ECE 20100 – Spring 2018
Exam #2

March 6, 2018

Section (include on scantron)

Michelusi (9:30) – 0001   Tan (1:30) – 0004   Li (10:30) – 0005

Hosseini (12:30) – 0006   Cui (11:30) – 0007

Kildishev (12:30) – 0008   Liu (8:30) – 0009   Zhu (3:30) – 0010

Instructions

1. DO NOT START UNTIL TOLD TO DO SO.
2. Write your name, section, professor, and student ID# on your **Scantron** sheet. We may check PUIDs.
3. This is a CLOSED BOOKS and CLOSED NOTES exam.
4. The use of a TI-30X IIS calculator is allowed.
5. If extra paper is needed, use the back of test pages.
6. Cheating will not be tolerated. Cheating in this exam will result in, at the minimum, an F grade for the course. In particular, **continuing to write after the exam time is up is regarded as cheating**.
7. If you cannot solve a question, be sure to look at the other ones, and come back to it if time permits.
8. ***All of the problems*** on Exam #2 provide evidence for satisfaction of this ECE 20100 Learning Objective:

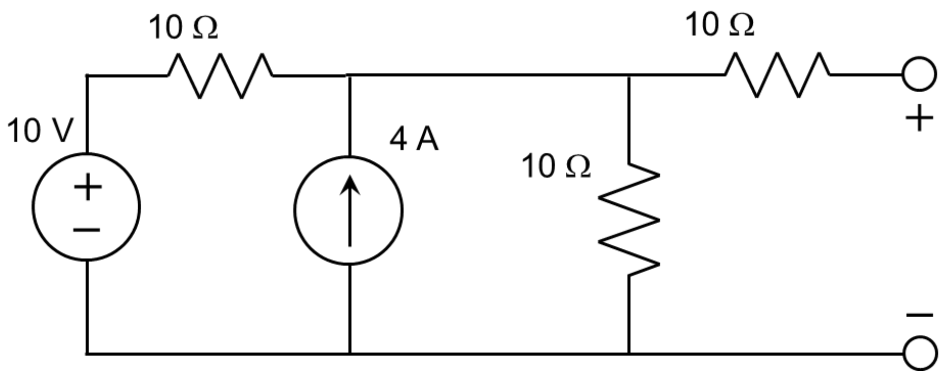
    ii) An ability to analyze 1^{st} order linear circuits with sources and/or passive elements..

    The minimum score needed to satisfy this objective will be posted on Blackboard after the exam has been graded. Remediation options will be posted in Blackboard if you fail to satisfy any of the course outcomes.

By signing the scantron sheet, you affirm you have not received or provided assistance on this exam.

Question 1

Find V_{OC} for the Thevenin equivalent network to the circuit shown.



(1) V_{oc} = 10 V

(2) V_{oc} = 14 V

(3) V_{oc} = 15 V

(4) V_{oc} = 16 V

(5) V_{oc} = 18V

(6) V_{oc} = 20 V

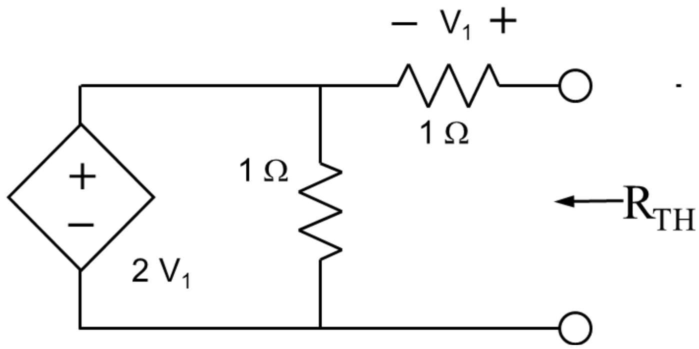
(7) V_{oc} = 25 V

(8) V_{oc} = 28 V

(9) None of the above

Question 2

Find the Thevenin equivalent resistance for the circuit below (in ohm).



