Name: ______________________________ (please print)

Signature: ___________________________

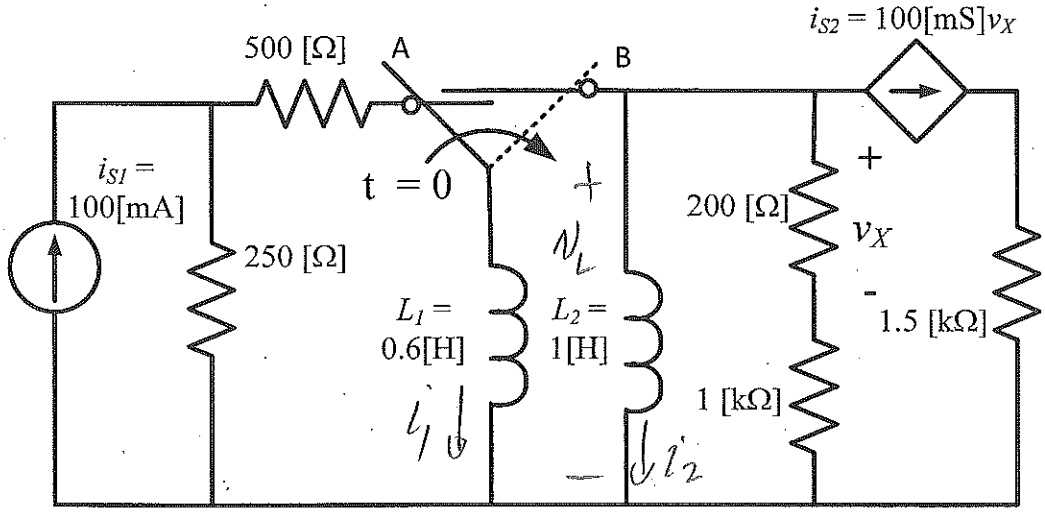
ECE 2300 – Quiz #6
November 15, 2012

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 necessary to complete the problem. A solution without the appropriate work shown will receive no credit.
3. Show all units in solutions, intermediate results, and figures. Units in the quiz will be included between square brackets.
4. Do not use red ink. Do not use red pencil.
5. You will have 40 minutes to work on this quiz.

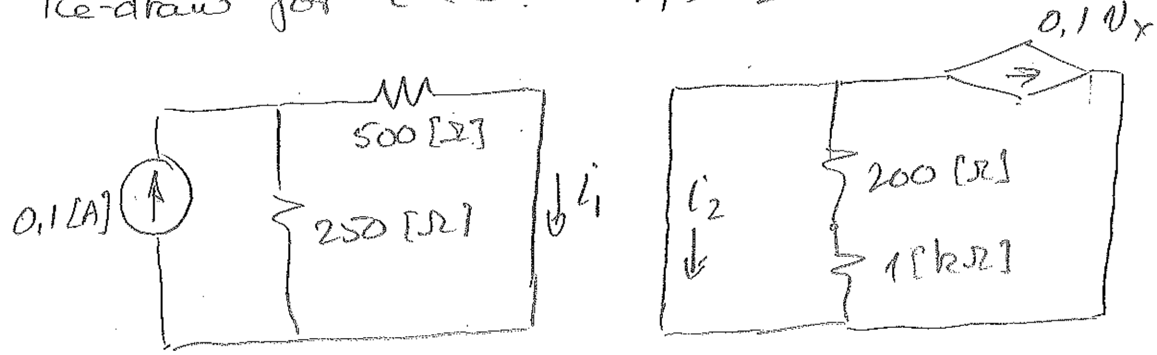
________________/20

The switch in the circuit below has been in position A for a long time. At t = 0 it moved to position B. Find v_X at t = 10.5 [ms].



Game Plan: After the switch moves to B, we will have two inductors in parallel. We will combine these into an equivalent and find the current in the equivalent. We will then differentiate to get the voltage v_L; and use VDR to get v_X.

Re-draw for $t<0$: $L_1, L_2 \rightarrow$ short



$$i_1(0^-) = 0.1 \frac{250}{250+500}$$

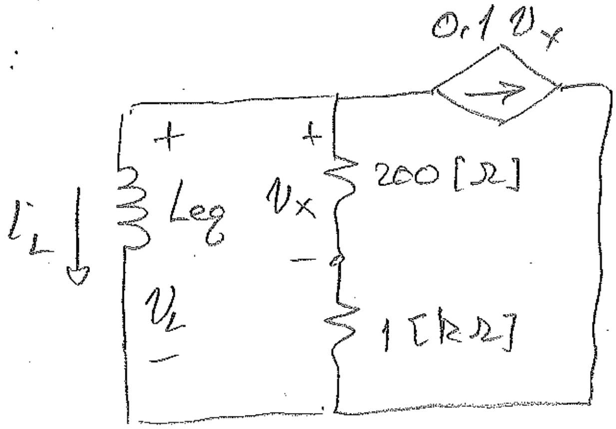
$$= 33.33 \text{ [mA]}$$

$$i_2(0^-) = 0$$

(no independent sources)

Room for extra work

$t > 0$:



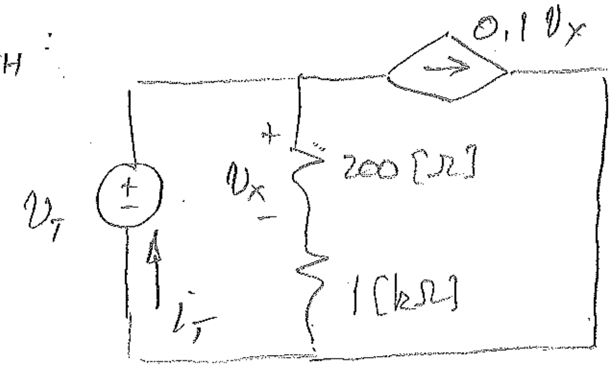
$$L_{eq} = \frac{L_1 \cdot L_2}{L_1 + L_2} = 0.375\,[H]$$

$$i_L(0^-) = i_L(0^+)$$
$$= i_1(0^-) + i_2(0^-)$$
$$= 33.33\,[mA]$$

$$i_L(t) = i_{L,f} + (i_L(0^+) - i_{L,f})\,e^{-t/\tau_L}$$

$i_{L,f} = 0$ since there are no independent sources here.

R_{TH}:



$$i_T = \frac{v_T}{1200} + 0.1 v_x$$

$$v_x = v_T \frac{200}{200+1000} = \frac{v_T}{6}$$

$$i_T = v_T \left(\frac{1}{1200} + \frac{0.1}{6}\right)$$

$$R_{TH} = v_T / i_T = 57.14\,(\Omega)$$

$$\tau_L = \frac{L_{eq}}{R_{TH}} = 6.56\,[ms]$$

So... $\quad i_L(t) = 33.33\,[mA]\,e^{-t/6.56\,[ms]} \qquad t \geq 0$

Room for extra work

$$v_L(t) = L_{eq} \frac{di_L}{dt} = (0.375)(0.03333)\left(\frac{-1}{0.00656}\right) e^{-t/6.56\,[ms]} \quad [V]$$

$$= -1.905\, e^{-t/6.56\,[ms]} \quad [V] \quad t > 0\,[ms]$$

$$\therefore \; v_x(t) = v_L(t) \cdot \frac{200}{200+1000} = \frac{v_L(t)}{6}$$

So at $t = 10.5\,[ms]$, we have

$$v_x(t = 6.56\,[ms]) = \frac{1}{6}\left(-1.905\, e^{-10.5/6.56}\right) = -64.1\,[mV]$$