Name: _____ (please print)

Signature: _____

ECE 2202 – Quiz 4

October 19, 2023

1. This quiz is closed book, closed notes. You may have one 8.5 x 11" crib sheet.
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 40 minutes to work on this quiz.

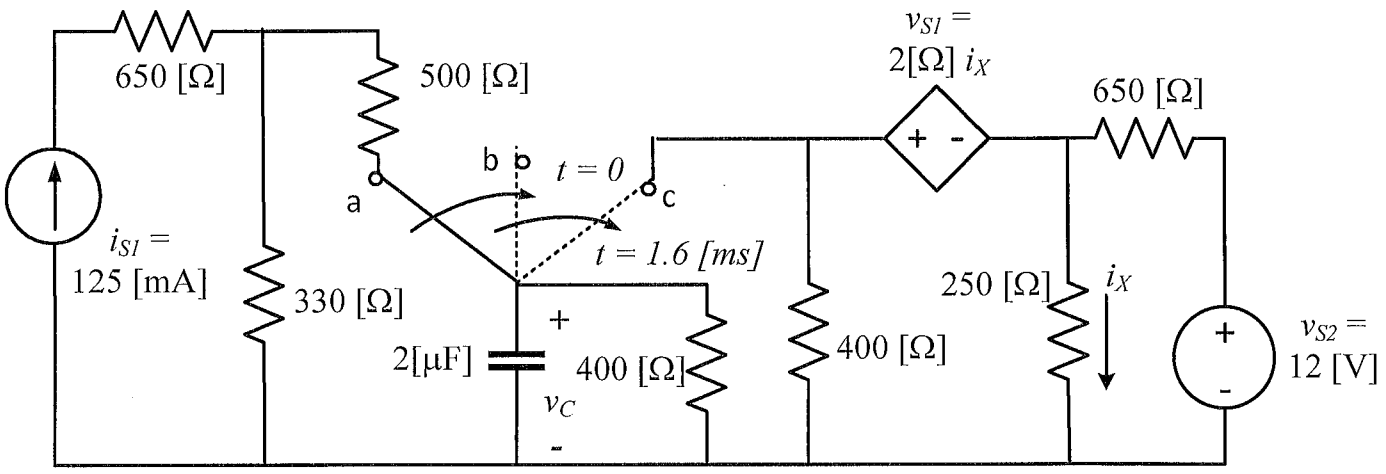
_____/20

Room for extra work

In the circuit below, the switch was at position 'a' for a long time. The switch moved instantaneously to position 'b' at t = 0, and then moved instantaneously to position 'c' at t = 1.6 [ms].

i) Draw the circuit for each of the time periods $t < 0$, $0 < t < 1.6$ [ms], and $t > 1.6$ [ms]. Indicate the time periods for each drawing. In your drawings, you may leave out any portion of the circuit you feel is not important during that time period.

ii) Find $v_C(2[\text{ms}])$.



