Signature

Name (print, please)

ECE 2300 Circuit Analysis

Summer 2011
Quiz 5

DO NOT OPEN THIS QUIZ BOOKLET UNTIL INSTRUCTED TO DO SO

This quiz has 3 pages including this cover page. If you are missing any pages, raise your hand. You have 30 minutes to complete the quiz.

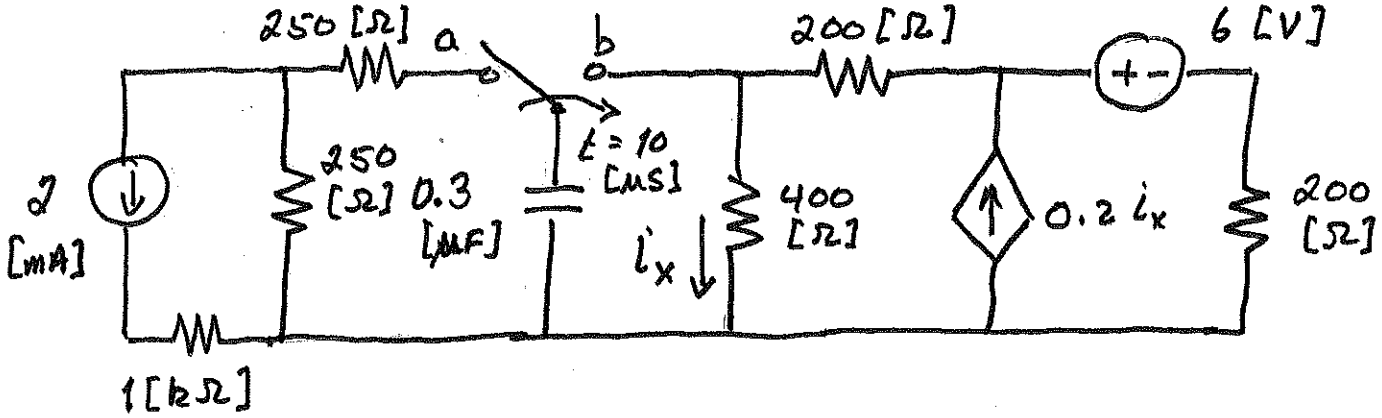
Notes

1. Be sure your name and signature appear above.
2. The quiz is closed-book. You may have a calculator and one 8 ½ " x 11" crib sheet.
3. To receive full credit for a problem, you must:

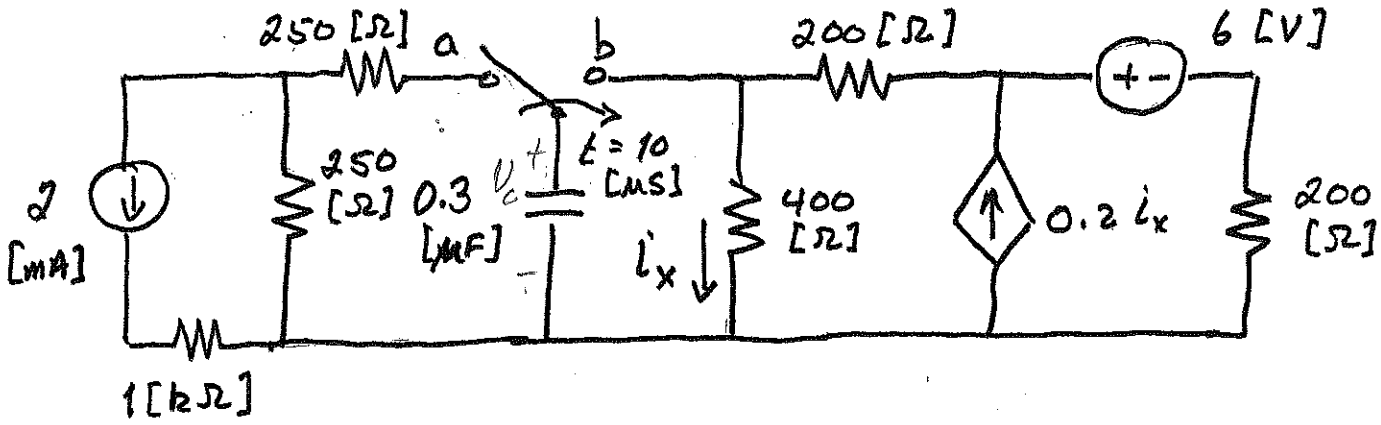
- Show all work necessary to solve the problem;
- Define all variables and parameters and label them on circuit diagrams;
- Use the proper notation for all variables.
- Show all units explicitly in intermediate and final results;
- Indicate clearly whether power being calculated is absorbed or delivered;

_____/50

In the circuit below, the switch was in position "a" for a long time. At t = 10 microseconds (μs), it moved to position "b". Find the current i_x at t = 25 [μs].