(1) 1

(2) 2

(3) 3

(4) 4

(5) 5

(6) 6

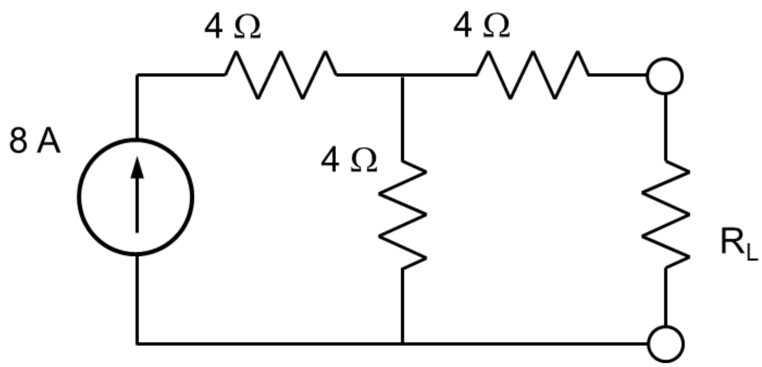
(7) 7

(8) 8

(9) None of the above

Question 3

Find the maximum power transferred (in W) to the load resistor, R_L, in the circuit below.



(1) 2

(2) 4

(3) 6

(4) 8

(5) 12

(6) 16

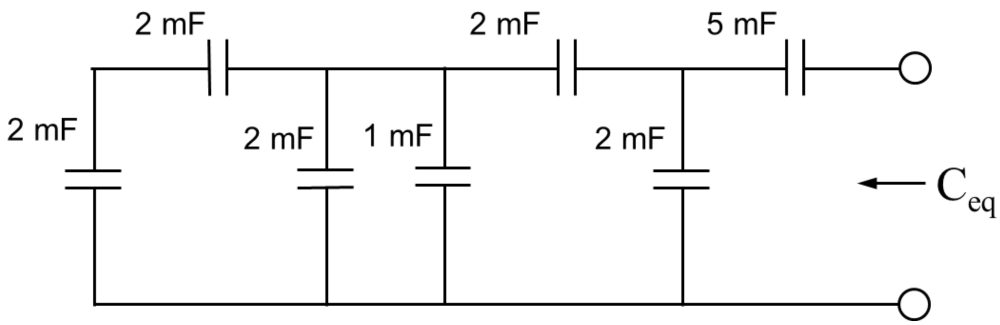
(7) 24

(8) 32

(9) None of the above

Question 4

Find the equivalent capacitance for the circuit shown (in mF).



(1) 1

(2) 2

(3) 3

(4) 4

(5) 5

(6) 6

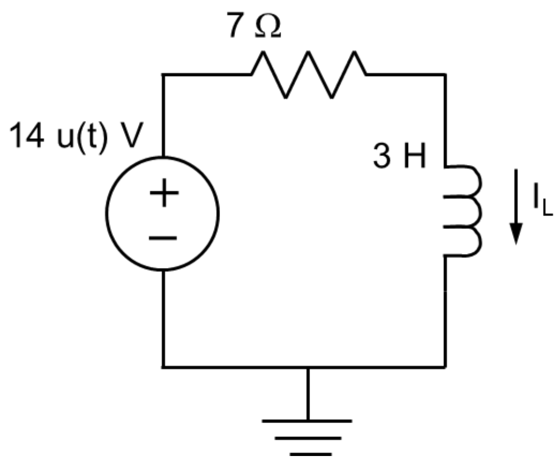
(7) 7

(8) 8

(9) None of the above

Question 5

Find the energy stored (in J) in the inductor at $t = \infty$.



