Desk Copy

ECE 300
Spring Semester, 2006
HW Set #7:

Due: March 7, 2006 **Name** wlg
wlg Print (last, first)

Use engineering paper. Work only on one side of the paper. Use this sheet as your cover sheet, placed on top of your work and stapled in the top left-hand corner. Number the problems at the top of the page, in the center of the sheet. **Do neat work. Underline your answers. Show how you got your equations. Be sure to show how you got your answers.** Each problem counts 10 points.

Work the following problems from the text.

7.3

7.5 Also use Pspice to obtain a plot of the current. Outlined in your small Pspice book.

7.9 Also use Pspice to obtain a plot of the voltage, $v_o(t)$.

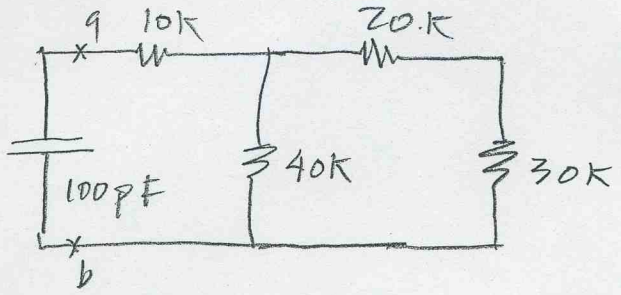
7.12 $i(o^+) = 4$ A, $i(t) = [4e^{-4t}\text{ A}]\,u(t)$

7.17

7.23

H.W. #7

7.3 Determine the time constant for the following



Find the resistance looking into a-b.

$$\frac{50K \times 40K}{90K} = 22.22K$$

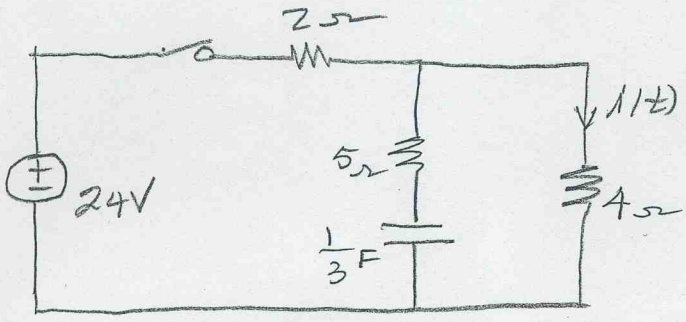
$R_{eq} = 10K + 22.22K$

$R_{eq} = 32.22K$

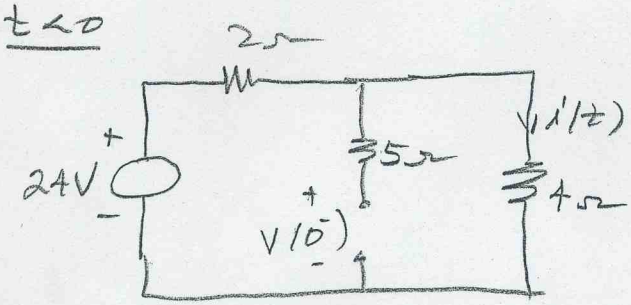
$\tau = 0.1 \times 10^{-9} \times 32.2 \times 10^{3}$