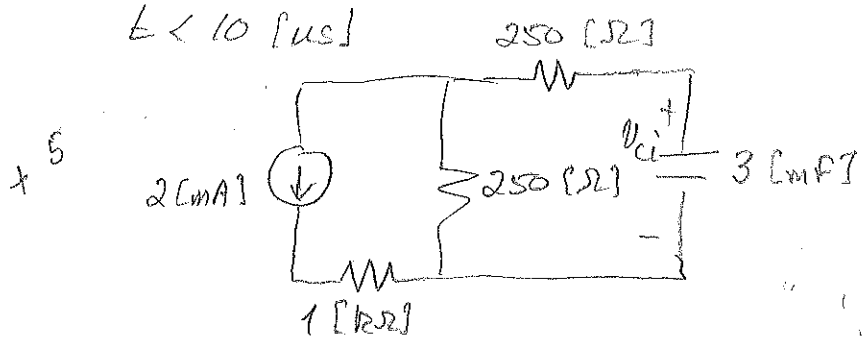


In the circuit below, the switch was in position "a" for a long time. At t = 10 microseconds (μs), it moved to position "b". Find the current i_x at t = 25 [μs].



Initial condition v_{ci} : C → open circuit

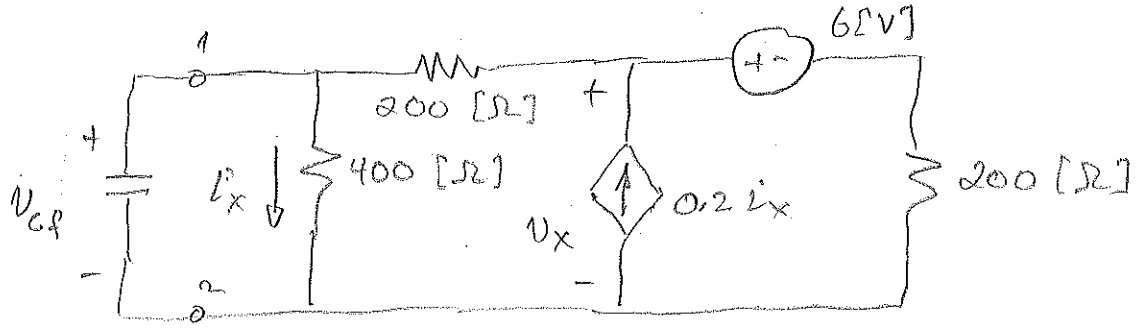
$t < 10$ [μs]



$v_{ci} = -(2\times10^{-3})(250)$

$v_{ci} = -0.5$ [V]

Switching event at 10 [μs]: $t > 10$ [μs]



Final (steady-state) condition: $t \to \infty \Rightarrow$ C → open circuit

$\Rightarrow v_o \to v_{cf}$

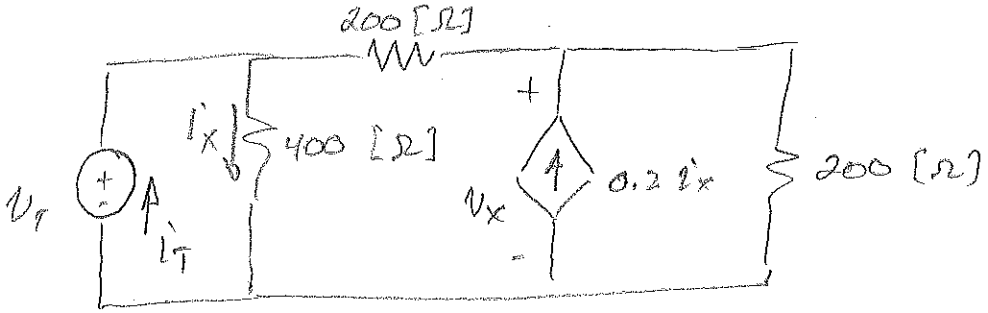
Room for Extra Work

+12

$$i_x = \frac{v_x}{600} \qquad -0.2\frac{v_x}{600} + \frac{v_x}{600} + \frac{v_x - 6}{200} = 0 \Rightarrow v_x = 4.737\ [V]$$

$$v_{cf} = v_x \cdot \frac{400}{600} = 3.158\ [V]$$

R_{th} : test source $v_T \Rightarrow 6\ [V] \rightarrow$ short



$$i_x = \frac{v_T}{400} \qquad -0.2\frac{v_T}{400} + \frac{v_x - v_T}{200} + \frac{v_x}{200} = 0$$

$$\Rightarrow \quad v_x = 0.55\, v_T$$

+15 $$i_T = i_x + \frac{v_T - v_x}{200} = \frac{v_T}{400} + \frac{v_T - 0.55 v_T}{200} = v_T\left(\frac{1}{400} + \frac{0.45}{200}\right)$$

+5 ×3 $$R_{th} = \frac{v_T}{i_T} = 210.5\ [\Omega] \qquad \tau_c = R_{th} C = 63.15\ [\mu s]$$

$$\therefore \quad v_c(t) = v_{cf} + (v_{ci} - v_{cf})\, e^{-(t - t_0)/\tau_c}$$

$$v_c(t) = 3.158 + (-0.5 - 3.158)\, e^{-(t-10)/63.15} \ [V] \quad t \geq 10\ [\mu s]$$

+8 $$v_c(t) = 3.158 - 3.658\, e^{-(t-10)/63.15} \ [V] \quad t \geq 10\ [\mu s]$$

+2 $$i_x(25\ [\mu s]) = \frac{v_c(25\ [\mu s])}{400} = 0.683\ [mA]$$