(1) 1

(2) 2

(3) 3

(4) 4

(5) 5

(6) 6

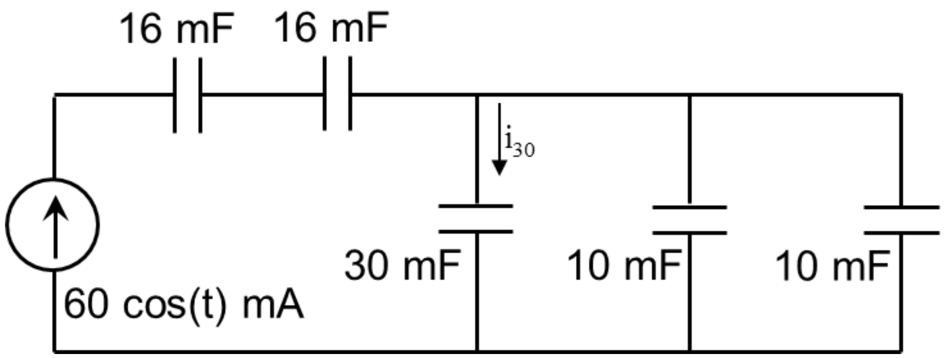
(7) 7

(8) 0

(9) None of the above

Question 6

Find the current (i_{30}) through the 30 mF capacitor assuming all capacitors have zero initial voltage at t = 0 sec.



(1) 15 *cos(t)* mA

(2) 24 *cos(t)* mA

(3) 30 *cos(t)* mA

(4) 36 *cos(t)* mA

(5) 40 *cos(t)* mA

(6) 48 *cos(t)* mA

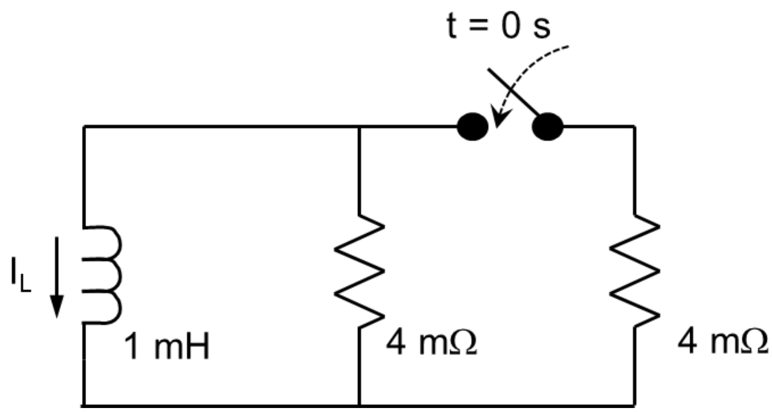
(7) 56 *cos(t)* mA

(8) 60 *cos(t)* mA

(9) None of the above

Question 7

The switch in the circuit closes at t = 0. The inductor current just before the switch is closed is $i_L(0^-)$ = 2 A. Find the value for $i_L(t)$ at t = 2 s (in A).



(1) $e^{-0.25}$

(2) $e^{-0.5}$

(3) e^{-1}

(4) $2\,e^{-0.25}$

(5) $2\,e^{-0.5}$

(6) $2\,e^{-2}$

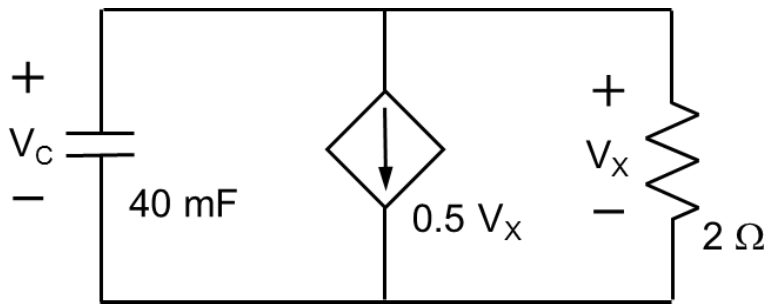
(7) $2\,e^{-4}$

(8) 2

(9) None of the above

Question 8

Find the capacitance voltage $v_c(t)$ (in V) for $t > 0$ when $v_c(0^-) = 1$ V.