$\tau = 3.22 \mu sec$

7.5

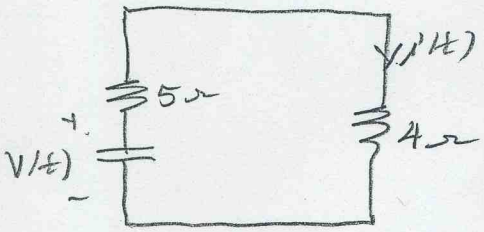


$t<0$



$$v(0^-) = \frac{24 \times 4}{4+2} = 16V = v(0^+)$$

$t>0$



$R_{eq} = 9\Omega$

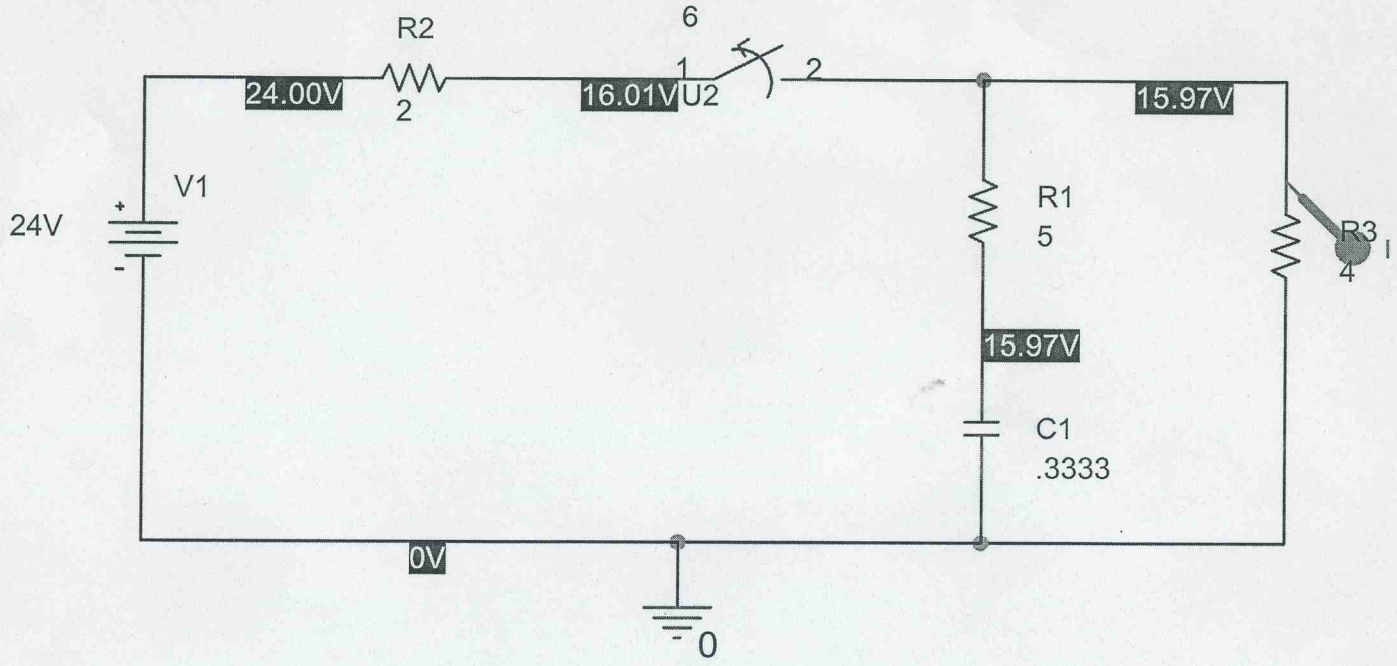
$\tau = R_{eq}C = \frac{9}{3} = 3s$

$$v(t) = 16e^{-\frac{t}{3}}$$

$$i = -C\frac{dv(t)}{dt} = \left(-\frac{1}{3}\right)\left(-\frac{1}{3}\right) \times 16e^{-\frac{t}{3}}$$

