Name: _____ (please print)

Signature: _____

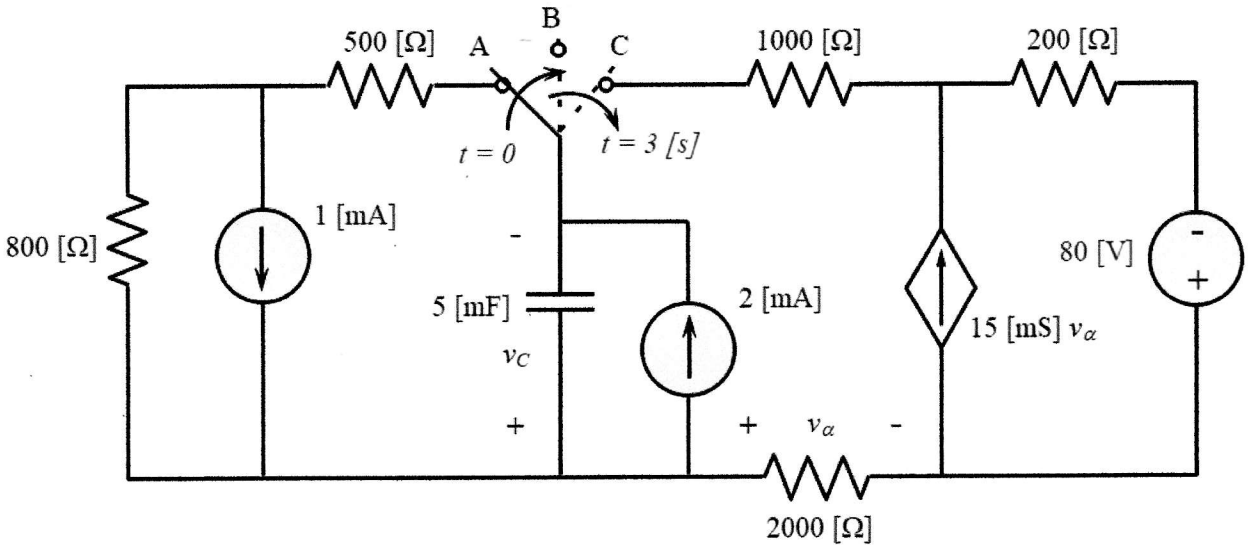
ECE 2202 Quiz 3
October 20, 2020
Online

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 switch was in position 'A' for a long time, and then moved to 'B' at t = 0. At t = 3 [s], the switch moved to 'C'. Find $v_C(t)$ for $t \geq 0$ [s]. In other words, find an expression for the capacitor voltage as a function of time for $0 < t < 3$ [s] and $t > 3$ [s].



Room for extra work

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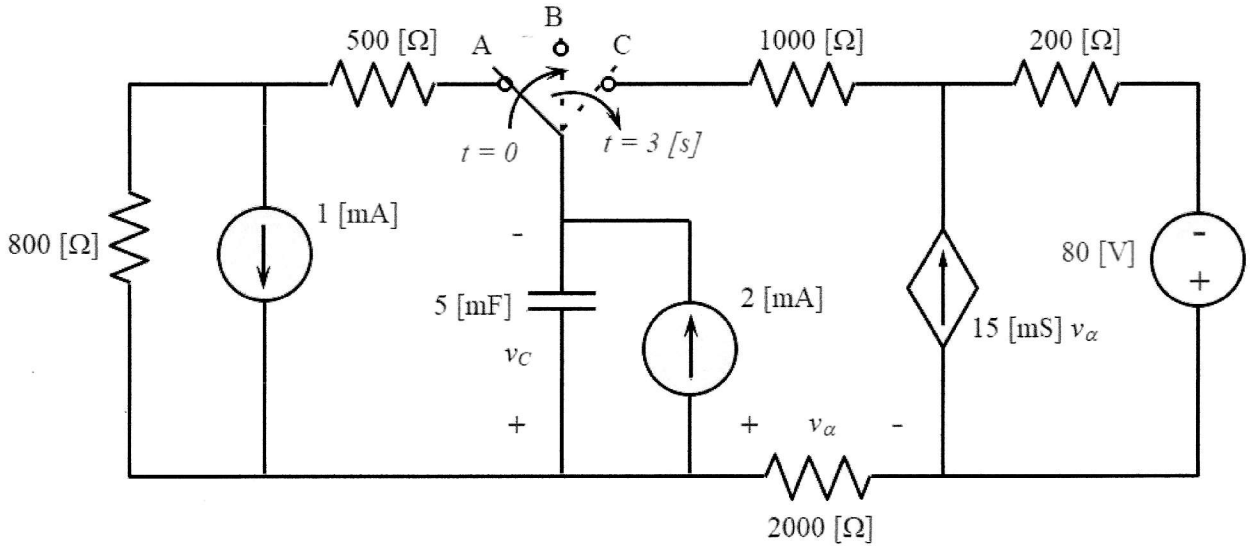
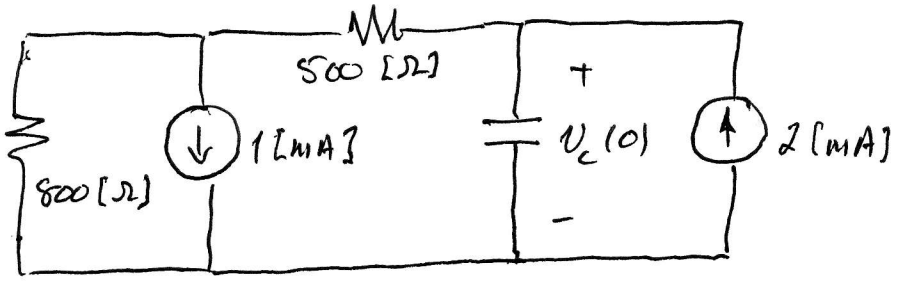


