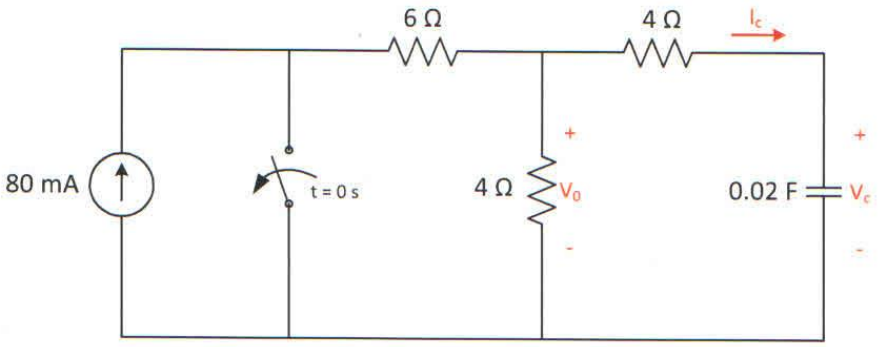
# EE 202 – 122

HW# 5 ( Due date: Monday 15.4.2013)

**Dr. Mohammad AlMuhaini**

***Q-1:***




The switch in the circuit shown above has been closed for a long time before opening at t=0 s. for t ≥ 0, find:

a) $V_c(t)$
b) $I_c(t)$
c) $V_0(t)$

(a) $V_c(0^-) = 0$

$V_c(\infty) = 80 \times 10^{-3}(4) = 0.32\ V$

$\tau = RC = 8(0.02) = 0.16$

$\rightarrow V_c(t) = 0.32 + (0 - 0.32)\, e^{-\frac{1}{0.16}t}$

$= 0.32 - 0.32\, e^{-\frac{1}{0.16}t} \qquad t \geq 0$

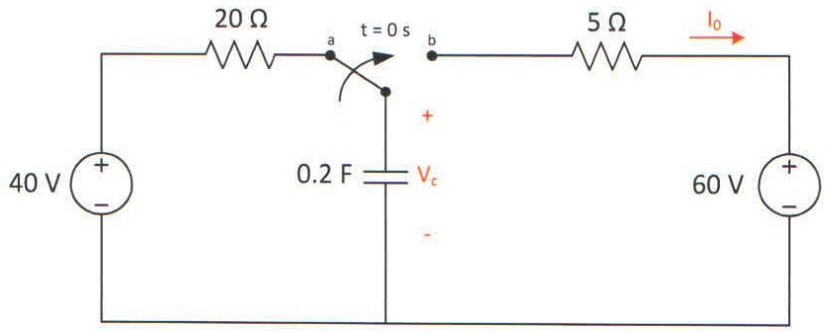
(b) $i_c(t) = C\,\frac{dV_c(t)}{dt} = 0.02\left(\frac{0.32}{0.16} e^{-\frac{1}{0.16}t}\right) = 0.04\, e^{-\frac{1}{0.16}t} \qquad t \geq 0$

(c) $V_0(t) = 4\, i_c(t) + V_c$

$= 0.16\, e^{-\frac{1}{0.16}t} + (0.32 - 0.32 e^{-\frac{1}{0.16}t})$

$= 0.32 - 0.16\, e^{-\frac{1}{0.16}t} \qquad t \geq 0$

**Q-2:**




The switch in the circuit shown above has been in position *a* for a long time before switching to position *b* at t=0 s. Find:

a) $V_c(0^+)$
b) $V_c(t)$ for $t \geq 0$
c) $V_c(\infty)$
d) Time constant for $t \geq 0$
e) $I_0(t)$ for $t \geq 0$

