Name: ______________________________ (please print)

Signature: ___________________________

ECE 2202 – Quiz #2
July 16, 2020

Online

1. This quiz is open book, open notes.
2. Show all work necessary to complete the problem. A solution without the appropriate work shown will receive no credit. A solution which is not given in a reasonable order will lose credit.
3. Show all units in solutions, intermediate results, and figures. Units in the quiz will be included between square brackets.
4. If the grader has difficulty following your work because it is messy or disorganized, you will lose credit.
5. Do not use red ink. Do not use red pencil.
6. You will have 20 minutes to work on this quiz, and 15 minutes to download/print, scan and submit.

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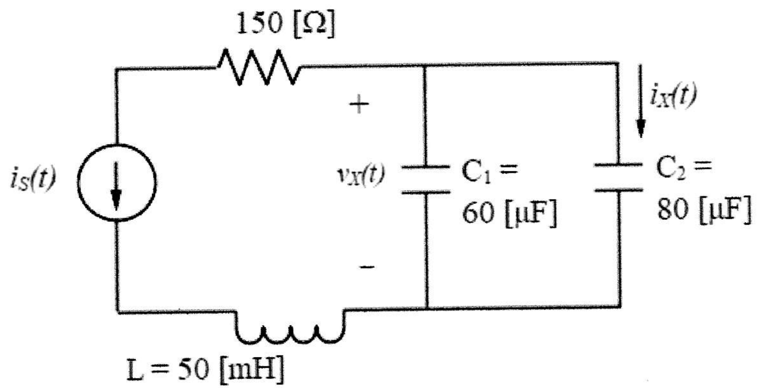
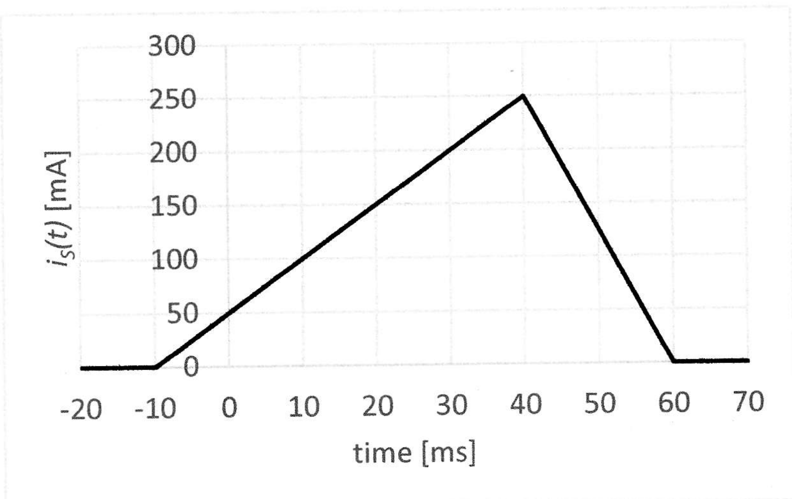
Room for extra work

For the circuit below, the value of the current source as a function of time is shown in the plot below the circuit. The value of $v_X(t)$ at t = -10 [ms] is known to be 44.643 [V].

a) Find the voltage $v_X(t)$ at t = 40 [ms].
b) Find an expression for the current i_X as a function of time, that is, find $i_X(t)$ for the time range 0 < t < 40 [ms].
c) Find the energy in the inductor at t = 30 [ms].

If your answers involve integration or differentiation, you must evaluate the integrals or derivatives to receive full credit.