$$i(t) = \frac{16}{9}e^{-\frac{t}{3}}$$

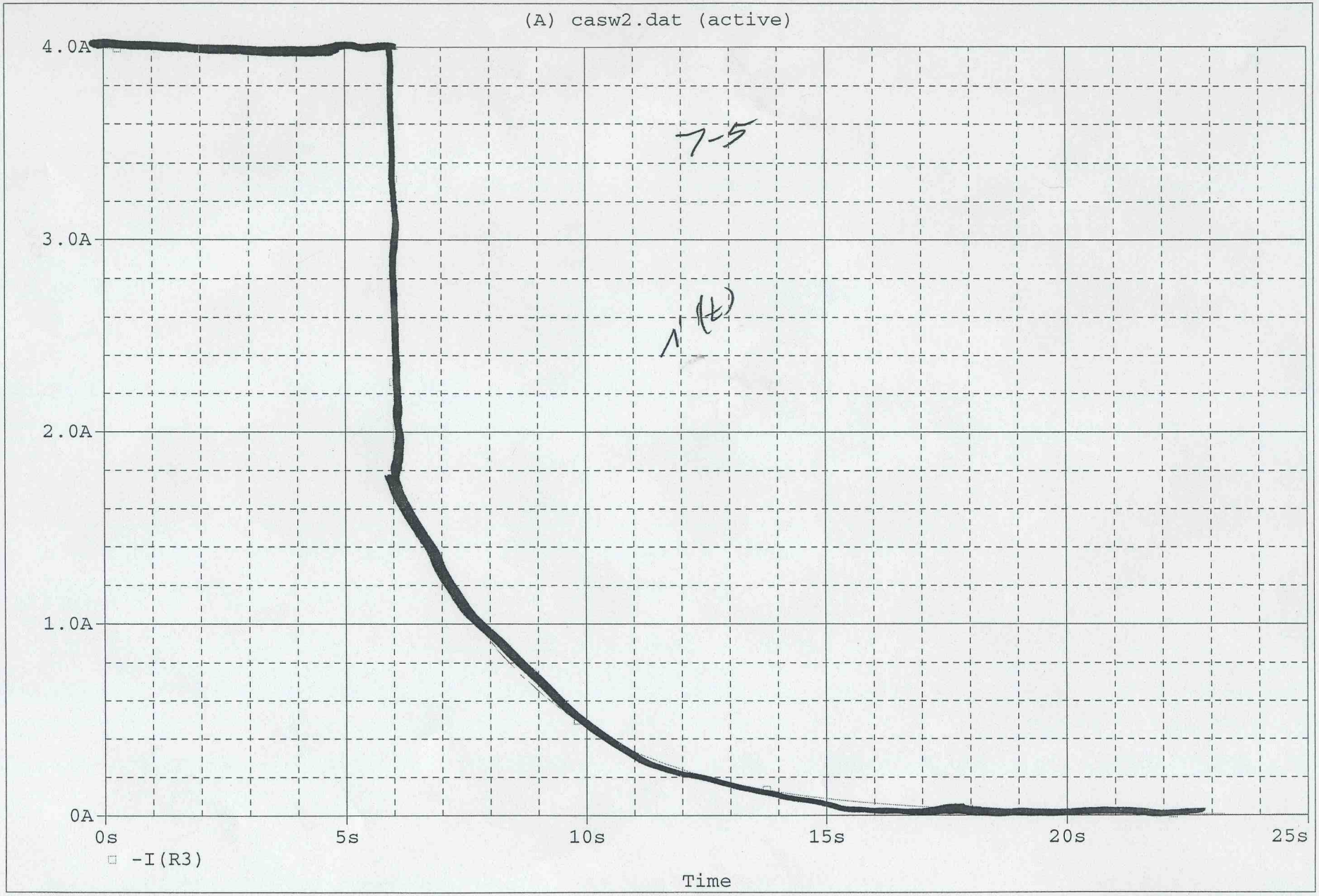
$$\boxed{i(t) = 1.778e^{-\frac{t}{3}}\ A}$$



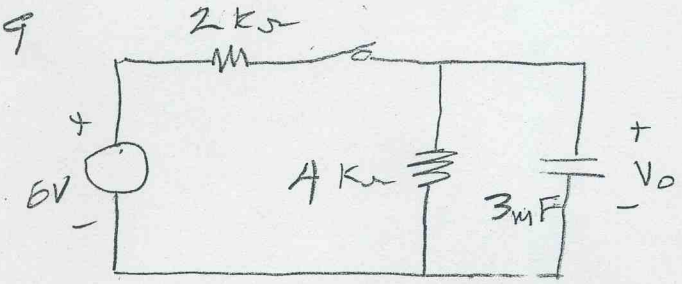
Problem 7_5 ECE 300 Spring 2006 wlg

** Profile: "SCHEMATIC1-casw2" [C:\MY DOCUMENTS\7_5 transient_RC-PSpiceFiles\SCHEMATIC1\casw2.sim]

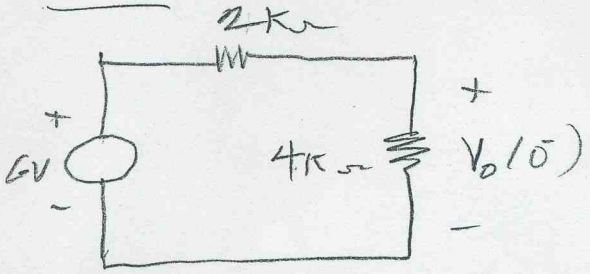
Date/Time run: 03/06/06 Temperature: 27.0



