Desk Copy

ECE 300
Spring Semester, 2007
HW Set #6

Due: March 8, 2007:
wlg

Name 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.

7.5 $v(t) = 16e^{-t/3}u(t)\ \ V;\qquad i(t) = 1.778e^{-t/3}u(t)\ \ A$

7.9 $v_o(t) = 4e^{-t/12}u(t)\ \ V$

7.11 $i_o(t) = 1.412e^{-3t}u(t)\ \ A$

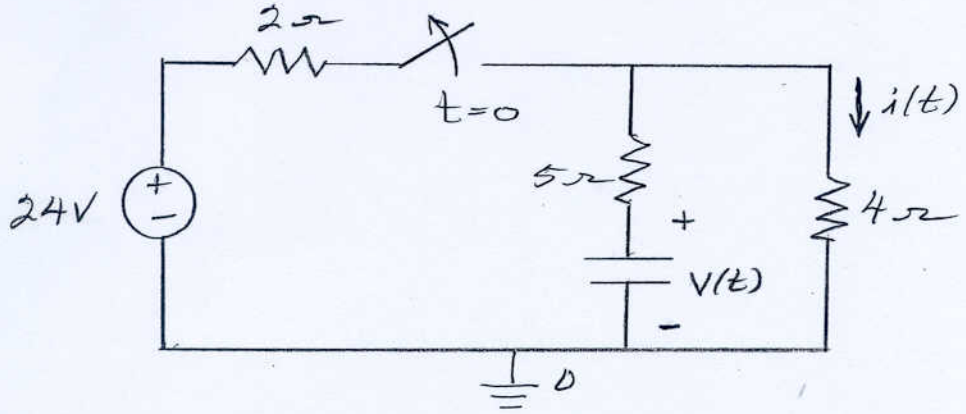
7.19 $i(t) = 2e^{-5t}u(t)\ \ A$

wdy

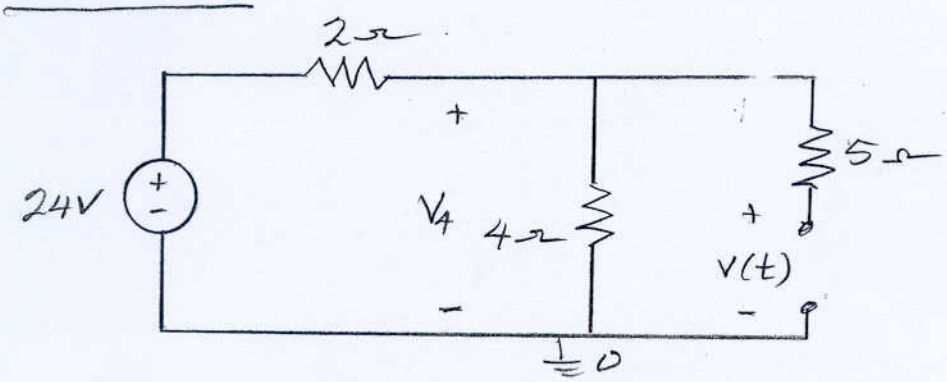
H.W. #6

7.5

The switch in the following ckt has been closed for a very long time. It is opened at $t=0$. Find $i(t)$ for $t \geq 0$



For $t < 0$



$$V_4 = \frac{24 \times 4}{2+4} = 16V$$

but the capacitor looks like an open ckt so

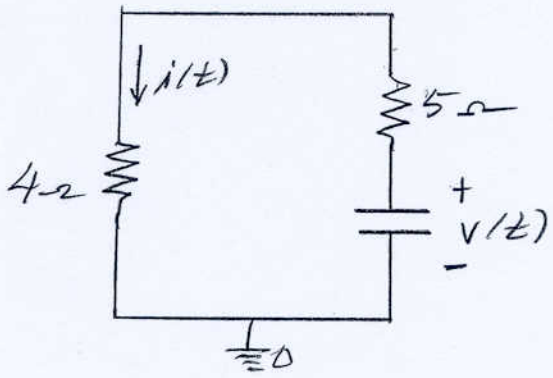
$$\boxed{v(0^-) = V_4 = 16V}$$

This establishes the initial condition for the capacitor voltage for $t \geq 0$.

