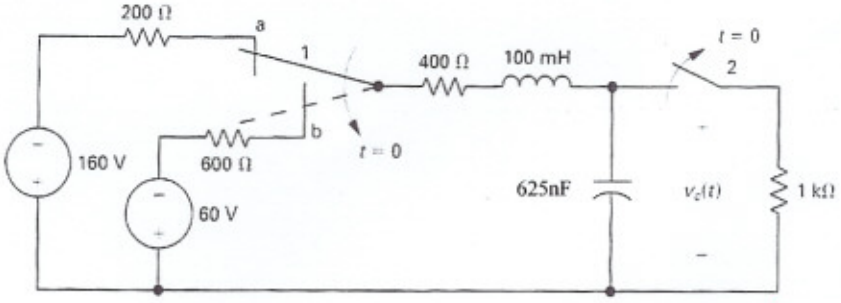
Serial #

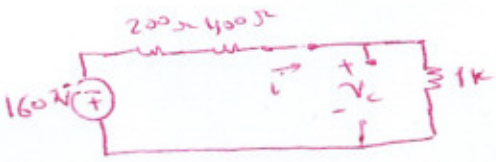
King Fahd University of Petroleum & Minerals
Electrical Engineering Department
EE205: Electric Circuits II (031)
Quiz 4

Name: KEY ID# Sec. 02

The two switches in the circuit seen in the figure below operate synchronously. When switch 1 is in position a, switch 2 is closed. When switch 1 is in position b, switch 2 is open. Switch 1 has been in position a for a long time. At $t = 0$, it moves instantaneously to position b. Find $v_c(t)$ for $t \geq 0$.



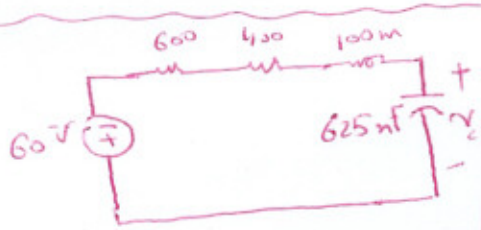
for $t<0$



$i_L(0) = \frac{-160}{1600} = -100\ mA$

$v_c = R i_L = (1k)(-100m) = -100V$

$t>0$



$\alpha = \frac{R}{2L} = \frac{1000}{200m} = 5000$ nepers

$\omega_o^2 = \frac{1}{LC} = \frac{1}{100m\ 625n} = 16000000$

$\omega_o^2 < \alpha^2$ over damped response

$s_1 = -\alpha + \sqrt{\alpha^2 - \omega_o^2} = -5000 + 3000 = -2000$

$= -5000 - 3000 = -8000$

s_2

$v_c(t) = V_f + A_1' e^{-2000t} + A_2' e^{-8000t}$

$V_f = v_c(\infty) = -60\ V$

Using the initial conditions.

$-100 = -60 + A_1' + A_2'$

$\Rightarrow \boxed{-40 = A_1' + A_2'}$ — ①

for the capacitor

$\frac{dv(0)}{dt} = \frac{i_c(0)}{C} = \frac{-100m}{625n} = -160000\ V/s$

$+160000 = +2000 A_1' + 8000 A_2'$ 1/2

$\boxed{80 = A_1' + 4A_2'}$ — ②

② − ①

$120 = 3A_2' \Rightarrow \boxed{A_2' = 40}$

Substitute in ① $\Rightarrow \boxed{A_1' = -80}$

$v_c(t) = -60 - 80 e^{-2000t} + 40 e^{-8000t}\ V$

$t \geq 0$

Good Luck,
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