ECE3 Spring 2020 Name [redacted] | [redacted]

Family (Last) Name) Name

Final Exam UID [redacted]

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	95

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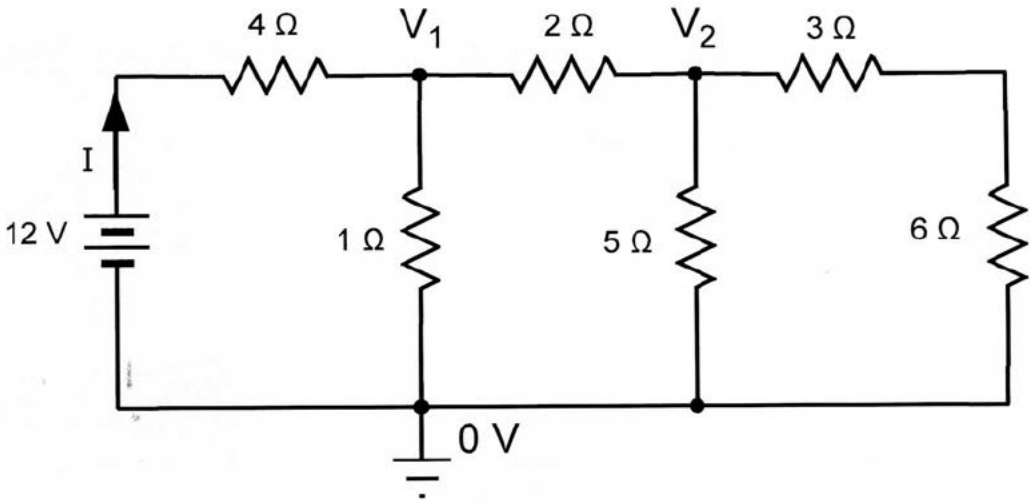

1

•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

1.) a. $V_1 - 12 = I_4(4)$

b. $V_1 - 0 = I_1(1)$

$V_1 = I_1$

c. $V_1 - V_2 = I_2(2)$

d. $I_4 + I_1 + I_2 = 0$

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

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

2.) $4\left(\frac{V_1-12}{4} + V_1 + \frac{V_1-V_2}{2} = 0\right)4$

$V_1 - 12 + 4V_1 + 2V_1 - 2V_2 = 0$

$7V_1 = 2V_2 + 12$

$V_1 = \frac{2V_2+12}{7}$

$\frac{V_2 - \frac{2V_2+12}{7}}{2} + \frac{V_2}{5} + \frac{V_2}{9} = 0$

$630\left(\frac{5V_2-12}{14} + \frac{V_2}{5} + \frac{V_2}{9} = 0\right)$

$225V_2 - 540 + 126V_2 + 70 = 0$

$421V_2 = 540$

$V_2 = \frac{540}{421}V \approx 1.28V$

$V_1 = \frac{2\frac{540}{421}+12}{7}$

$V_1 = \frac{6132}{2947}$

$V_1 = \frac{876}{421}V \approx 2.08V$

3.) $I = \frac{12-V_1}{4}$

$I = \frac{12-\frac{876}{421}}{4}$

$I = \frac{1044}{421}A \approx 2.48A$

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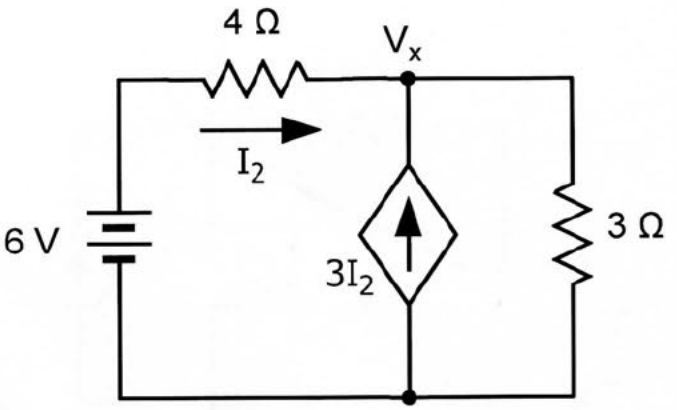
4 Find V_x.