Draw for $t < 0$:



C → open ckt

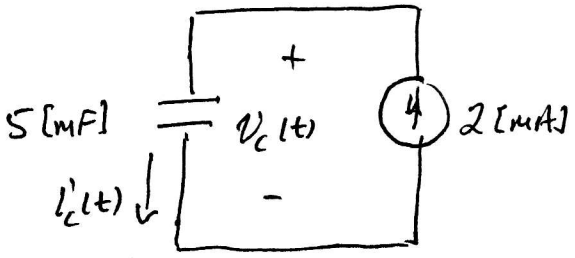
$$-v_c(0) + 500(0.002) + 800(0.002 - 0.001) = 0$$

$$\Rightarrow v_c(0) = 1.8 \text{ [V]}$$

Draw for $0 < t < 3$ [s] ...

We have a current source in series with the capacitor...

Room for extra work $0 < t < 3\,[s]$

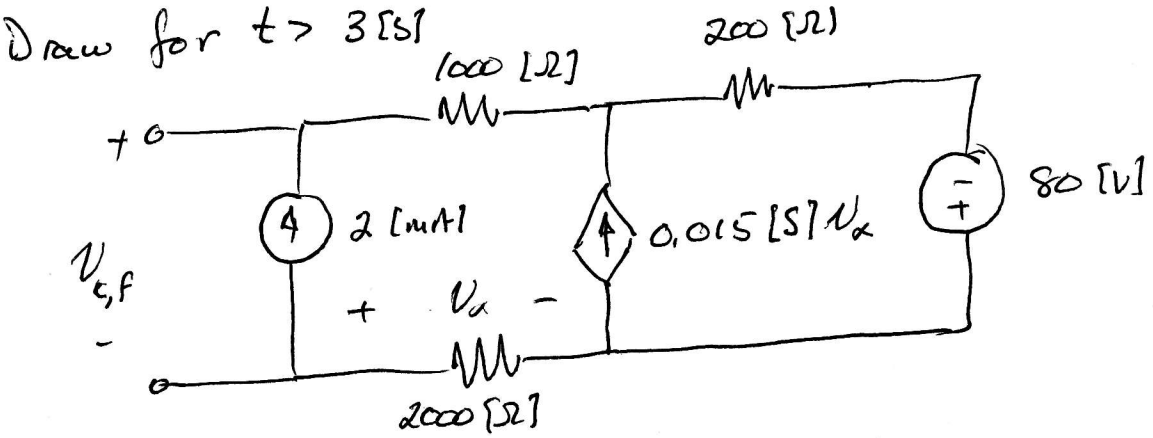


$$v_c(t) = \frac{1}{C}\int_0^t i_c(t)\,dt + v_c(0)$$

$$= \frac{1}{5\times10^{-3}}\int_0^t 0.002\,dt + 1.8\,[V]$$

$$\boxed{v_c(t) = 0.4t + 1.8\,[V]} \qquad 0 \le t \le 3\,[s]$$

Draw for $t > 3\,[s]$



This is a step-response problem for which

$$v_c(t) = v_{c,f} + (v_c(3\,[s]) - v_{c,f})\,e^{-(t-3\,[s])/\tau_c}$$

The diagram above is set up for finding $v_{c,f}$, so...

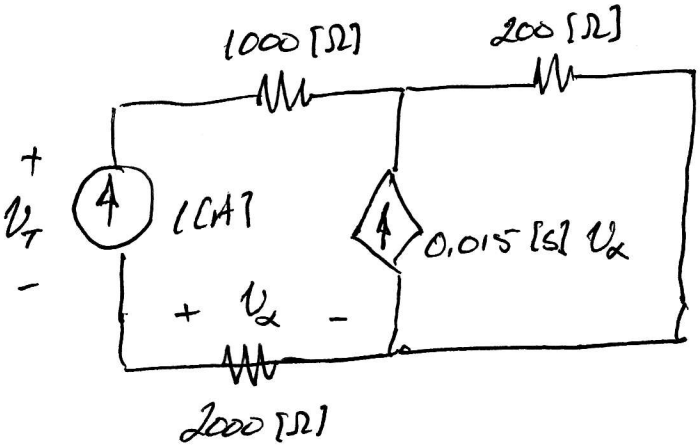
$$v_{c,f} = 1000(0.002) + 200(0.002 + 0.015\,v_\alpha) - 80 - v_\alpha$$

$$v_\alpha = -2000(0.002) = -4\,[V]$$

$$\boxed{v_{c,f} = -85.6\,[V]}$$

→ p.2.

Room for extra work



For τ_c we need R_{TH}:

$V_T = 3000 + 200(1 + 0{,}015\, V_\alpha)$

$V_\alpha = -2000\ [V]$

$\Rightarrow \quad V_T = -2800\ [V] \quad \Rightarrow \quad R_{TH} = -2800\ [V]$

$\Rightarrow \boxed{\tau_c = R_{TH} \cdot C = (-2800)(5 \times 10^{-3}) = -14\ [s]}$

$\boxed{V_c(3\ [s]) = 0.4t + 1.8\Big|_{3\ [s]} = 3\ [V]}$

$\therefore \quad \boxed{V_c(t) = -85.6 + (3 - (-85.6))\, e^{+(t - 3\ [s])/14\ [s]}} \qquad t \geq 3\ [s]$

$\boxed{V_c(t) = -85.6 + 88.6\, e^{(t-3\ [s])/14\ [s]}} \qquad t \geq 3\ [s]$