ECE 20100 – Fall 2016
Exam #2

October 20, 2016

Sections (put section number on scantron)

Hosseini (9:30) – 0002   Peleato-Inarrea (3:30) – 0004   Michelusi (1:30) – 0005

Qi (10:30) – 0011   **Cui (8:30) – 0012**

Peroulis (11:30) – 0013   Kildishev (1:30) – 0014

Name _____________________________   PUID____________

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 and will be dealt with according to the policy in your section. 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:

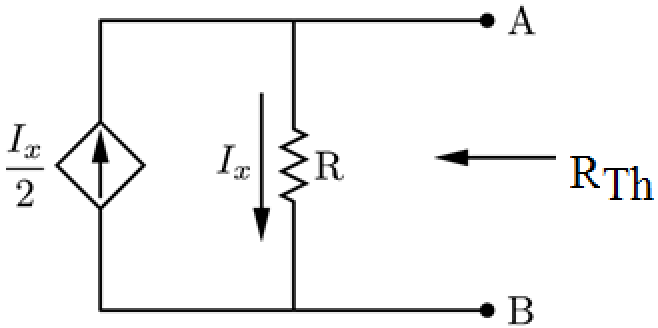
   ii) An ability to analyze linear resistive circuits.

   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

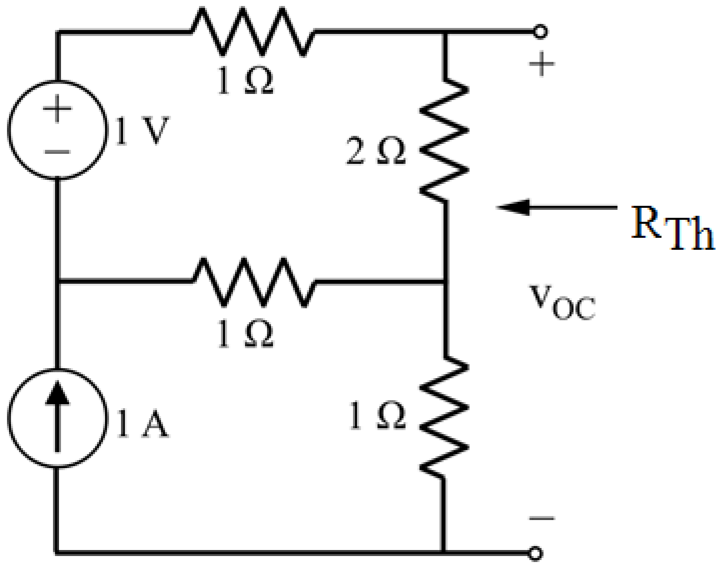
For the circuit below find the Thevenin equivalent resistance with respect to nodes A and B.



(1) R/2
(2) 2R
(3) R/3
(4) 3R
(5) R/4
(6) 4R
(7) R
(8) None of the above

Question 2

Find the V_{OC} and R_{th} of the two-terminal linear network shown below.



