Name: _____ (please print)

Signature: _____

ECE 2202 – Quiz #3
July 20, 2020

Online

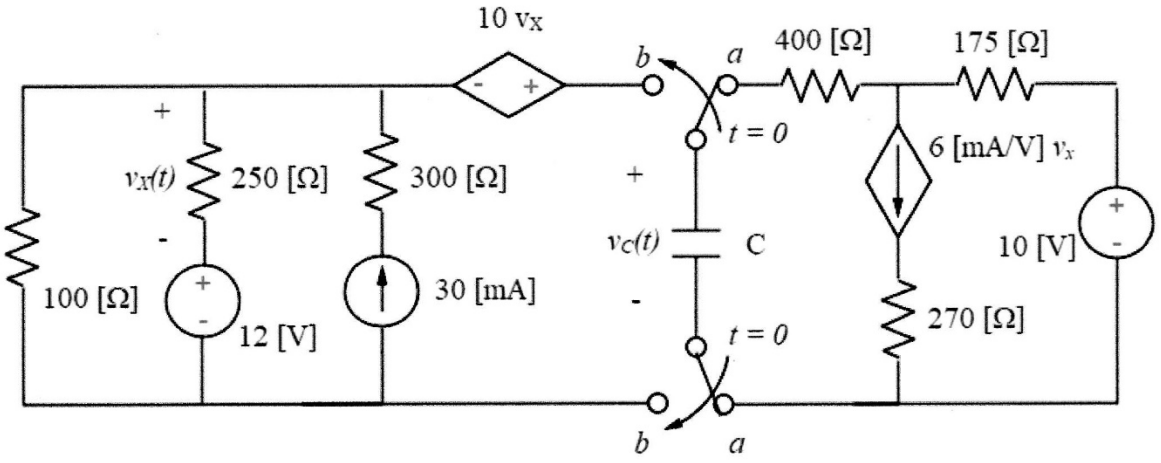
1. This quiz is open book, open notes.
2. Show all work necessary to complete the problem. A solution without the appropriate work shown will receive no credit. A solution which is not given in a reasonable order will lose credit.
3. Show all units in solutions, intermediate results, and figures. Units 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 30 minutes to work on this quiz, and 15 minutes to download/print, scan and submit.

_____/25

Room for extra work

In the circuit below, the switches had been in position 'a' for a long time. At t = 0, they moved to position 'b'. The value of the capacitance is equal to the first four digits of your student ID, in units [nF]. For example, if your student ID is 1234567, C = 1234 [nF].

a) Find the voltage $v_C(t)$ for $t \geq 0$.
b) Find $v_X(t)$ after 2 time constants, i.e., for $t = 2\tau_C$.



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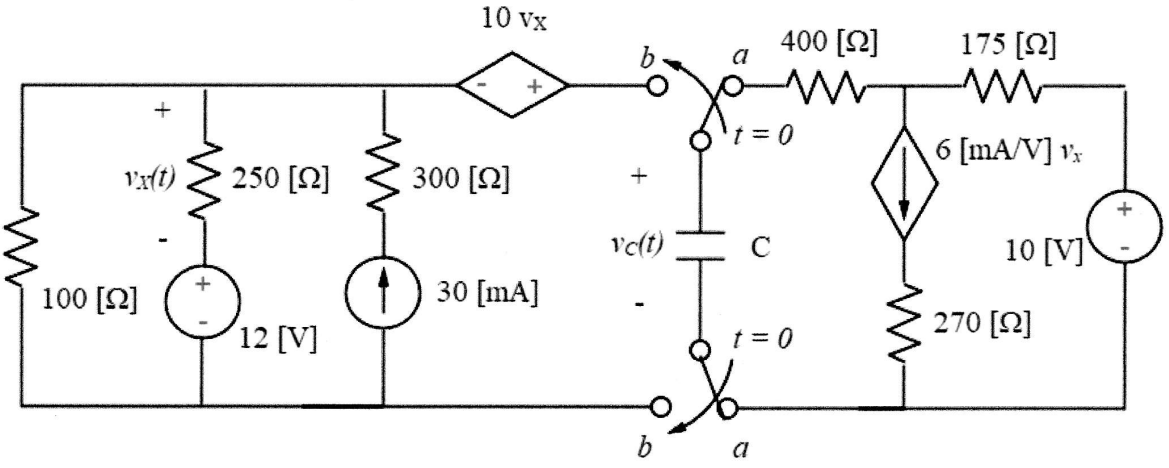
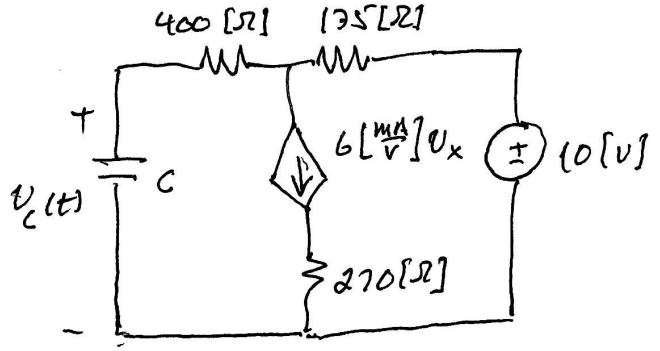