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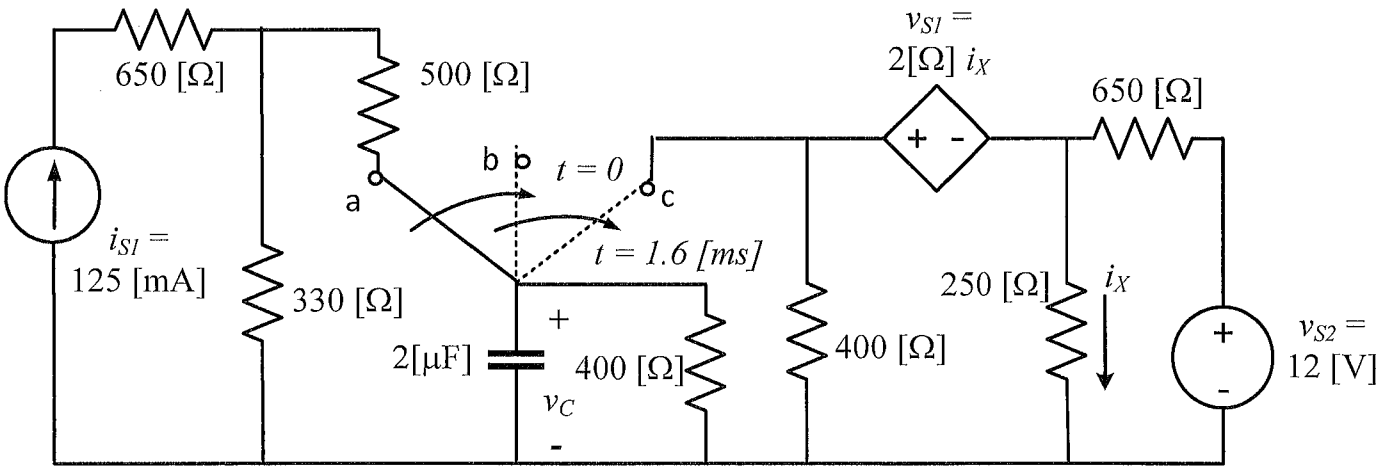
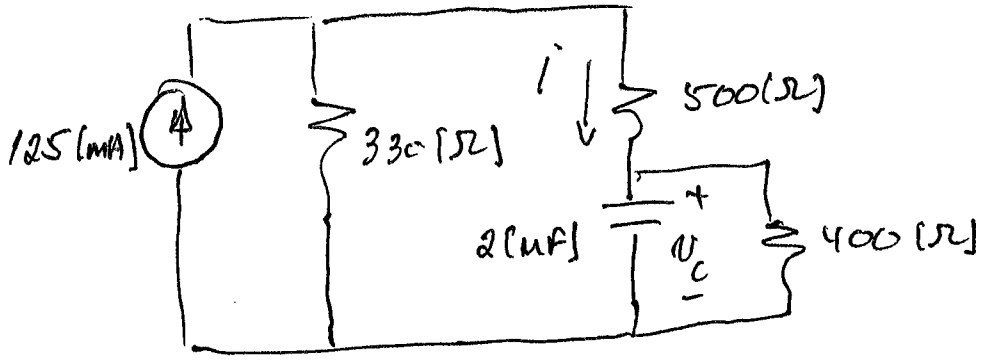
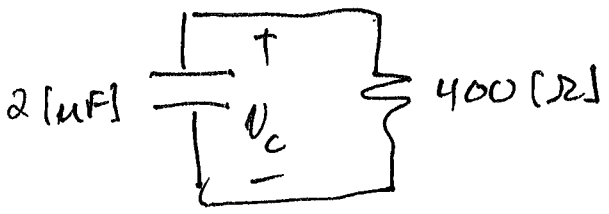
ii) Find $v_C(5[\text{ms}])$.



$t < 0$

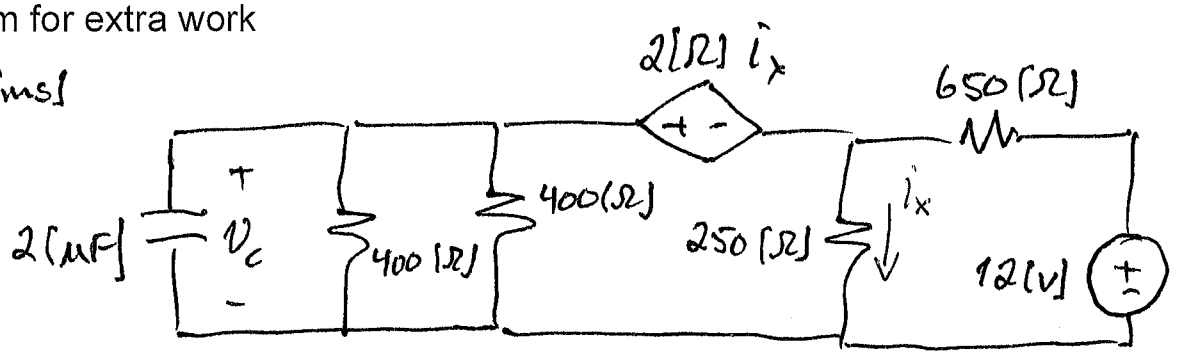


$0 < t < 1.6$ [ms]



Room for extra work

$t > 1.6\,[ms]$



+4

ii) From the t<0 diagram: with C → open circuit:

CDR: $i = 0.125 \dfrac{330}{330 + 900} = 33.537\,[mA]$

+3 $v_c(0) = 400\, i = 13.42\,[V]$

From the $0 < t < 1.6\,[ms]$ circuit:

+2 +2 +1 $v_c(t) = v_{c,f} + (v_c(0) - v_{c,f})\, e^{-t/\tau_c}$ $\tau_c = R_{TH} \cdot C$