7.9

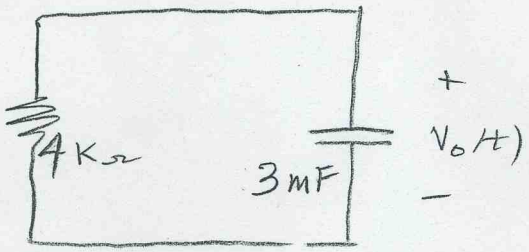


$t < 0$



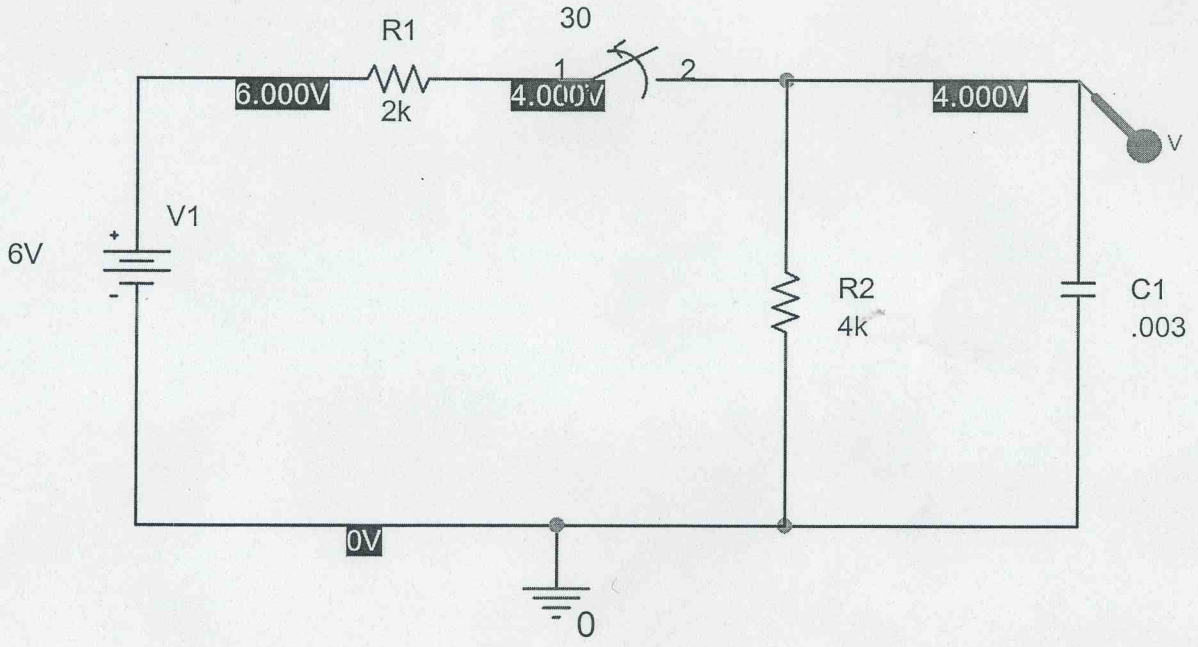
$$V_o(0^-) = V_o(0^+) = V_o = \frac{6 \times 4K}{6K} = 4V$$