I will use C = 1,234 [nF].

$t < 0$



To find $v_C(0)$, set capacitor to open circuit.

We will also need v_x: $\frac{v_x}{250} + \frac{v_x + 12}{100} - 0.03 = 0$

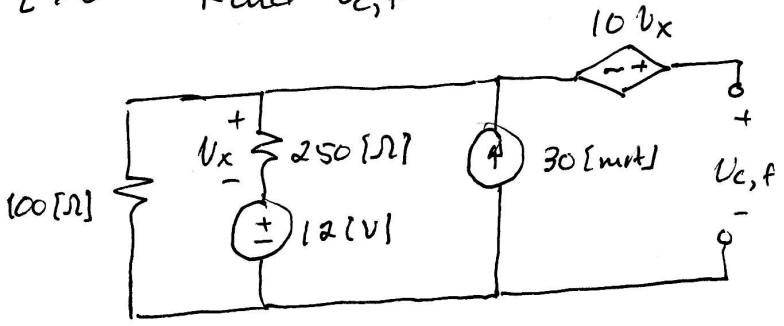
$\Rightarrow v_x = -6.43$ [V]

$v_c - 10 + 0.006(-6.43)(175) = 0$

$\Rightarrow \boxed{v_c(0) = 16.75 \text{ [V]}}$

Room for extra work

$t > 0$ Find $v_{c,f}$ $\Rightarrow$ C $\rightarrow$ open circuit

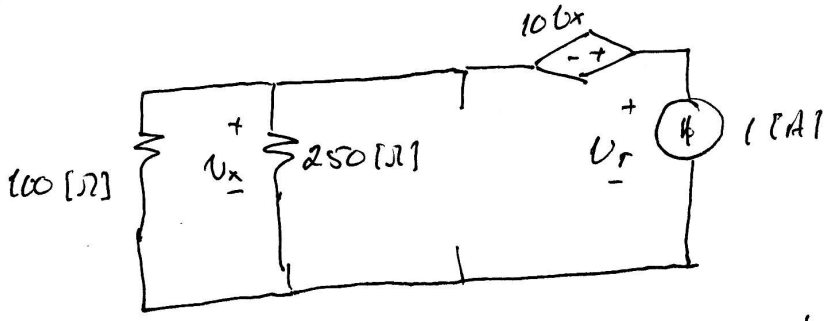


with C $\rightarrow$ open, v_x is the same as it was earlier...

$v_x = -6.43$ [V]

$-v_{c,f} + 10v_x + v_x + 12 = 0 \Rightarrow \boxed{v_{c,f} = 11v_x + 12 = -58.73 \text{ [V]}}$

Find R_{TH}



If we use a test current, we can find v_x quickly:

CDR $v_x = 1\text{[A]} \cdot \frac{100}{100+250} \cdot 250 = 71.43 \text{ [A]}$

$-v_T + 10v_x + v_x = 0 \Rightarrow v_T = 11v_x = 785.7 \text{ [V]}$

$\Rightarrow R_{TH} = 785.7 \text{ [Ω]}$

$\Rightarrow \boxed{\tau_c = R_{TH} C = 0.97 \text{ [ms]}}$

$v_c(t) = v_{c,f} + (v_c(0) - v_{c,f}) e^{-t/\tau_c}$

a) $\boxed{v_c(t) = -58.73 + (3.25 - (-58.73)) e^{-t/0.97\text{[ms]}}}$ [V] $t \geq 0$ [ms]

(p.2)

Room for extra work

b)

KVL : $-v_c(t) + 10\,v_x(t) + v_x(t) + 12 = 0$

$$v_x(t) = \frac{v_c(t) - 12}{11}$$

$$v_c(t = 2\tau_c) = -58.73 + (61.98)e^{-2} = -50.34 \ [V]$$

$$\therefore \quad v_x(t = 2\tau_c) = \frac{-50.34 - 12}{11} = -5.67 \ [V]$$