(1) $e^{-0.04\,t}$

(2) $e^{-0.10\,t}$

(3) $e^{-0.5\,t}$

(4) $e^{-10\,t}$

(5) $e^{-25\,t}$

(6) $e^{-40\,t}$

(7) $e^{-60\,t}$

(8) $e^{-100\,t}$

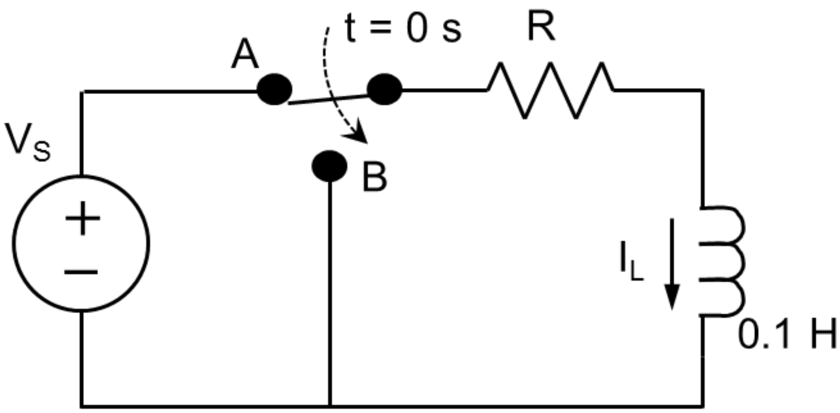
(9) None of the above

Question 9

The voltage source (V_s) and the resistor (R) in the RL circuit below are unknown. The switch has been at position A for a long time and it turns to position B at t = 0 s. The inductor current $i_L(t)$ for t > 0 is,

$$i_L(t) = 6\, e^{-5t} \text{ A}$$

Find V_s (in V).



(1) 1

(2) 2

(3) 3

(4) 4

(5) 5

(6) 6

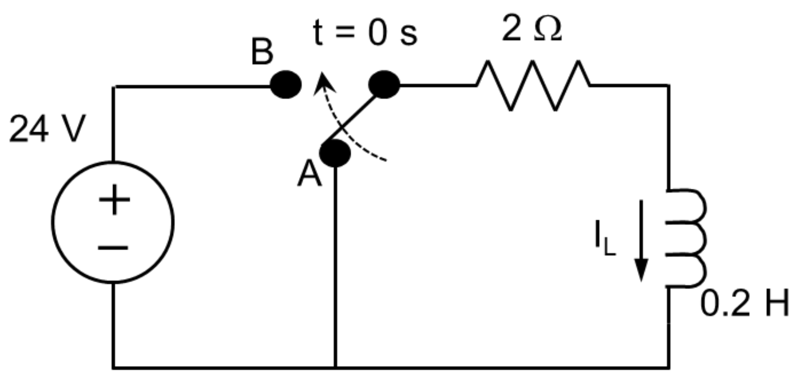
(7) 7

(8) 8

(9) None of the above

Question 10

The switch in the RL circuit below has been at position A for a long time and it turns to position B at t = 0. Find the inductor current (in A) as a function of time for $t \geq 0$ s.



(1) $12 - 12\, e^{-10\,t}$

(2) $12 - 6\, e^{-10\,t}$

(3) $12 - 12\, e^{-\,t/10}$

(4) $18 - 18\, e^{-10\,t}$

(5) $18 - 18\, e^{-\,t/10}$

(6) $24 - 24\, e^{-10\,t}$

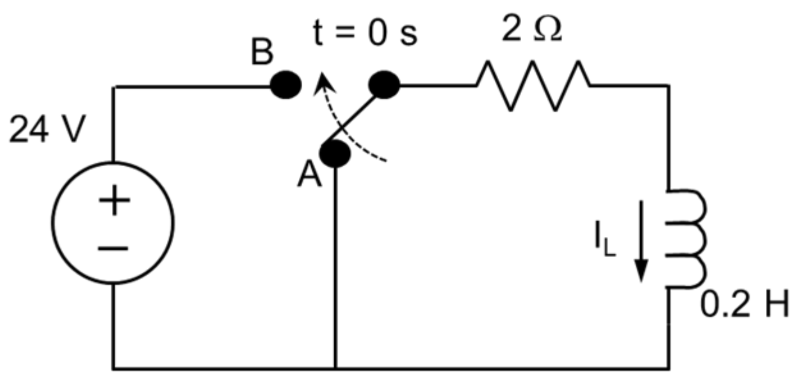
(7) $24 - 24\, e^{-\,t/10}$

(8) $24 - 6\, e^{-10\,t}$

(9) None of the above

Question 11

For the circuit shown below, how long does it take for the inductor current to change from 1 A to 8 A (in sec).



