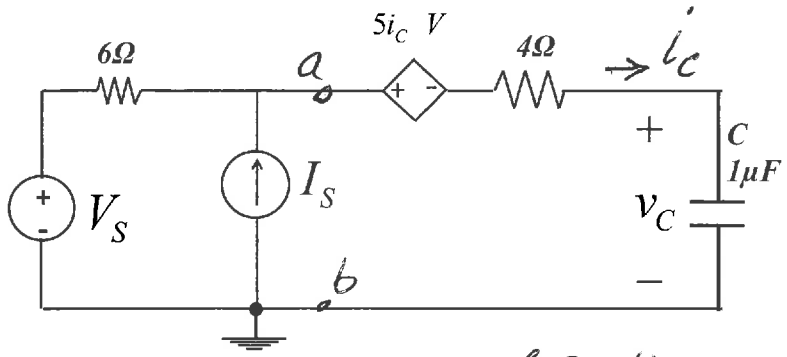
EECS 215-002 Quiz 6 Fall 2017

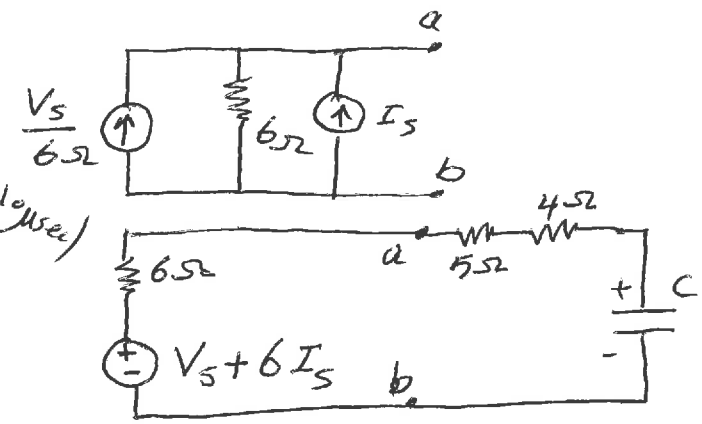
Name : **ID #**

Problem # 1(20 Points)

a) Find $v_C(t)$ in the following circuit if $V_S(t) = 6u(t)$ and $I_S(t) = 4u(t - 10\mu\text{sec})$.



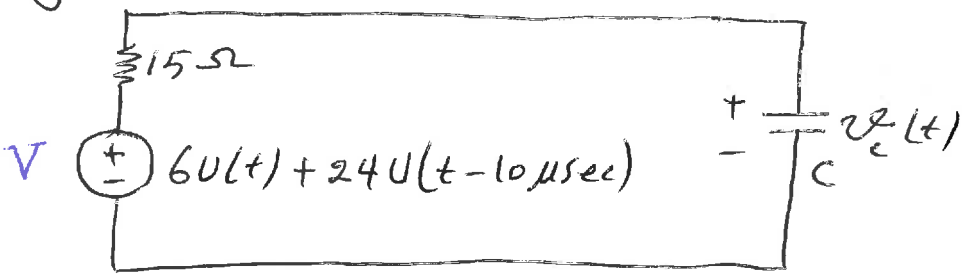
Let's first do some source transformation, and also replace $5i_C$ by a 5Ω resistance.



$\therefore V_{th} = V_S + 6I_S = 6U(t) + 24U(t - 10\mu\text{sec})$

$R_{th} = 15\Omega$

Using superposition



$$v_c(t) = 6\left(1 - e^{-t/\tau}\right)U(t) + 24\left(1 - e^{-(t-10^{\mu\text{sec}})/\tau}\right)U(t - 10^{\mu\text{sec}})$$

$$\tau = RC = 15^{\Omega} \times 1 \times 10^{-6} = 15\ \mu\text{sec}$$

b) Find the final value of the voltage on the capacitor

$$V_c(t \to \infty) = 6 + 24 = 30\ V$$

Another approach

You can also use this method to find $v_c(t)$

$$v_{c_1}(t) = 6\left(1 - e^{-t/\tau}\right) u(t) \quad ,$$

Then at $t = 10\,\mu sec$, V jumps to 30 V, with capacitor having initial value

$$v_{c_1}(t) = 6\left(1 - e^{-10\,\mu sec / 15\,\mu sec}\right) = 2.9\ V$$

$$v_c(t) = V_F + (V_i - V_F)\, e^{-t/\tau} \quad \text{for } t > 10\,\mu sec$$

$$v_c(t) = 30 + (2.9 - 30)\, e^{-(t - 10\mu s)/\tau}$$

$$v_c(t) = 30 - 27.1\, e^{-(t - 10\mu s)/15\,\mu sec}$$