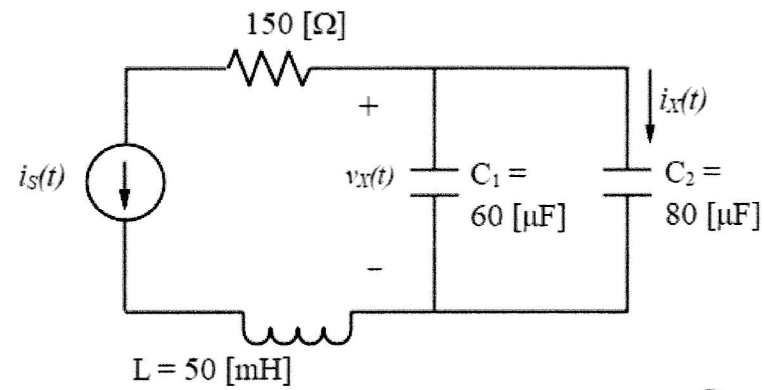


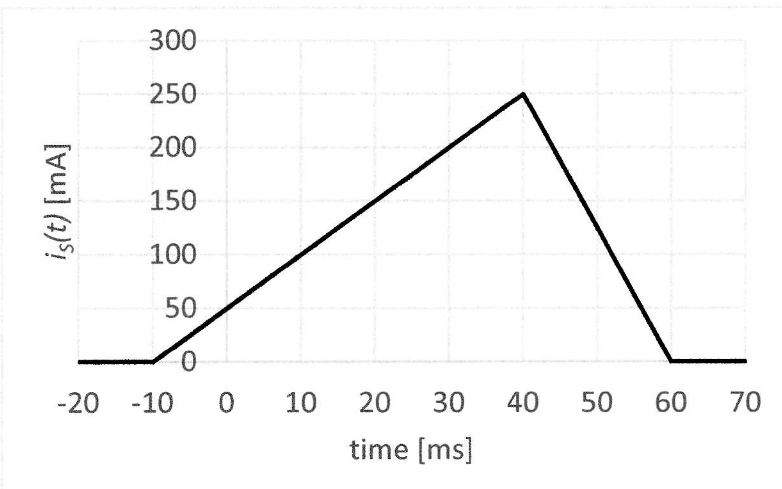
Room for extra work

For the circuit below, the value of the current source as a function of time is shown in the plot below the circuit. The value of $v_X(t)$ at t = -10 [ms] is known to be ~~17.589~~ [V].
44,643

a) Find the voltage $v_X(t)$ at t = 40 [ms].
b) Find an expression for the current i_X as a function of time, that is, find i_X (t) for the time range 0 < t < 40 [ms].
c) Find the energy in the inductor at t = 30 [ms].

If your answers involve integration or differentiation, you must evaluate the integrals or derivatives to receive full credit.





a) To find $v_x(t)$, we will need to integrate $i_s(t)$. We will also need an equivalent capacitance C_{eq}.

C_1 and C_2 in parallel

$$\Rightarrow C_{eq} = C_1 + C_2 = 140 [\mu F]$$

we could integrate to 40 [ms] to find $v_x(40[ms])$, but we need $v_x(t)$ for part b, so ... (note active sign relationship)

$$v_x(t) = -\frac{1}{C_{eq}} \int_{-0.01[s]}^{t} i_s(t)\,dt + v_x(-0.01[ms])$$

$$i_s(t) = 0.05 [A] + 5 [\tfrac{A}{s}] t$$
for t in [s]

Room for extra work

$$v_x(t) = -\frac{1}{140\times10^{-6}}\int_{-0.01\,[s]}^{t} 0.05\,dt - \frac{1}{140\times10^{-6}}\int_{-0.01\,[s]}^{t} 5t\,dt + 44.64\,[V]$$

$$= -\frac{1}{140\times10^{-6}}\,0.05t\Big|_{-0.01\,[s]}^{t} - \frac{1}{140\times10^{-6}}\,2.5t^2\Big|_{-0.01\,[s]}^{t} + 44.64\,[V]$$

$$= -\frac{1}{140\times10^{-6}}\left[0.05(t+0.01\,[s]) + 2.5(t^2-(0.01)^2)\right] + 44.64\,[V]$$

Let's do b:

$$i_x(t) = C_2\frac{dv_x(t)}{dt}$$

$$= -\frac{80\times10^{-6}}{140\times10^{-6}}\left[0.05+5t\right]$$

b)

$$\boxed{i_x(t) = -0.5714\,[0.05+5t]\;[A]}$$

a) Now we plug $t = 40\times10^{-3}\,[s]$ in $v_x(t)$:

$$v_x(40\,[ms]) = -\frac{1}{140\times10^{-6}}\left[0.05(0.05) + 2.5(0.04^2-0.01^2)\right] + 44.64$$

$$\boxed{v_x(40\,[ms]) = -44.643\,[V] + 44.643\,[V] = 0}\;!$$

c)

$$\boxed{W_L(30\,[ms]) = \frac{1}{2}L\,i_L^2(30\,[ms]) = \frac{1}{2}(0.05)(0.2)^2 = 1\,[mJ]}$$