(a) $V_c(0^+) = V_c(0^-) = 40\ V$

(b) $V_c(\infty) = 60\ V$

$V_c(t) = 60 + (40 - 60)e^{-t} = 60 - 20e^{-t} \quad t \geq 0$

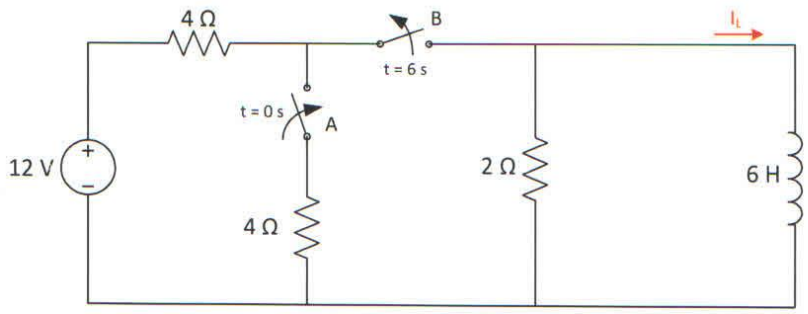
(c) $V_c(\infty) = 60\ V$

(d) $\tau = RC = 0.2 \times 5 = 1$

(e) $I_0(t) = \frac{V_c(t) - 60}{5}$

$= \frac{(60 - 20e^{-t}) - 60}{5} = -4e^{-t} \quad t \geq 0$

**Q-3:**




The switch A in the circuit shown above has been open and switch B has been closed for a long time. At t=0, switch A closes. After 6 seconds, switch B opens. Find $I_L(t)$ for $t \geq 0$.

① for $0 \leq t \leq 6$

$i_L(0^-) = 3$ A

$i_L(\infty) = 3$ A

$i_L(t) = 3 + (3-3)e^{-\frac{1}{6}t} = 3$ A $\qquad 0 \leq t \leq 6$

② for $t \geq 6$

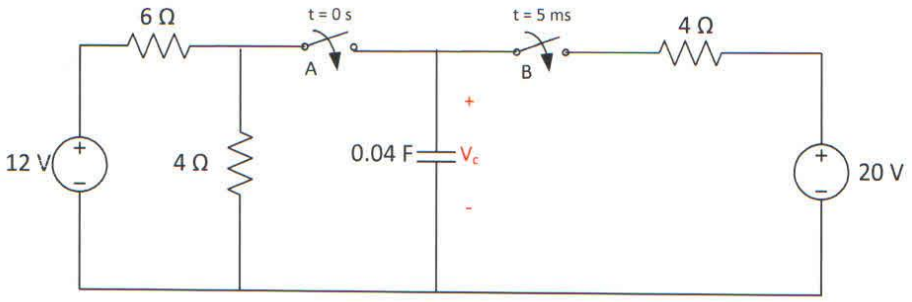
$i_L(6^-) = 3$ A

$i_L(\infty) = 0$

$i_L(t) = 0 + (3-0)e^{-\frac{1}{3}(t-6)}$

$= 3e^{-\frac{1}{3}(t-6)} \qquad t \geq 6$

**Q-4:**




The switch A in the circuit shown above has been open and switch B has been closed for a long time. At t=0, switch A closes. At t = 5 milliseconds, switch B then closes. Find $V_c(t)$ for $t \geq 0$.

① for $0 \leq t \leq 0.005$

$V_c(0^-) = 0$

$V_c(\infty) = 12 \frac{4}{10} = 4.8 \text{ V}$

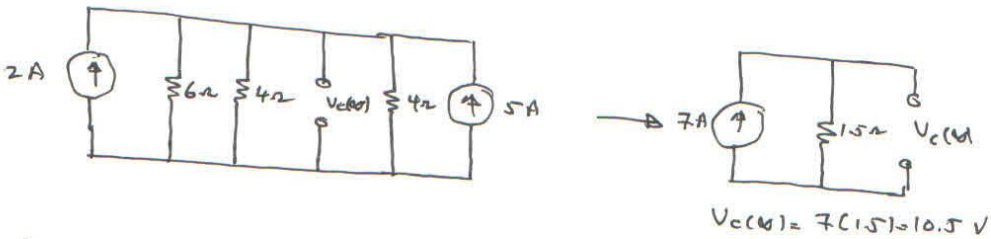
$\tau = RC = \frac{4 \times 6}{10}(0.04) = 0.096$

$V_c(t) = 4.8 - 4.8\, e^{\frac{-1}{0.096}t}$ $\quad 0 \leq t \leq 0.005$ s

② for $t \geq 0.005$

$V_c(0.005^-) = 4.8 - 4.8\, e^{-\frac{1}{0.096}(0.005)} = 0.243 \text{ V}$

$V_c(\infty) = 10.5 \text{ V}$




$V_c(\infty) = 7(1.5) = 10.5 \text{ V}$

$V_c(t) = 10.5 + (0.243 - 10.5)\, e^{-\frac{1}{(1.5)(0.04)}(t-0.005)}$

$= 10.5 - 10.257\, e^{\frac{-1}{0.06}(t-0.005)}$ $\quad t \geq 0.005$ s