Name: ______________________________ (please print)

Signature: ___________________________

ECE 2300 – Quiz #4
July 10, 2014

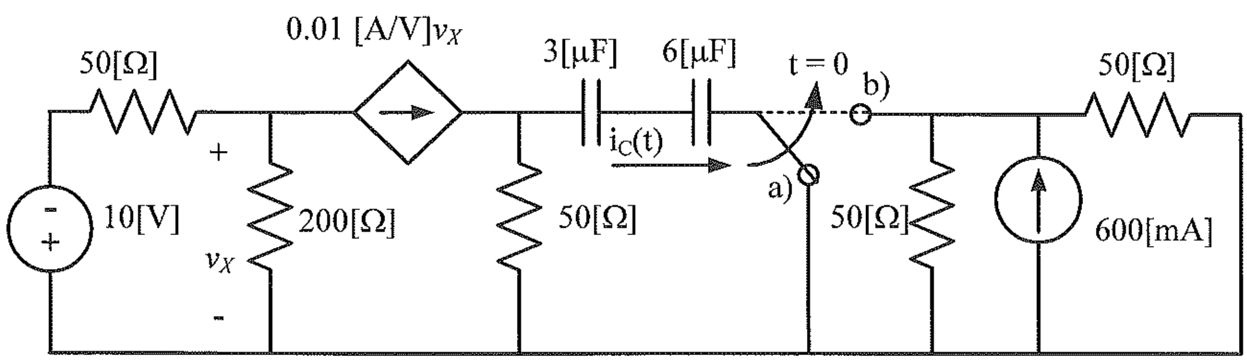
Keep this quiz closed and face up until you are told to begin.

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. 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 40 minutes to work on this quiz.

________________/25

Room for extra work

In the circuit below, the switch was in position a) for a long time, and then moved to position b) at $t = 0$. Find $i_C(t)$ for $t > 0$.



Room for extra work

Name: ______________________________ (please print)

Signature: ___________________________

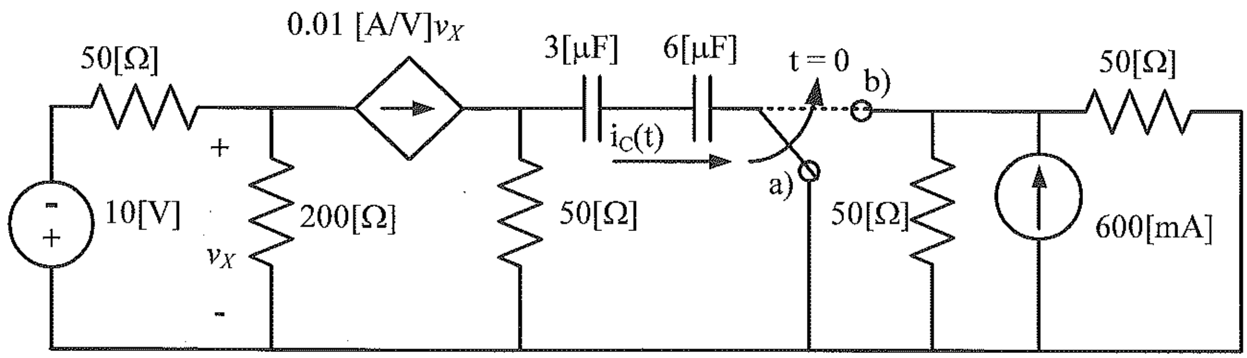
ECE 2300 – Quiz #4
July 10, 2014

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. 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 40 minutes to work on this quiz.

________________/25

In the circuit below, the switch was in position a) for a long time, and then moved to position b) at t = 0. Find $i_C(t)$ for t > 0.



It's a good idea to combine the capacitors, and to find the voltage across the equivalent. We will then differentiate. So...

(+1)

$$C_{eq} = \left(\frac{1}{3[\mu F]} + \frac{1}{6[\mu F]} \right)^{-1} = 2[\mu F]$$

2[μF], + $V_c(t)$ −

Our general formula is...

