Name: ______________________________ (please print)

Signature: ___________________________

ECE 2300 – Quiz #5
April 17, 2013

Keep this quiz closed and face up until you are told to begin.

1. This quiz is closed book, closed notes. You may use one 8.5" x 11" crib sheet, or its equivalent.
2. Show all work on these pages. 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. It is assumed that your work will begin on the same page as the problem statement. If you choose to begin your work on another page, you must indicate this on the page with the problem statement, with a clear indication of where the work can be found. **If your work continues on to another page, indicate clearly where your work can be found. Failure to indicate this clearly will result in a loss of credit.**
4. Show all units in solutions, intermediate results, and figures. Units in the quiz will be included between square brackets.
5. Do not use red ink. Do not use red pencil.
6. You will have 30 minutes to work on this quiz.

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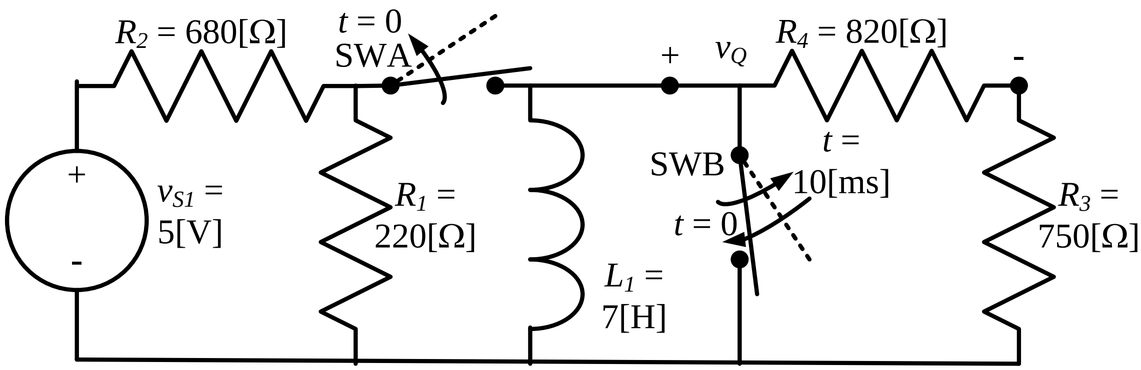
Room for extra work

Use the circuit below to solve this problem. The SWA switch was closed and the SWB switch was open for a long time before $t = 0$, at which time switch SWA opened and switch SWB closed. Then, 10[ms] later, switch SWB opened again.

a) Find $v_Q(10[\text{ms}]^+)$.
b) Find $v_Q(20[\text{ms}])$.

