ECE3 Spring 2020 Name_____|_____
Family (Last) Name Given (First) Name

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DO NOT OPEN UNTIL INSTRUCTED TO DO SO.

- We will copy some graded exam papers for archival purposes!
- Put your name in the blank on EVERY page.
- Show your setup.
- Circle your answers.
- Add notes to help the graders determine your intentions.

Problem	Value	Score	Problem	Value	Score
1a	1		4	25	
1b	1		5	15	
1c	1		6a	5	
1d	1		6b	5	
1e	4		7a	8	
2	20		7b	8	
3	6		TOTAL	100	

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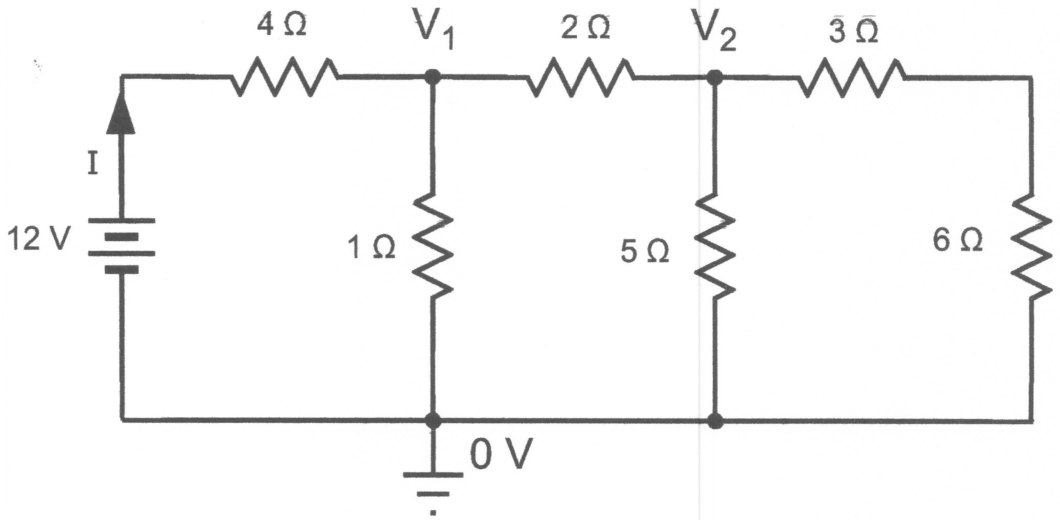

1

•IF YOU ARE PRINTING THE TEST AND WRITING ON IT, USE THE NEXT PAGE FOR ANSWERS.

a. Using Node Voltage Analysis, write an Ohm's Law expression (in terms of V_1 and V_2) for the current going through the 4 Ω resistor.
b. Under the same assumption, write an Ohm's Law expression (in terms of V_1 and V_2) for the current through the 1 Ω resistor.
c. Continuing, write an expression (in terms of V_1 and V_2) for the current through the 2 Ω resistor.
d. Now, combine the answers to 1a,b,c into a KCL equation for Node 1.
e. Write the KCL equation for Node 2 (in terms of V_1 and V_2).

2

You now have 2 equations in 2 unknowns. Solve them for V_1 and V_2.

3

Now that you know V_1, you can compute I.

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USE THIS PAGE FOR CALCULATIONS

1a) $V = IR$

$(V_1 - 12V) = I(4\Omega)$

$I = \frac{(V_1 - 12V)}{(4\Omega)}$ if we assume the current is leaving V_1

$I = \frac{(12V - V_1)}{4\Omega}$ if the current is entering V_1

1b) Assuming current is leaving V_1

$(V_1 - 0V) = I(1\Omega)$

$I = \frac{V_1}{1\Omega} = V_1$

1c) Assuming current is leaving V_1

$V = IR$

$(V_1 - V_2) = I(2\Omega)$

$I = \frac{(V_1 - V_2)}{2\Omega}$

1d) KCL: currents in a node add up to zero
(Assume all are exiting)

