ECE3 Spring 2020 Name [redacted] | [redacted]
Family (Last) Name Given (First) Name

Final Exam UID [redacted]

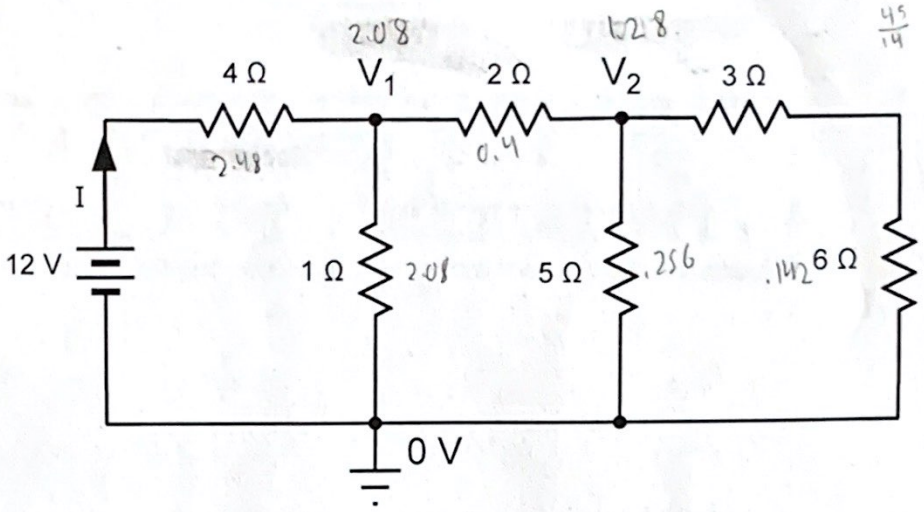
DO NOT OPEN UNTIL INSTRUCTED TO DO SO.

- 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	

ECE3 Spring 2020 Name [redacted] | [redacted]
Family (Last) Name Given (First) Name

Final Exam UID [redacted]



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.

ECE3 Spring 2020 Name [redacted] | [redacted]
Family (Last) Name Given (First) Name

Final Exam UID [redacted]

USE THIS PAGE FOR CALCULATIONS

1) a) $I_{4\Omega} = \frac{12V - V_1}{4\Omega}$

b) $I_{1\Omega} = \frac{V_1}{1\Omega}$

c) $I_{2\Omega} = \frac{V_1 - V_2}{2\Omega}$

d) $\frac{V_1 - 12V}{4\Omega} + \frac{V_1}{1\Omega} + \frac{V_1 - V_2}{2\Omega} = 0$

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

2) V_1 node: $V_1 - 12 + 4V_1 + 2V_1 - 2V_2 = 0 \rightarrow 7V_1 - 2V_2 = 12$

V_2 node: $45V_2 - 45V_1 + 18V_2 + 10V_2 = 0 \rightarrow -45V_1 + 73V_2 = 0$

$V_1 = 2.08\ V$
$V_2 = 1.28\ V$

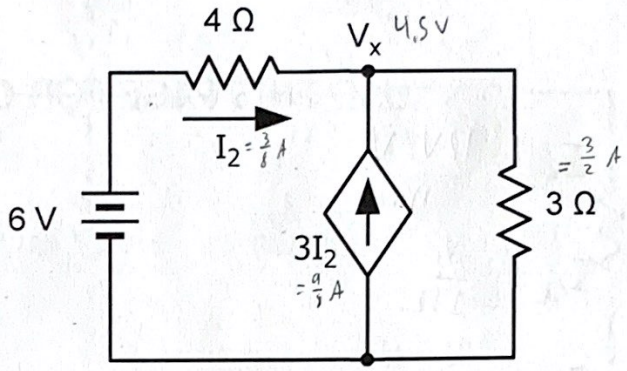
3) $I = \frac{12V - V_1}{4\Omega} = \frac{12 - 2.08}{4}$

$I = 2.48\ A$

ECE3 Spring 2020 Name [redacted] | [redacted]
Family (Last) Name Given (First) Name

Final Exam UID [redacted]