V_x:

$-I_2 - 3I_2 + \frac{V_x}{3} = 0$

$I_2 = \frac{V_x}{12}$

$V_x = 12I_2$

$V_x = 12\left(\frac{6-V_x}{4}\right)$

$V_x = 18 - 3x$

$4V_x = 18$

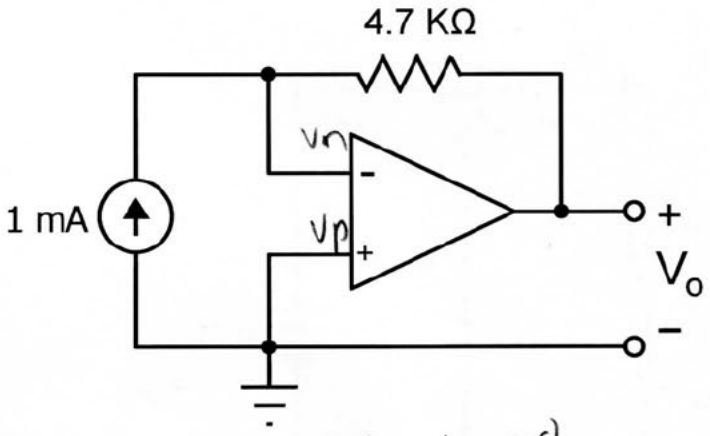
$V_x = \frac{9}{2} = 4.5\ V$

$6 - V_x = I_2 4$

$I_2 = \frac{6-V_x}{4}$

5

Find V_o.



$0 - V_o = \frac{0.001}{4700}$

$V_o \approx 0.21\,\mu V$

$V_n = V_p = 0$

$i_n = 0 = i_p$

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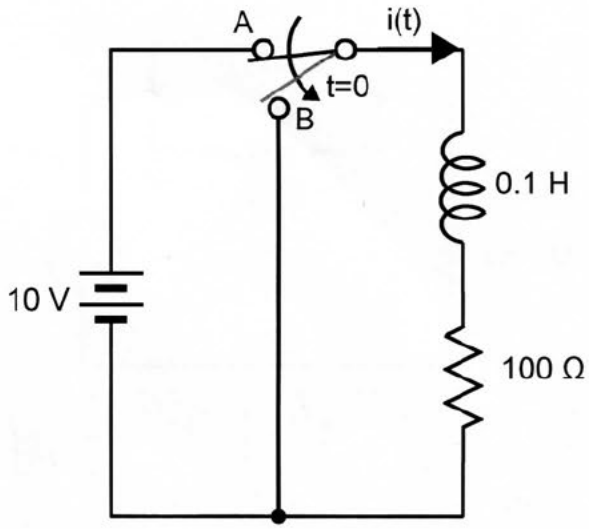

The switch has been in position A for a Long Time. At t=0, it moves instantaneously from A to B. Find the trajectory of the current i(t).

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

a. The inductor opposes changes in current, so $i(0^-) = i(0^+)$

a. $i(0^-) = \frac{10}{100} = \boxed{0.1A}$

b. $i(0^+) = i(0^-) = \frac{10}{100} = \boxed{0.1A}$

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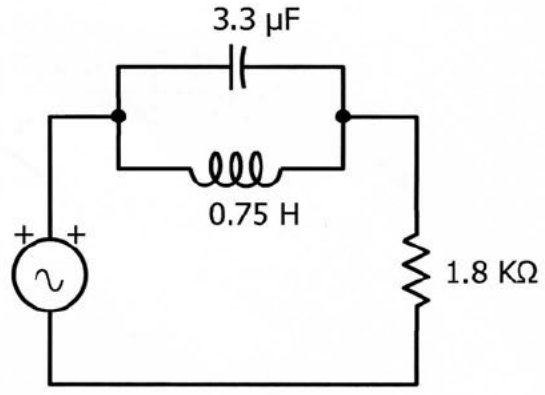

In this circuit, ω=6283 rad/s.

a. Find Z_L.
b. Find Z_C.

a. $Z_L = jwL$

$Z_L = j(6283)(0.75)$

$Z_L \approx 4712.5j\ \Omega$

b. $Z_C = -j\frac{1}{wC}$

$Z_C = -j\frac{1}{(6283)(3.3E-6)}$

$Z_C \approx -48.23j\ \Omega$