$\frac{V_1 - 12}{4} + V_1 + \frac{V_1 - V_2}{2} = 0$

1e) Node 2: All currents leaving

$\frac{V_2 - V_1}{2} + \frac{V_2 - 0}{5} + \frac{V_2 - 0}{3+6} = 0$

$\frac{V_2 - V_1}{2} + \frac{V_2}{5} + \frac{V_2}{9} = 0$

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2) two equations

$$\frac{V_1 - 12}{4} + V_1 + \frac{V_1 - V_2}{2} = 0 \longrightarrow V_1 - 12 + 4V_1 + 2V_1 - 2V_2 = 0$$

$$7V_1 - 2V_2 = 12$$

$$\frac{V_2 - V_1}{2} + \frac{V_2}{5} + \frac{V_2}{9} = 0 \longrightarrow 45V_2 - 45V_1 + 18V_2 + 10V_2 = 0$$

$$-45V_1 + 73V_2 = 0$$

$$45V_1 = 73V_2$$

$$V_1 = \frac{73}{45}V_2$$

$$7\left(\frac{73}{45}V_2\right) - 2V_2 = 12$$

$$\frac{511}{45}V_2 - \frac{90}{45}V_2 = 12$$

$$\frac{421}{45}V_2 = 12$$

$$V_2 = 1.28\,V$$

$$V_1 = \frac{73}{45}(1.28\,V)$$

$$\boxed{V_1 = 2.08\,V}$$

$$\boxed{V_2 = 1.28\,V}$$

3) I = current across 4 Ω resistor entering the node V_1

$$I = \frac{(12V - 2.08V)}{4\,\Omega} = \boxed{2.48\,A}$$

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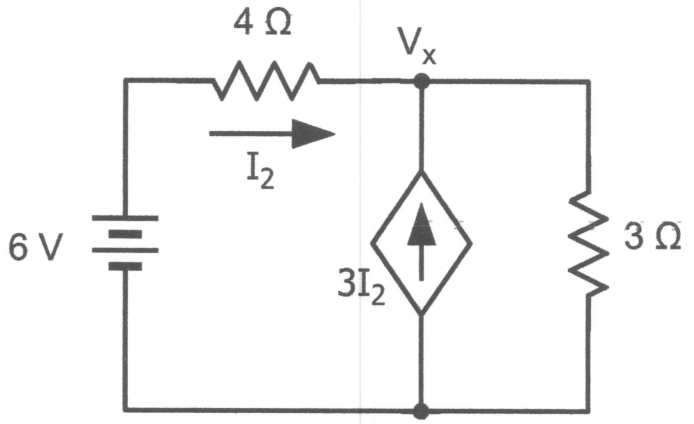
4 Find V_x.



Node voltage analysis V_x

$$\frac{(V_x - 6V)}{4\Omega} - 3I_2 + \frac{V_x - 0}{3\Omega} = 0$$

$$I_2 = \frac{(6V - V_x)}{4}$$

$$3V_x - 18 - 36I_2 + 4V_x = 0$$

$$7V_x - 18 - 36I_2 = 0$$

$$7V_x - 18 - 36\left(\frac{6 - V_x}{4}\right) = 0$$

$$7V_x - 18 - 54 + 9V_x = 0$$

$$16V_x = 72$$

$$\boxed{V_x = 4.5\,V}$$

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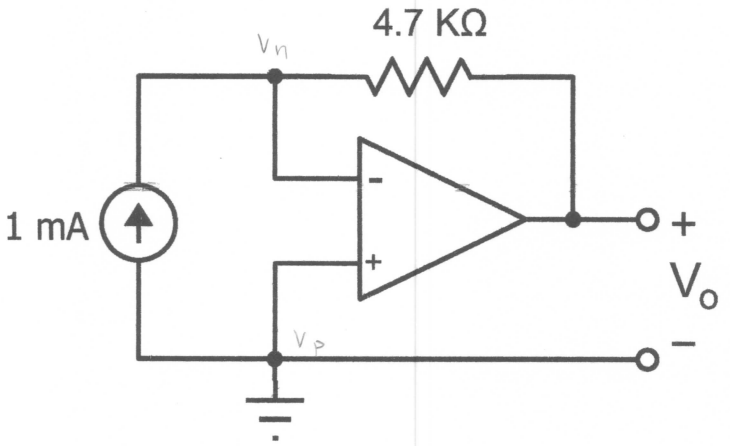
Find V_o.