(1) $V_{OC} = 0$ V and $R_{th} = 0\ \Omega$

(2) $V_{OC} = 1$ V and $R_{th} = 0\ \Omega$

(3) $V_{OC} = 1$ V and $R_{th} = 1\ \Omega$

(4) $V_{OC} = 2$ V and $R_{th} = 1\ \Omega$

(5) $V_{OC} = 1$ V and $R_{th} = 2\ \Omega$

(6) $V_{OC} = 2$ V and $R_{th} = 2\ \Omega$

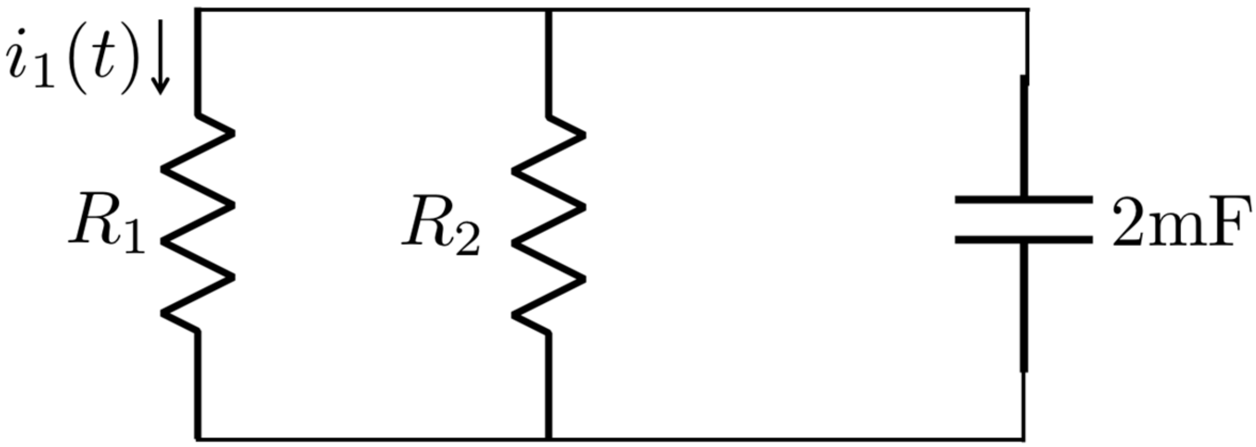
(7) $V_{OC} = 2$ V and $R_{th} = 3\ \Omega$

(8) $V_{OC} = 3$ V and $R_{th} = 3\ \Omega$

(9) None of the above

Question 3

In this circuit, $R_1 = R_2 = 2$ kΩ. At time $t = 0$, the current through R_1 is $i_1(0) = 1$ mA. Find the amount of *energy dissipated through R_2* in the time interval $(0,\infty)$.



(1) 1 mJ

(2) 2 mJ

(3) 3 mJ

(4) 4 mJ

(5) 0.25 mJ

(6) 0.50 mJ

(7) 0.75 mJ

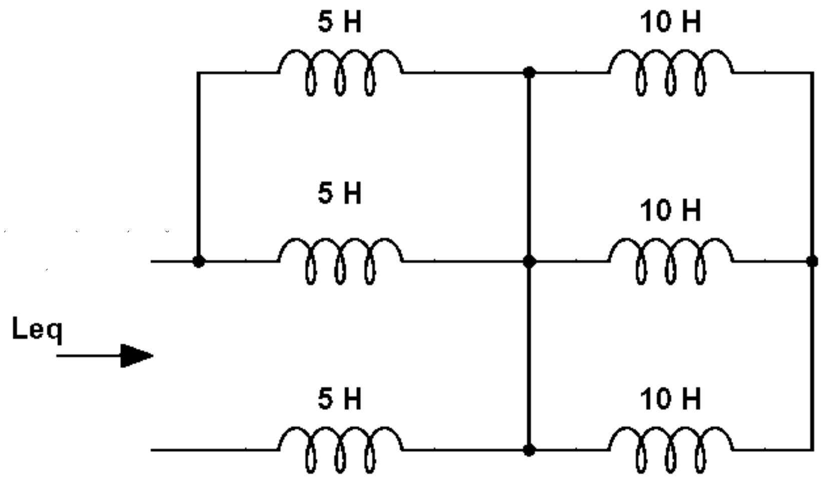
(8) 8 mJ

(9) 0 J

(10) None of the above

Question 4

Find the equivalent inductance:



(1) $L_{eq} = 2.5$ H

(2) $L_{eq} = 3.33$ H

(3) $L_{eq} = 5$ H

(4) $L_{eq} = 6.66$ H

(5) $L_{eq} = 7.5$ H

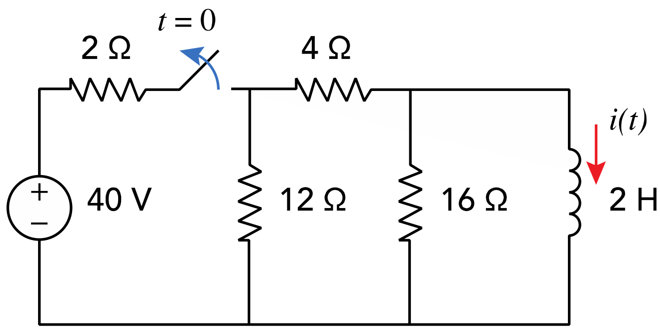
(6) $L_{eq} = 10$ H

(7) $L_{eq} = 10.83$ H

(8) None of the above

Question 5

The switch in the circuit as shown in the figure below has been closed for a long time. At $t = 0$, the switch is opened. Calculate $i(t)$ for $t > 0$.