$t > 0$



$$\tau = RC = 4 \times 10^{3} \times 3 \times 10^{-3} = 12s$$

$$V_o(t) = 4e^{-\frac{t}{12}} = 4e^{-0.0833t}$$



Problem 7_9 ECE 300 HW #7 Spring 2006 wlg

** Profile: "SCHEMATIC1-case8" [C:\MY DOCUMENTS\7_9_transient_RC-PSpiceFiles\SCHEMATIC1\case8.sim]
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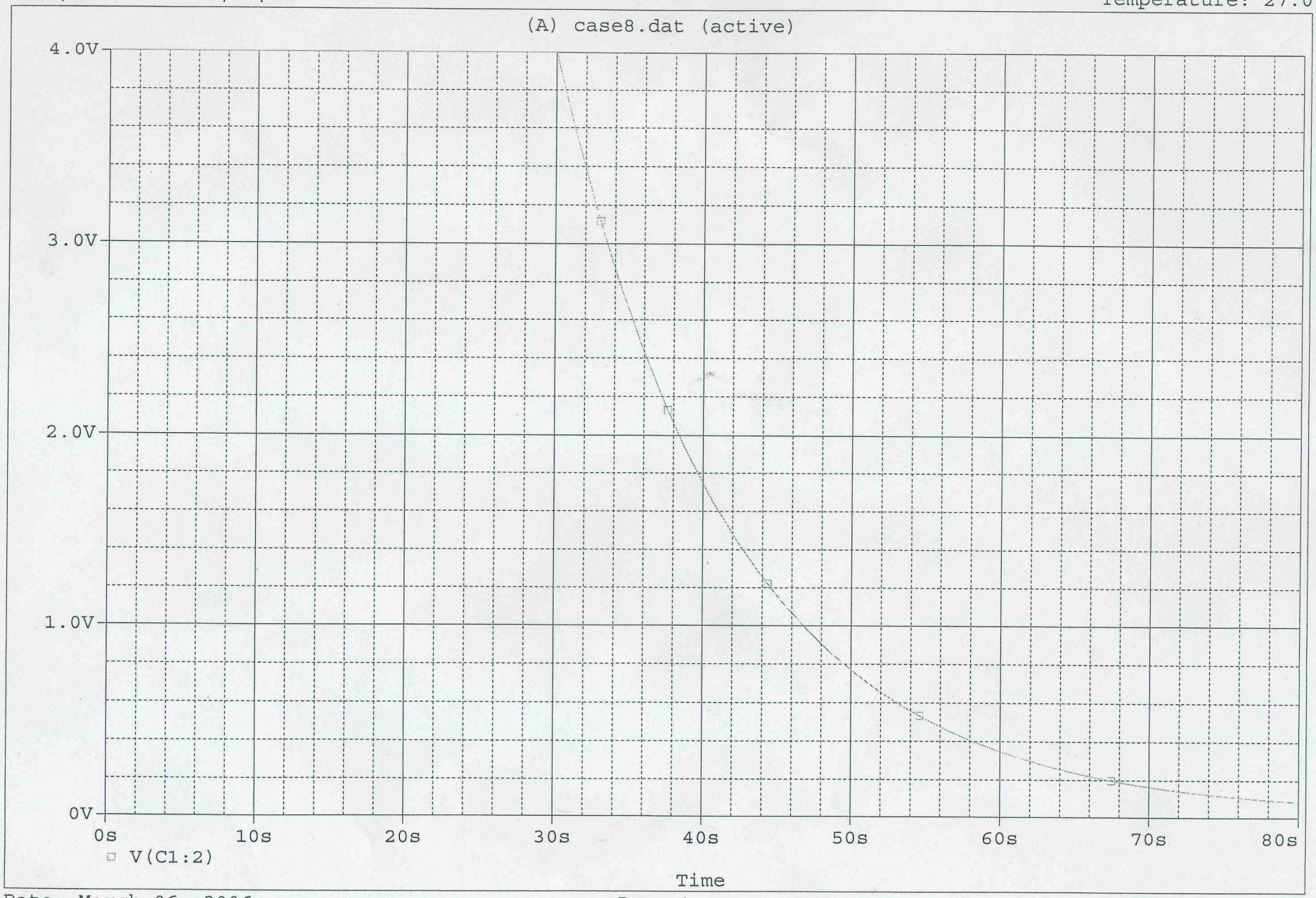
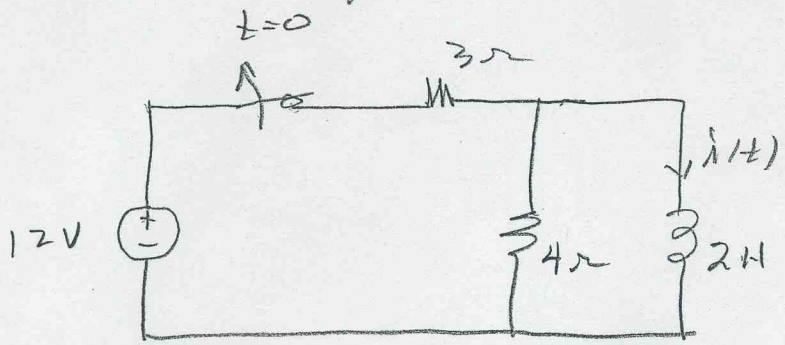