BY KCL

$$\frac{V_n - V_o}{4.7\,k\Omega} - 1mA = 0$$

constraints: $V_n = 0$

$$\frac{-V_o}{4.7\,k\Omega} - 1mA = 0$$

$$-V_o = 1mA(4.7\,k\Omega)$$

$$= (1 \times 10^{-3} A)(4.7 \times 10^{3} \Omega)$$

$$= 4.7\,V$$

$$\boxed{V_o = -4.7\,V}$$

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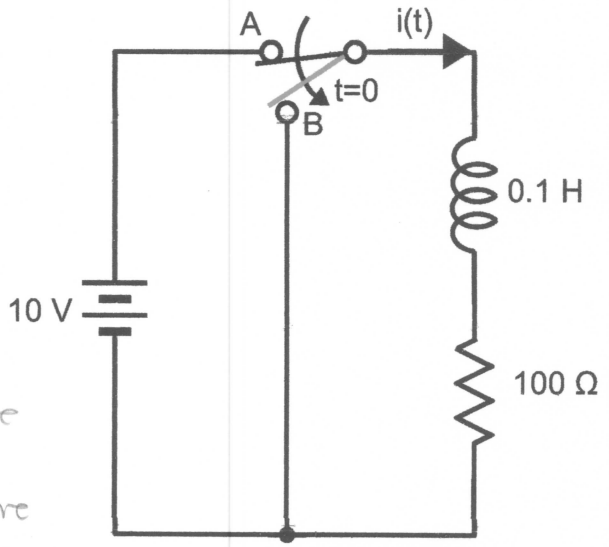

The switch has been in position A for a Long Time. At t=0, it moves instantaneously from A to B. Find the trajectory of the current i(t).

a. What is the current $i(0^-)$?
b. What is the current $i(0^+)$?

a) Before the switch is flipped + long time
series circuit
After a long time, inductors act like a wire
$V = IR$
$(10\,V) = I\,(100\,\Omega)$
$\boxed{i(0^-) = 0.10\,A}$

b) immediately after the switch is flipped, the inductor resists change in current, so
$i(0^+) = i(0^-) = \boxed{0.10\,A}$

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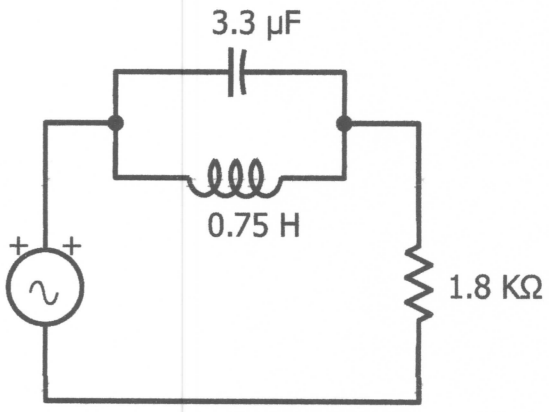

In this circuit, ω=6283 rad/s.

a. Find Z_L.
b. Find Z_C.

a) $Z_L = j\omega L$

$= j(6283 \text{ rad/s})(0.75 \text{ H})$

$= j(4712.25)$

b) $Z_C = \frac{1}{j\omega C}$

$= \frac{1}{j(6283 \text{ rad/s})(3.3 \times 10^{-6} \text{ F})}$

$= -j(48.23)$

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USE THIS PAGE FOR OVERFLOW CALCULATIONS.