(1) $3\ e^{-2t}$ A

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

(3) $-6\ e^{-0.25t}$ A

(4) $6\ e^{-0.25t}$ A

(5) $-6\ e^{-4t}$ A

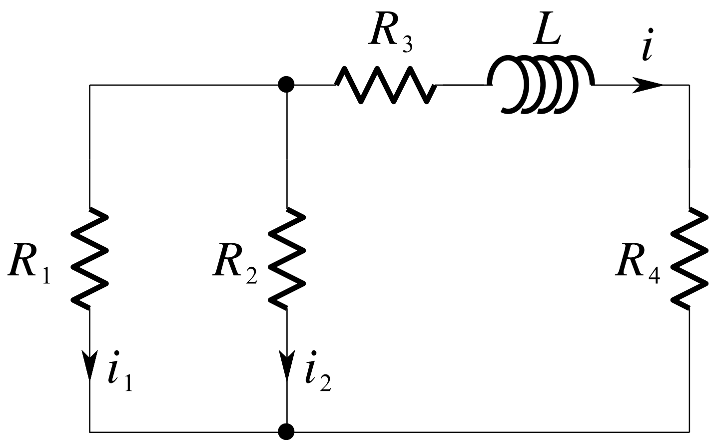
(6) $4\ e^{-6t}$ A

(7) $6\ e^{-4t}$ A

(8) None of the above

Question 6

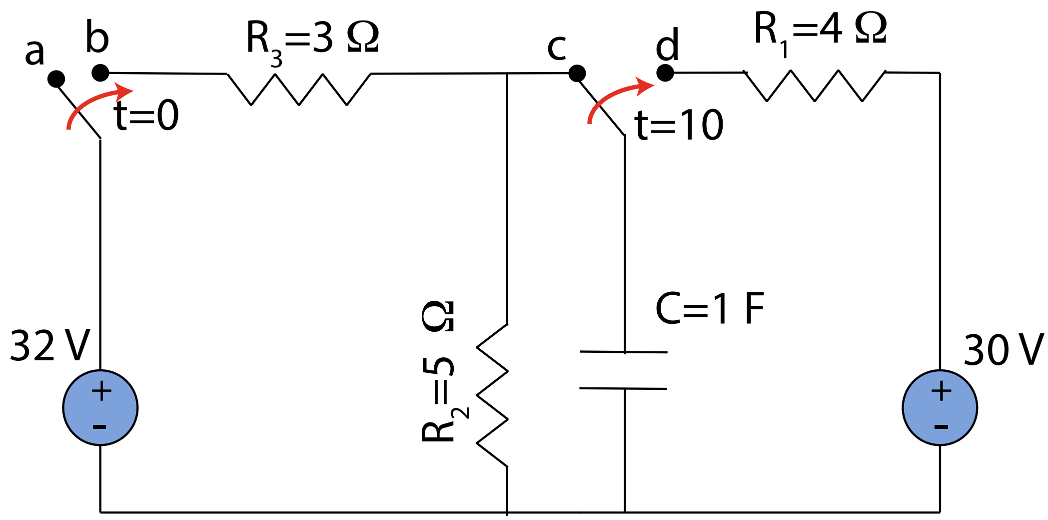
Given that the current through the inductor at time t = 0 is 2 A, *i.e.* i(t = 0) = 2 A, what is the current, $i_2(t)$ (as shown on the figure below) flowing through the resistor, R_2, at time t > 0 ? Assume all resistors are 1 ohm, $R_1 = R_2 = R_3 = R_4 = 1\ \Omega$, and L = 5 H.