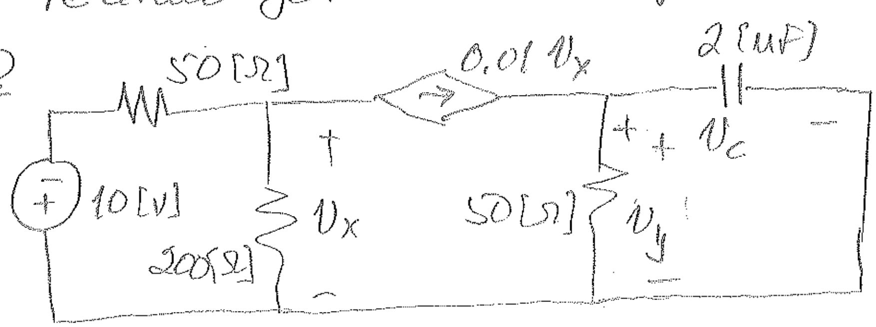
$$V_c(t) = V_{c,i} + [V_{c,f} - V_{c,i}] e^{-t/\tau_c}$$

where $V_{c,f} = V_c(t \to \infty)$ and $V_{c,i}$ is $V_c(t=0)$.

(+6)

We redraw for t<0 to find $V_{c,i}$:

t<0



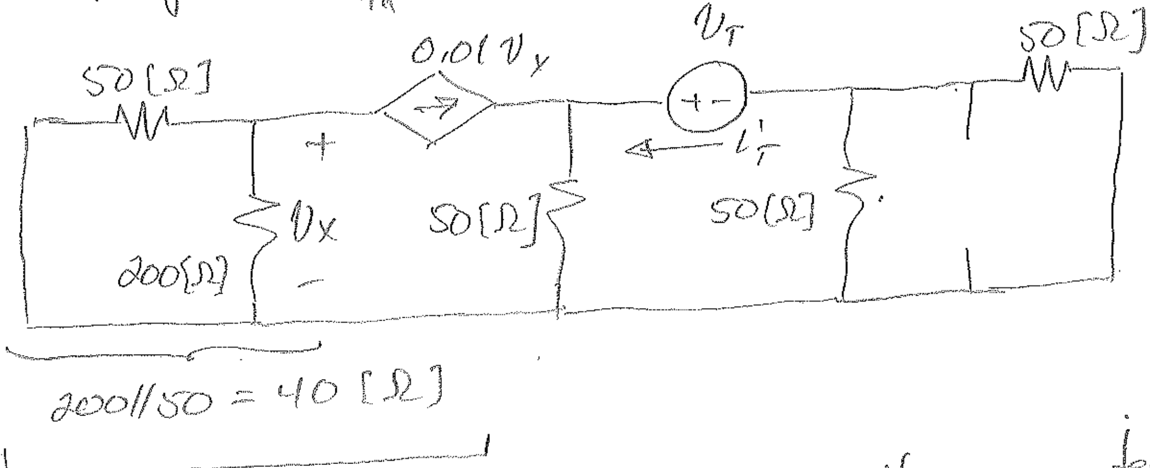
C_{eq} is an open circuit so...

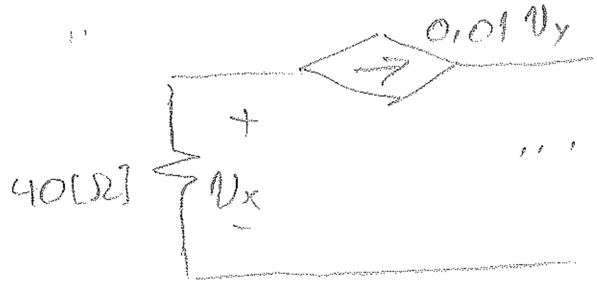
$$\frac{V_x}{200} + \frac{V_x + 10}{50} + 0.01 V_x = 0 \Rightarrow V_x = -5.714 [V]$$

$$V_y = \frac{50}{100} V_x = -2.857 [V]$$

Room for extra work

Re-draw for $t > 0$ and replace C_{eq} with a test source to find R_{TH}:





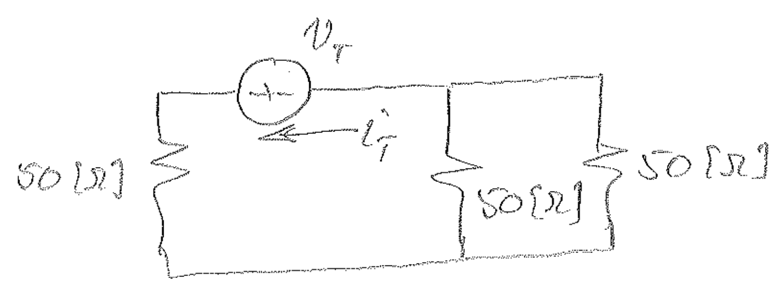
Something interesting going on here...

$$v_X = 40 \times 0{,}01\, v_X$$

$$\Rightarrow v_X = 0 \, !$$

So the current source is an open circuit!

Re-drawing ...



(+5)

$$R_{TH} = 50 // 50 + 50 = 75 \; [\Omega]$$

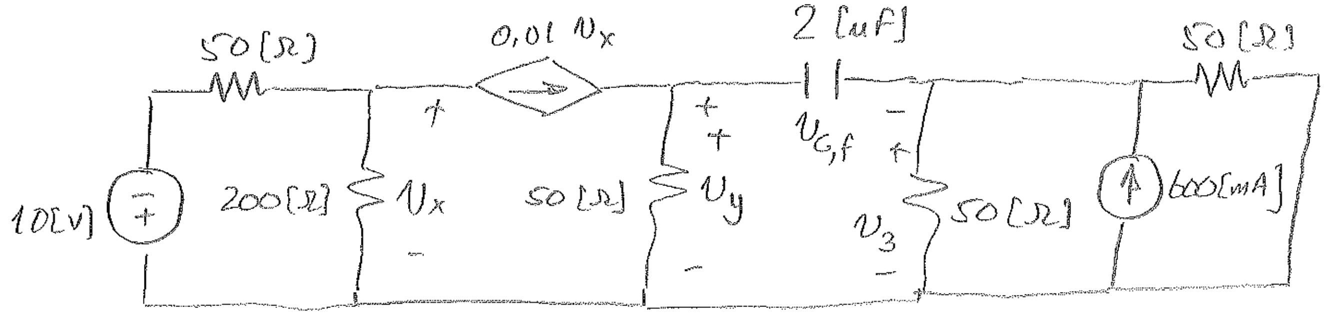
(+1)

$$\tau_c = R_{TH} \cdot C_{eq} = 75 (2 \times 10^{-6}) = 150 \; [\mu s]$$

pg. 2

Room for extra work

For $v_{c,f}$:



Since there is no current in C_{eq}, the circuit to the left of C_{eq} is exactly what it was for $t<0$, so v_y is the same. Also, v_3 can be had with CDR.

$v_y = -2.857$ [V] $\qquad v_3 = 0.6 \dfrac{50}{50+50}(50) = 15$ [V]

So $\quad v_{c,f} = v_y - v_3 = -17.86$ (V)

and $\quad v_c(t) = -17.86 + (-2.86 - (-17.86))e^{-t/150[us]}$ [V] $t \geq 0$

$= -17.86 + 15e^{-t/150[us]}$ [V] $t \geq 0$

$i_c(t) = C \dfrac{dv_c(t)}{dt}$

$= (2\times10^{-6})\left(\dfrac{-1}{150\times10^{-6}}\right)(15)e^{-t/150[us]}$

$i_c(t) = -0.2\, e^{-t/150[us]}$ [A] $\quad t>0$