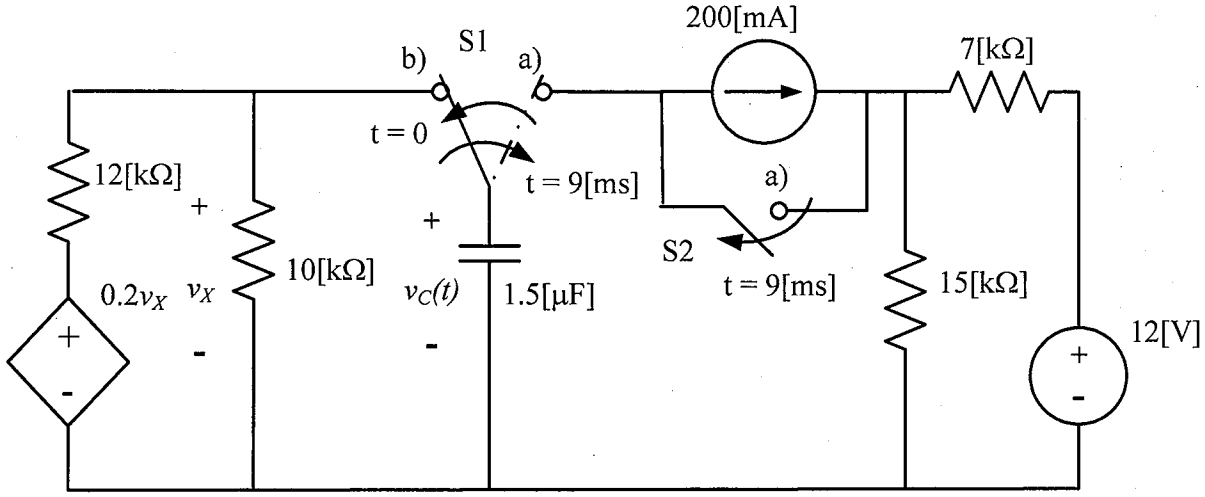
Name: _____ (please print)

Signature: _____

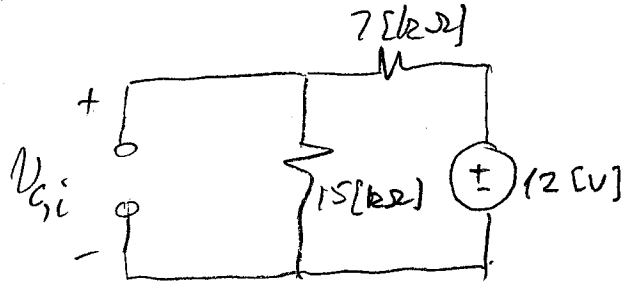
ECE 2300 – NOT Quiz #5
July 14, 2015

This quiz is "take-home". Dr. Trombetta will grade it for you if you wish, but it will not count for a grade in the course. You should be able to work it in 30 minutes without help and without aids except for a one-page crib sheet.

Switches S1 and S2 were in position a) for a long time, and then moved to b) at t = 0. At t = 9 [ms], switch S1 moved back to position a), and switch S2 opened. Find the voltage across the capacitor v_C (t) at t = 12 [ms].

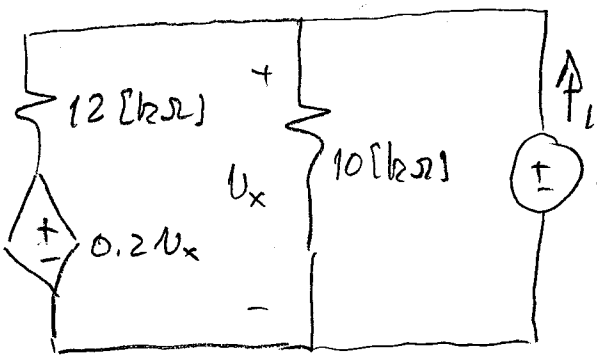


Re-draw for $t<0$:



$$v_{ci} = 12 \cdot \frac{15}{22} = 8.182\ [V]$$

Re-draw for $0<t<9$ [ms] and insert a test source:



$$i_T' = \frac{1}{10^4} + \frac{1-0.2v_x}{12000}$$

$v_x = 1\ [V]$

$$\Rightarrow i_T' = 10^{-4} + 6.667\times10^{-5}$$

$$= 0.1667\ [mA]$$

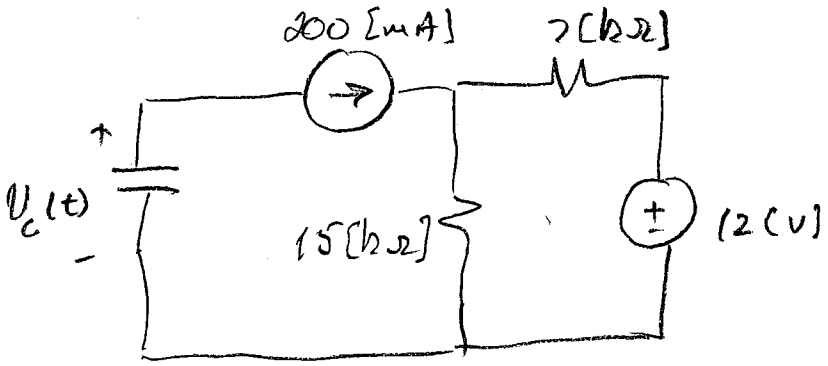
$$R_{TH} = \frac{1}{i_T'} = 6\ [k\Omega] \Rightarrow \tau = R_{TH} C = 9\ [ms]$$

Room for extra work

$\therefore \quad 0 < t < 9\,[ms] \Rightarrow v_c(t) = 8{,}182\,[V]\, e^{-t/9\,[ms]}$

at $t = 9\,[ms]$, $v_c = 8{,}182\, e^{-1} = 3{,}01\,[V]$

Re-draw for $t > 9\,[ms]$:



$$v_c(t) = -\frac{1}{C}\int_{9\,[ms]}^{t} 0.2\,[A]\,dt + v_c(9\,[ms])$$

$$= -\frac{0.2\,[A]}{1.5\times10^{-6}\,[F]}\,(t - 9\,[ms]) + 3{,}01\,[V] \qquad t \geq 9\,[ms]$$

At $t = 12\,[ms]$ $\quad v_c = -1.333\times10^{5}\left[\frac{A}{F}\right]\cdot 3\times10^{-3}\,[s] + 3{,}01$

$$= -400 + 3{,}01 = \underline{\underline{-397\,[V]}}$$