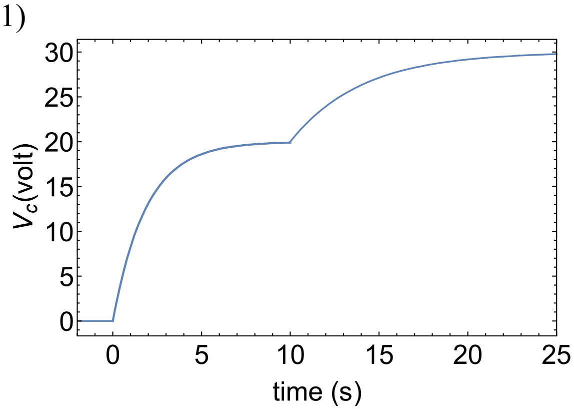
1) $i_2(t) = -2\ e^{-t/2}$ A
2) $i_2(t) = 2\ e^{-t/2}$ A
3) $i_2(t) = -\ e^{-2t}$ A
4) $i_2(t) = e^{-2t/5}$ A
5) $i_2(t) = 2e^{-2t/5}$ A
6) $i_2(t) = -\ e^{-5t/2}$ A
7) $i_2(t) = -\ e^{-t/2}$ A
8) None of the above

Question 7

For time t < 0, the capacitor is discharged, *i.e.* v(t < 0) = 0. At time t = 0 s, the switch moves from node “a” to node “b” and at time t = 10 s, the switch is flipped from node “c” to “d”. Which plot is the closest description of the voltage across the capacitor, $v_c(t)$?



1)



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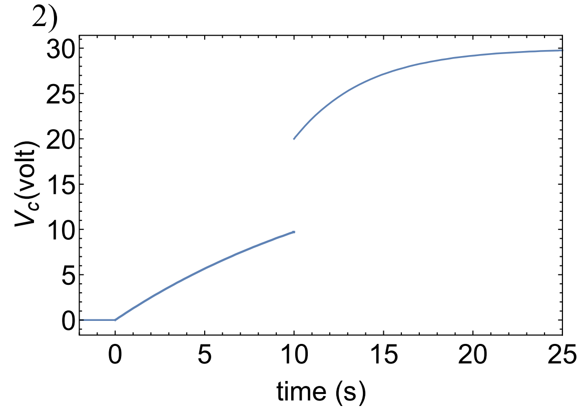

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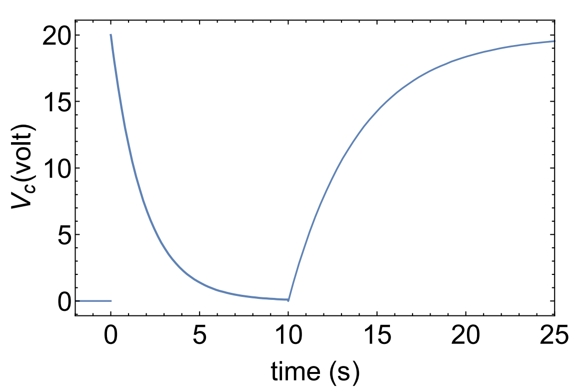

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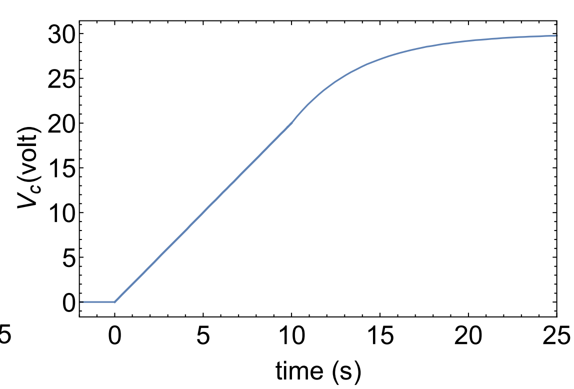