4 Find V_x.



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

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

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

$$3V_x - 18 + V_x = 0$$

$$4V_x = 18$$

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

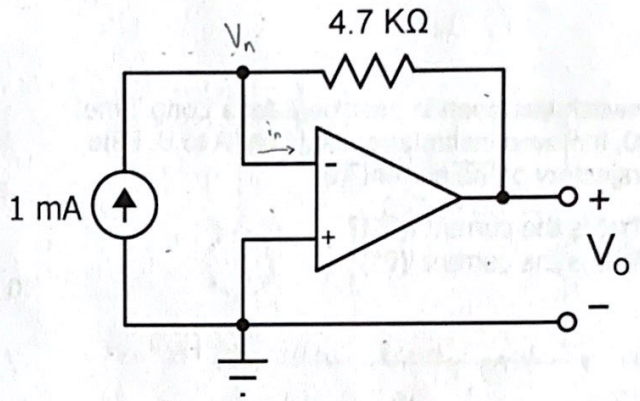
Check:
$\frac{3}{8} + \frac{9}{8} = \frac{12}{8} = \frac{3}{2}$ A ✓

ECE3 Spring 2020 Name [redacted] | [redacted]
Family (Last) Name Given (First) Name

Final Exam UID [redacted]

5

Find V_o.



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

Summing point constraints:

$$i_n = i_p = 0$$

$$V_n = V_p$$

$$V_p = 0 \Rightarrow V_n = 0$$

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

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

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

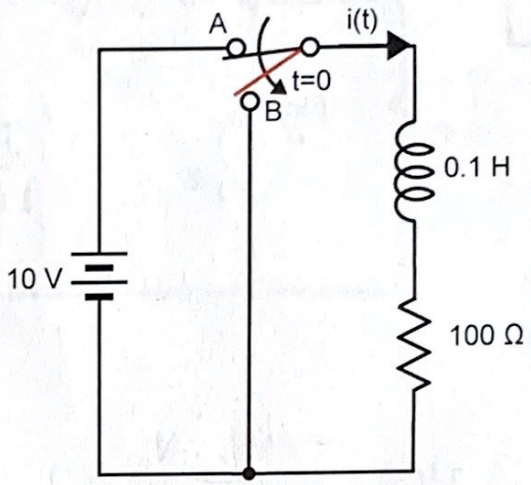
ECE3 Spring 2020 Name [redacted] | [redacted]
Family (Last) Name Given (First) Name

Final Exam UID [redacted]

6

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) After a long time, the effective impedance of the inductor is 0

So $i(0^-) = \frac{10\,V}{100\,\Omega} = \boxed{0.1\,A = i(0^-)}$

b) Inductors resist changes in current, so

$i(0^+) = i(0^-) = \boxed{0.1\,A = i(0^+)}$

KVL: $L\frac{di}{dt} + iR = 0$

Let $i = Ae^{st}$

$L(Ase^{st}) + (Ae^{st})R = 0$

$Ae^{st}(Ls + R) = 0$

$Ls + R = 0$

$s = -\frac{R}{L} = -\frac{100}{0.1} = -1000$

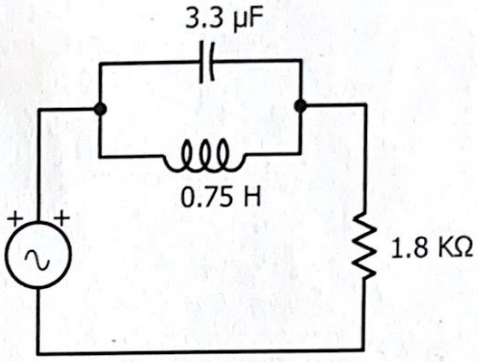
$A = i(0^+) = 0.1A$

$i(t) = 0.1e^{-1000t}$

ECE3 Spring 2020 Name [redacted] | [redacted]
Family (Last) Name Given (First) Name

Final Exam UID [redacted]

7



In this circuit, ω=6283 rad/s.

a. Find Z_L.
b. Find Z_C.

a) $Z_L = j\omega L = j(6283)(0.75)$

$Z_L = 4712.25j\ \Omega$

b) $Z_C = \frac{1}{j\omega C} = -j\frac{1}{(6283)(3.3\times10^{-6})} = -48.23j\ \Omega$

$Z_C = -48.23j\ \Omega$

$Z_{tot} = \frac{Z_L Z_C}{Z_L + Z_C} + Z_R$

$= \frac{(4712.25j)(-48.23j)}{4712.25j - 48.25j} + 1.8k$

$= 1800 - 48.73j\ \Omega$