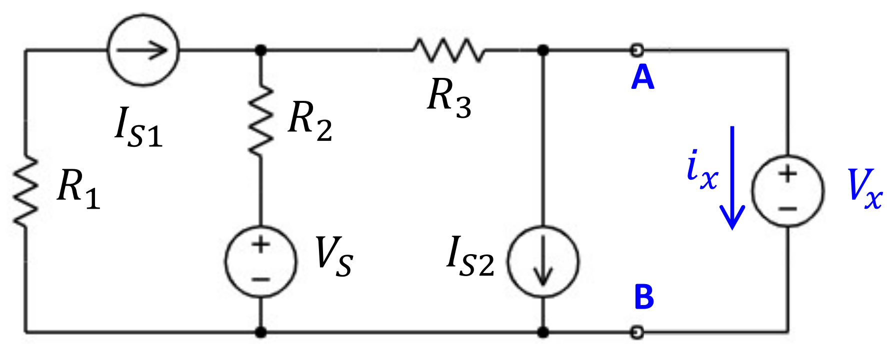
b. We now add voltage source V_x to the circuit, as shown below. You are also told:

- If V_S = 0 V, $I_{S1} = Y$, $I_{S2} = 0$ A and V_x = 10 V, we find i_x = I_1.
- If $V_S = X/2$, I_{S1} = 0 A, $I_{S2} = Z/2$ and V_x = 0 V, we find i_x = I_2.

Consider $V_S = X$, $I_{S1} = Y$, $I_{S2} = Z$ and V_x = 10 V. What is i_x in this case?

c. What is i_x when $V_S = X$, $I_{S1} = Y$, $I_{S2} = Z$ and V_x = 22 V ?

(Hint: you can solve this using part a and b)



ECE 35, Winter 2022

Your sequence number

Last name

First + middle name(s)

PID

Quiz 3

/ 12

Instructions:

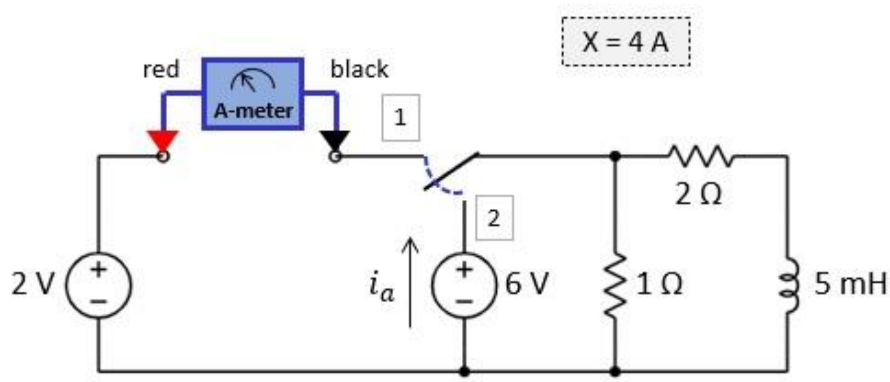
- Read each problem completely and thoroughly before beginning
- All calculations need to be done on these sheets
- Put a box around your answer for each question. Make sure you list units!
- Answers without supporting calculations will receive zero credit

(1) *(6 points)*

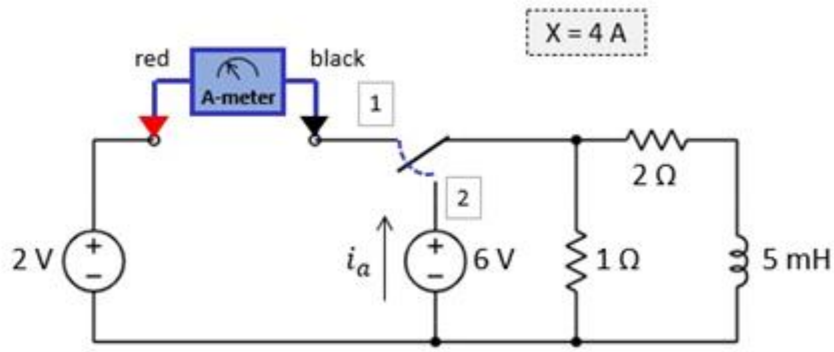
Consider the circuit below. For $t < 2$ s, the switch is in position 1 and it is possible that the system has not yet reached steady state.

When the ideal ammeter reading has a value of X, we move the switch from position 1 to position 2. This happens at time $t = 2$ s. The switch then remains in position 2.

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



The circuit is also copied on the next page for your convenience.


X = 4 A
red
A-meter
black
1
2
2 Ω
2 V
i_a
6 V
1 Ω
5 mH

(2) *(6 points)*

Consider the circuit below.

For $t < 0$ s, both switches are closed, and the system has reached steady state.
At time $t = 0$ s, both switches open and remain open.
The current I_S varies as shown in the graph.

a. Find the node voltage v_a at time $t = 0^+$ s (i.e., immediately after the switches open).
b. Find the node voltage v_b at time $t = 0^+$ s.
c. Find the node voltage v_a at time $t = 6$ s.
d. Find the node voltage v_b at time $t = 6$ s.