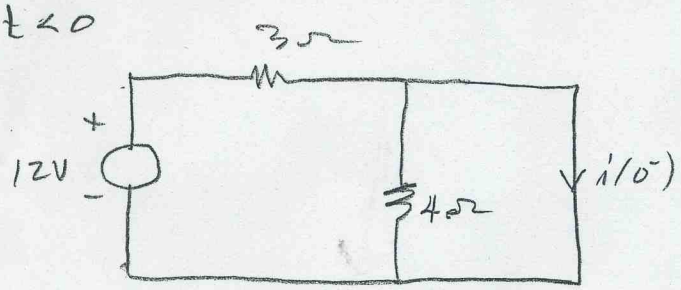
Date: March 06, 2006 Page 1 Time: 11:09:15

7.12

Circuit is in steady state. At $t=0$, the switch is opened. Find $i(t)$ for $t \geq 0$.

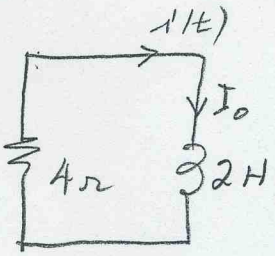


$t < 0$



$$i(0^-) = i(0^+) = \frac{12}{3} = 4\,A$$

$t > 0$



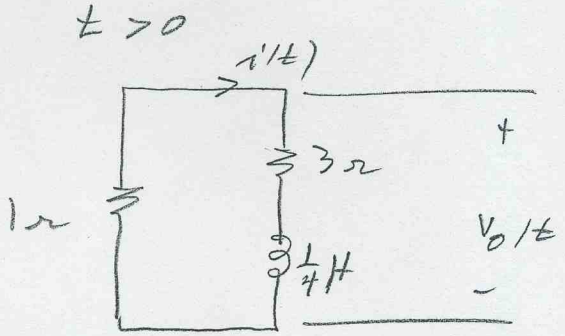
$I_0 = 4\,A$

$$i(t) = I_0 e^{-\frac{t}{\tau}} \qquad \tau = \frac{L}{R} = \frac{2}{4} = 0.5$$

$$\boxed{i(t) = 4e^{-2t}\,A}$$

7.17

Find $V_o(t)$ if $i(0) = 2A$, $V(t) = 0$



$$i(t) = I_o e^{-\frac{t}{\tau}} \qquad I_o = 2A, \quad \tau = \frac{L}{R} = \frac{1/4}{4} = \frac{1}{16} \text{ sec}$$

$$i(t) = 2e^{-16t} \text{ A}$$

$$V_o = 3i(t) + L\frac{di}{dt}$$

$$V_o = 3(2e^{-16t}) + \frac{1}{4} \times (-16 \times 2e^{-16t})$$

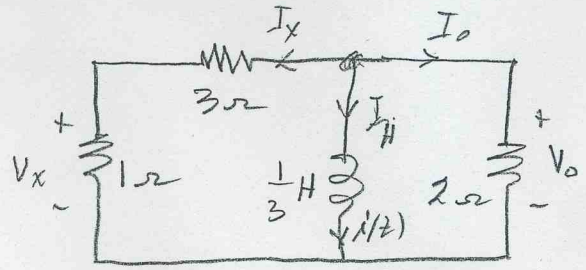
$$= (6e^{-16t} - 8e^{-16t}) \text{ V}$$

$$\boxed{V_o(t) = -2e^{-16t} \text{ u(t) V}}$$

7.23

Given the following circuit in which $v_o(0) = 2\,V$.

FIND $v_o(t)$ and $v_x(t)$, $t \geq 0$.



$$I_x = \frac{2}{4} = 0.5\,A, \quad I_o = \frac{2}{2} = 1\,A$$

$$I_H = -I_x - I_o = -1.5\,A$$

$$R_{eq} = 2 \| 4 = \frac{2 \times 4}{6} = \frac{4}{3}$$

$$\tau = \frac{L}{R_{eq}} = \frac{1 \times 3}{3 \times 4} = \frac{1}{4}$$

$$i = -1.5e^{-4t}\,A$$

$$v_o = L\frac{di}{dt} = \frac{1}{3}(-)(1.5)(-4)e^{-4t} = 2e^{-4t}$$

$$\boxed{v_o(t) = 2e^{-4t}u(t)\,V}$$

$$v_x = \frac{v_o \times 1}{1+3} = 0.5e^{-4t}\,V \quad u(t)$$

$$\boxed{v_x = 0.5e^{-4t}u(t)\,V}$$