$v_{c,f} = 0$ $v_c(0) = 13.42\,[V]$ $R_{TH} = 400\,[\Omega]$ $\tau_c = 0.8\,[ms]$

+2 $v_c(t) = 13.42\, e^{-t/0.8\,[ms]}$ $0 < t < 1.6\,[ms]$

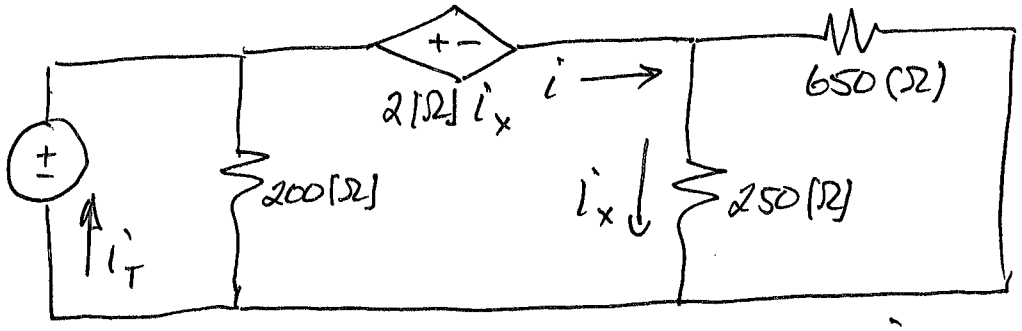
+3 $v_c(1.6\,[ms]) = 13.42\, e^{-2} = 1.816\,[V]$

Pg. 2

Room for extra work

From the $t > 1.6$ [ms] circuit, and with a test source ...

R_{TH}:



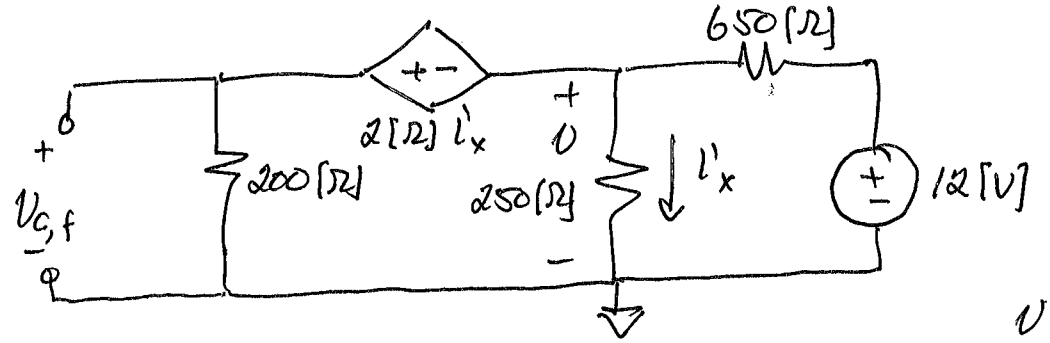
$650 \| 250 = 180.56\ [\Omega]$

$$i_T' = \frac{1}{200} + \underbrace{\frac{1 - 2i_x'}{650 \| 250}}_{i} \qquad i_x' = \underbrace{\frac{1 - 2i_x'}{650 \| 250}}_{i} \cdot \frac{650}{650 + 250}$$

Solving: $i_T' = 10.49$ [mA] $\quad i_x' = 3.968$ [mA]

+5 +1 $\Rightarrow R_{TH} = 95.29\ [\Omega] \Rightarrow \tau = R_{TH} C = 0.1906$ [ms]

$V_{C,f}$:



$v = 1.745$ [V]

$$\frac{v + 2i_x'}{200} + \frac{v}{250} + \frac{v - 12}{650} = 0 \qquad i_x' = \frac{v}{250} \Rightarrow i_x' = 6.981\ [\text{mA}]$$

+5 $\quad V_{C,f} - v - 2i_x' = 0 \Rightarrow V_{C,f} = 1.759$ [V]

So $\quad v_C(t) = V_{C,f} + (V_C(1.6\text{[ms]}) - V_{C,f})\, e^{-(t - 1.6\text{[ms]})/\tau_C}$

+3 $\quad = 1.759 + (1.816 - 1.759)\, e^{-(t - 1.6\text{[ms]})/0.191\text{[ms]}}$ [V] $\quad t > 1.6$ [ms]

+1 $\quad \boxed{v_C(5\text{[ms]}) = 1.766\ [\text{V}]}$