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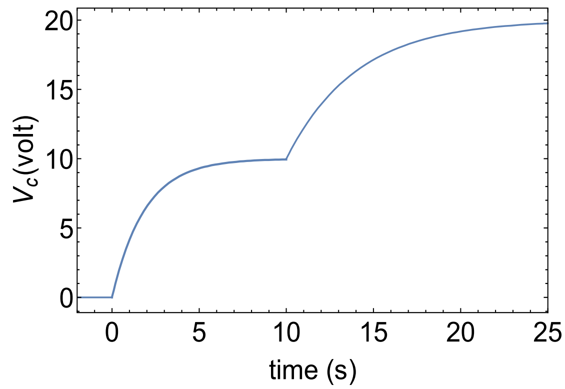
5)



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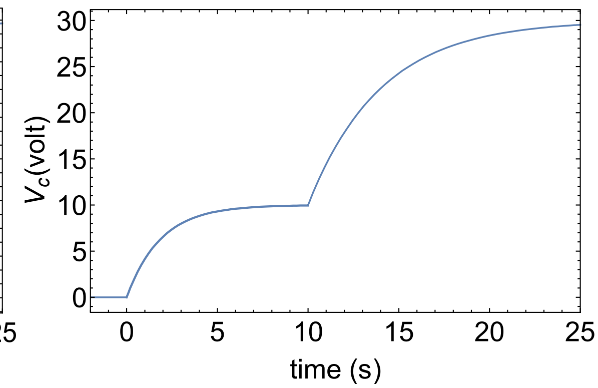

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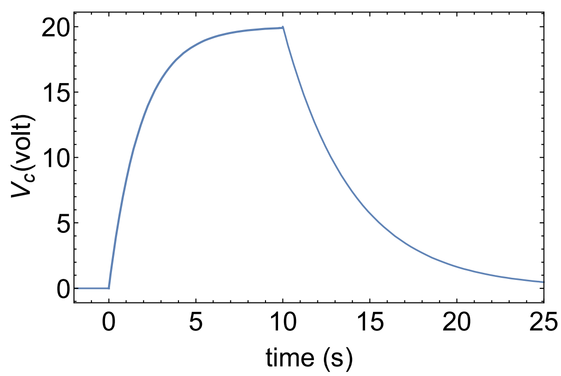
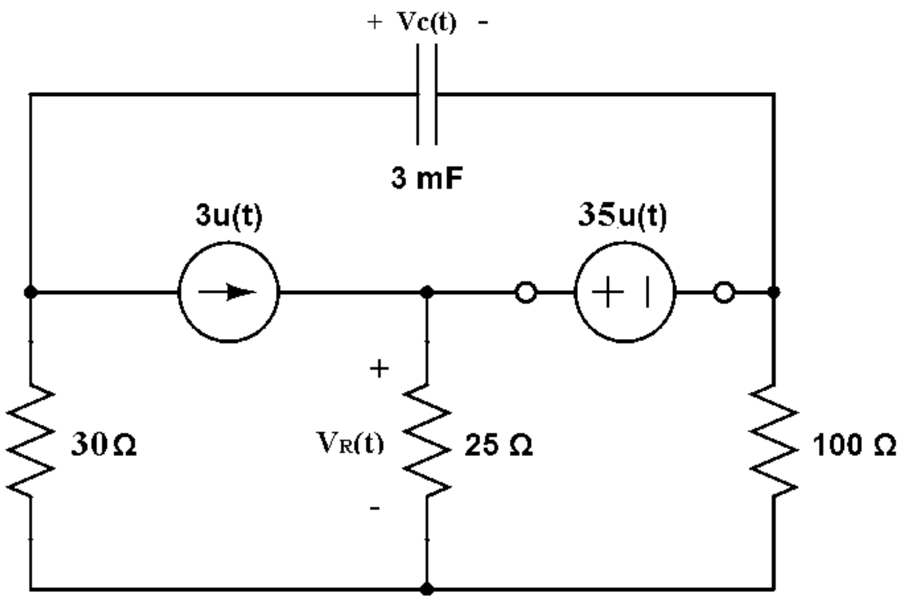


8) None of the above

Question 8

In the circuit below, both sources are activated at t = 0. If the capacitor was initially discharged at t = 0, the voltage in the 25 Ohm resistor at t = 0.15 sec is $V_R(0.15) = 67 - 48.8\exp(-1)$ V. Find the voltage $V_R(0.15)$ if the capacitor had an initial charge of $Vc(0) = 3$ Volts.