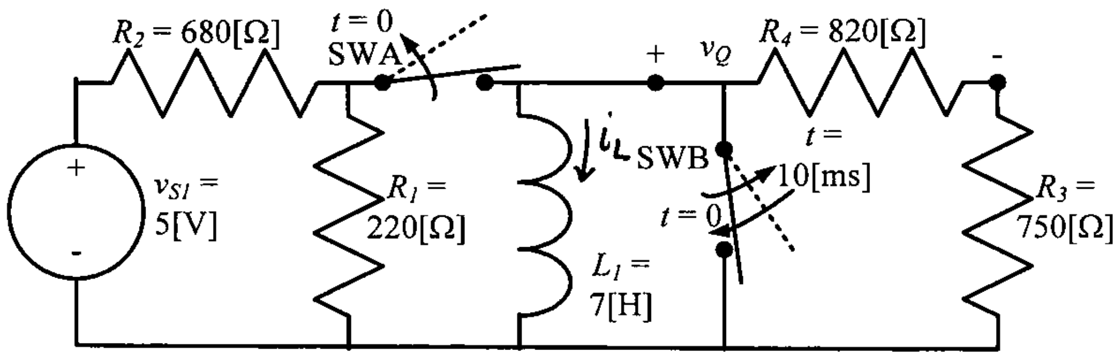


Room for extra work

ECE 2300 -- Quiz #5 – April 17, 2013 – Solution

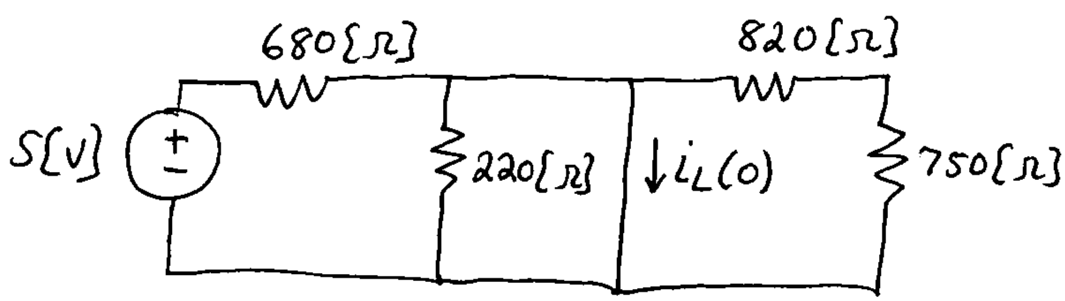
Use the circuit below to solve this problem. The SWA switch was closed and the SWB switch was open for a long time before $t = 0$, at which time switch SWA opened and switch SWB closed. Then, 10[ms] later, switch SWB opened again.

a) Find $v_Q(10[ms]^+)$.
b) Find $v_Q(20[ms])$.



We begin by defining the current through the inductor, i_L, in the diagram above.

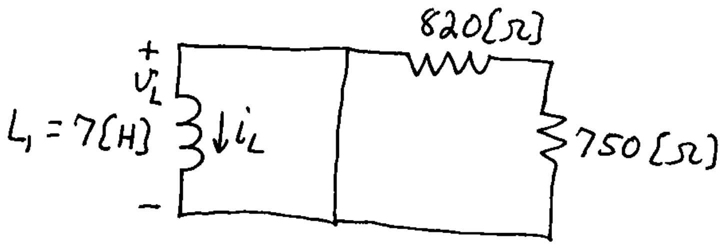
Then, redraw for $t<0$



$$i_L(0) = \frac{5[V]}{680[\Omega]} = 7.353[mA]$$

See next page

Next, redraw for $0 < t < 10[ms]$



$$v_L(t) = 0 \text{ for } 0<t<10[ms]$$

$$v_L(t) = L_1 \frac{di_L}{dt} = 0$$

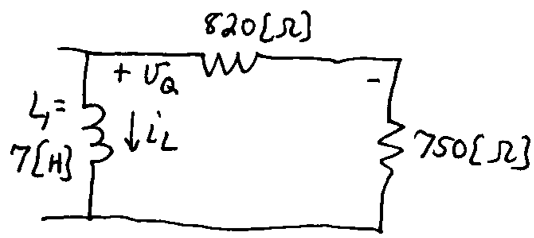
$$\frac{di_L}{dt} = 0$$

so $i_L(t)$ is not changing during this time.

$$i_L(t) = 7.353[mA]; \text{ for } 0 \le t \le 10[ms].$$

Note that we can include the equality in the time period above because it is an inductor current.

Next, redraw for $t > 10[ms]$



This is a natural response. The R_{EQ} seen by the inductor is

$$R_{EQ} = 820[Ω] + 750[Ω]$$
$$= 1570[Ω]$$

Thus $\tau = L_1 / R_{EQ} = \frac{7[H]}{1570[Ω]} = 4.459[ms]$

So, $i_L(t) = 7.353[mA]\, e^{-\frac{(t-10[ms])}{4.459[ms]}}; \text{ for } t \ge 10[ms].$

(see next page)

a) Now, $v_Q = -i_L\, 820\{\Omega\}$, so

$$v_Q(10\{ms\}^+) = -7.353\{mA\}(e^0)\, 820\{\Omega\}$$

$$= \boxed{-6.029\{V\}}$$

b) $$v_Q(20\{ms\}) = (-7.353\{mA\})(820\{\Omega\})\, e^{-\frac{(20-10)}{4.459}}$$

$$= \boxed{-0.64\{V\}}$$