(1) 0.1 *ln*(8)

(2) 0.1 *ln*(11/8)

(3) 0.1 *ln*(4/11)

(4) 0.1 *ln*(11/4)

(5) 10 *ln*(4/11)

(6) 10 *ln*(8)

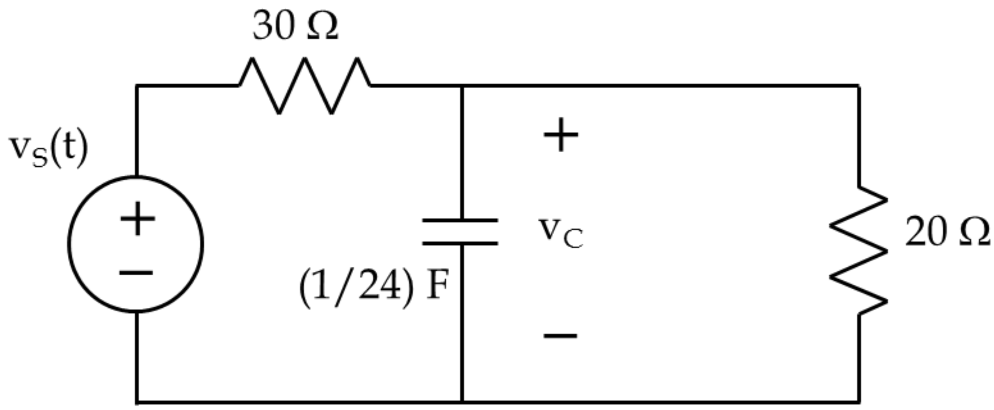
(7) 10 *ln*(11/8)

(8) 10 *ln*(11/4)

(9) None of the above

Question 12

The response $v_c(t)$ for $t \geq 0$ in the circuit below are listed in the table for two conditions. Find $v_c(t)$ for $t \geq 0$ for the third condition (in V).



Condition	$v_c(0^-)$	$v_s(t)$	$v_c(t)$
1	2 V	0	$2\ e^{-2t}$ V
2	0	5u(t) V	$2(1-e^{-2t})$V
3	10 V	15u(t) V	?

(1) $4 + e^{-2t}$

(2) $4 - e^{-2t}$

(3) $5 + e^{-2t}$

(4) $5 - e^{-2t}$

(5) $6 + 4e^{-2t}$

(6) $6 - 4e^{-2t}$

(7) $9 + 4e^{-2t}$

(8) $9 - 4e^{-2t}$

(9) None of the above

Potentially Useful Formulas

$$x(t) = x(\infty) + \left[x(t_0^+) - x(\infty) \right] e^{-(t-t_0)/\tau} \text{ , where } \tau = R_{TH} C \text{ or } \tau = \frac{L}{R_{TH}}$$

$$v_L(t) = L \frac{di_L(t)}{dt}$$

$$i_L(t) = i_L(t_0) + \frac{1}{L} \int_{t_0}^{t} v_L(t') dt'$$

$$W_L(t_0, t_1) = \frac{L}{2} \left[\left(i_L(t_1) \right)^2 - \left(i_L(t_0) \right)^2 \right]$$

$$i_C(t) = C \frac{dv_C(t)}{dt}$$

$$v_C(t) = v_C(t_0) + \frac{1}{C} \int_{t_0}^{t} i_C(t') dt'$$

$$W_C(t_0, t_1) = \frac{C}{2} \left[\left(v_C(t_1) \right)^2 - \left(v_C(t_0) \right)^2 \right]$$

Elapsed time formula: $t_2 - t_1 = \tau \ln \dfrac{x(t_1) - x(\infty)}{x(t_2) - x(\infty)}$

$$-\ln x = \ln \frac{1}{x}$$

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Solution Key:

1. (7)
2. (3)
3. (8)
4. (2)
5. (6)
6. (4)
7. (7)
8. (5)
9. (3)
10. (1)
11. (4)
12. (5)