(1) $V_R(0.15) = 67 - 50e^{-1}$ V

(2) $V_R(0.15) = 67 - 47.6e^{-1}$ V

(3) $V_R(0.15) = 67 - 51.8e^{-1}$ V

(4) $V_R(0.15) = 70 - 48.8e^{-1}$ V

(5) $V_R(0.15) = 65 - 48.8e^{-1}$ V

(6) $V_R(0.15) = 68.2 - 48.8e^{-1}$ V

(7) $V_R(0.15) = 67 - 48.8e^{-2}$ V

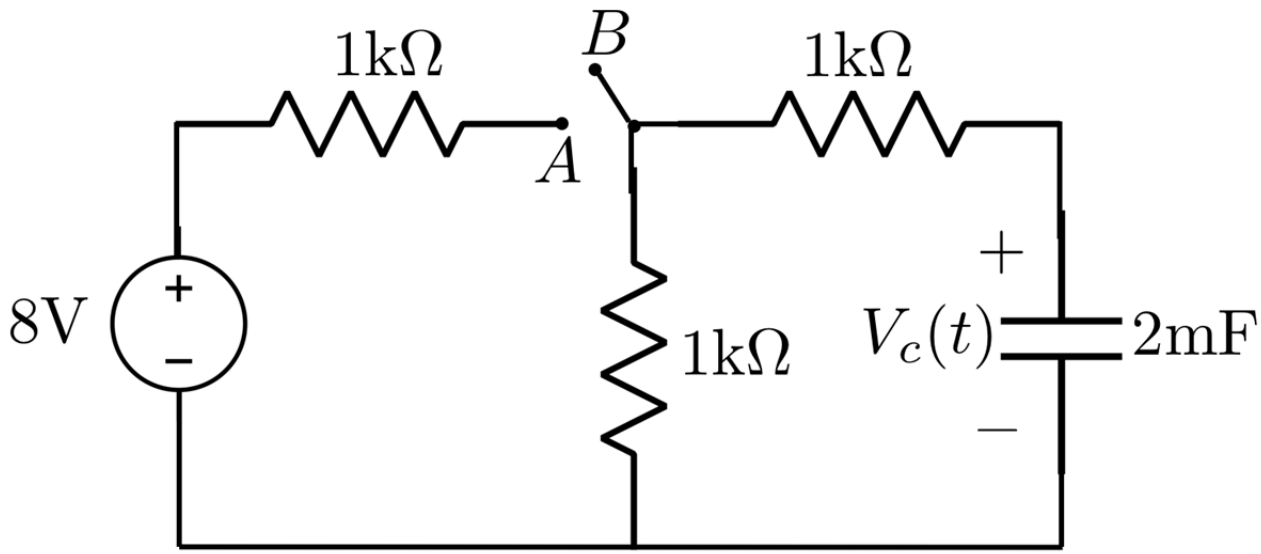
(8) $V_R(0.15) = 67 - 48.8e^{-3}$ V

(9) $V_R(0.15) = 67 - 48.8e^{-0.15}$ V

(10) None of the above

Question 9

In this circuit, $V_c(0) = 1V$ and the switch is at position A at time $t = 0$. The switch moves to position B whenever $V_c(t) = 3V$, and moves to position A whenever $V_c(t) = 1V$. Find the period of the voltage waveform generated across the capacitor.



(1) 0 s

(2) 2.19 s

(3) 3.30 s

(4) 4.39 s

(5) 5.40 s

(6) 6.60 s

(7) 7.69 s

(8) 8.79 s

(9) 10.99 s

(10) None of the above

Potentially Useful Formulas

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

$$v_L(t) = L \frac{di_L(t)}{dt} \qquad i_C(t) = C \frac{dv_C(t)}{dt}$$

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

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

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

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