7.5 cont.

<u>For $t \geq 0$</u>

The ckt becomes as follows:



$$v(t) = v(0)\, e^{-\frac{t}{\tau}}$$

where $\tau = R_{eq} C$

$R_{eq} = (4+5) = 9\,\Omega$

$C = \frac{1}{3}\,F$

$\tau = \frac{9}{3} = 3\,sec$

$$\boxed{v(t) = 16\, e^{-t/3}\, u(t)\ V}$$

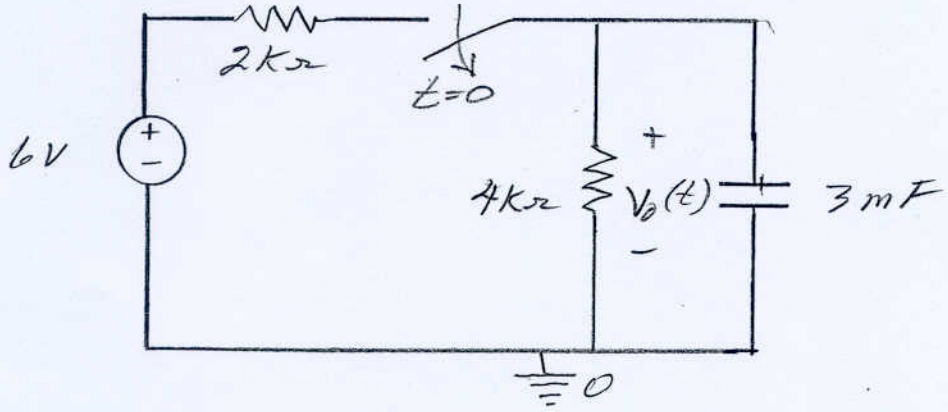
$$i(t) = -C\frac{dv}{dt} = -\frac{1}{3}\left(\frac{d}{dt}\left(16 e^{-\frac{t}{3}}\right)\right)$$

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

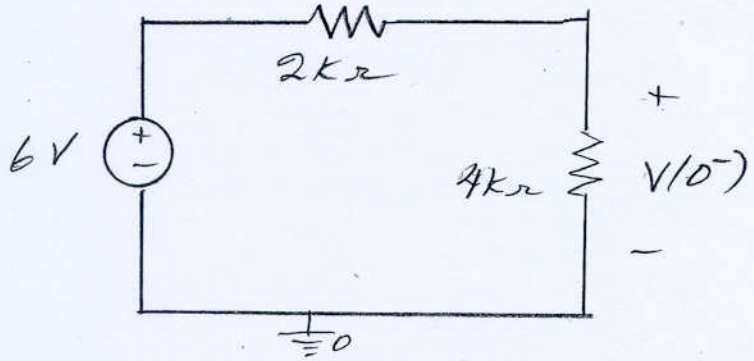
$$\boxed{i(t) = 1.78\, e^{-t/3}\, u(t)\ A}$$

7.9

The switch in the following circuit has been closed for a very long time and is opened at $t=0$. Find $V_o(t)$ for $t \geq 0$

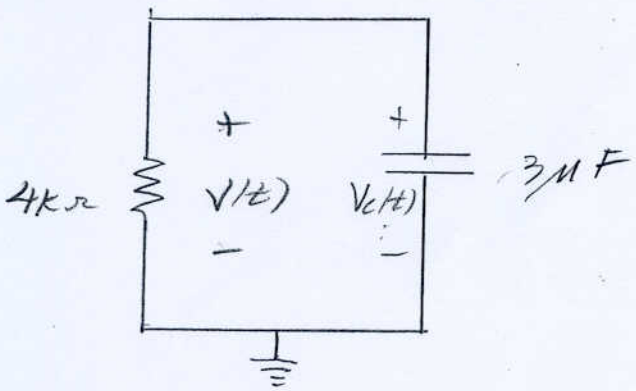


For $t < 0$



$$V(0^-) = \frac{6 \times 4K}{4k + 2k} = 4\,V$$

For $t \geq 0$



7.9 cont

From the previous ckt we know

$$V(t)_{\text{resistor}} = V_c(t)$$

AND

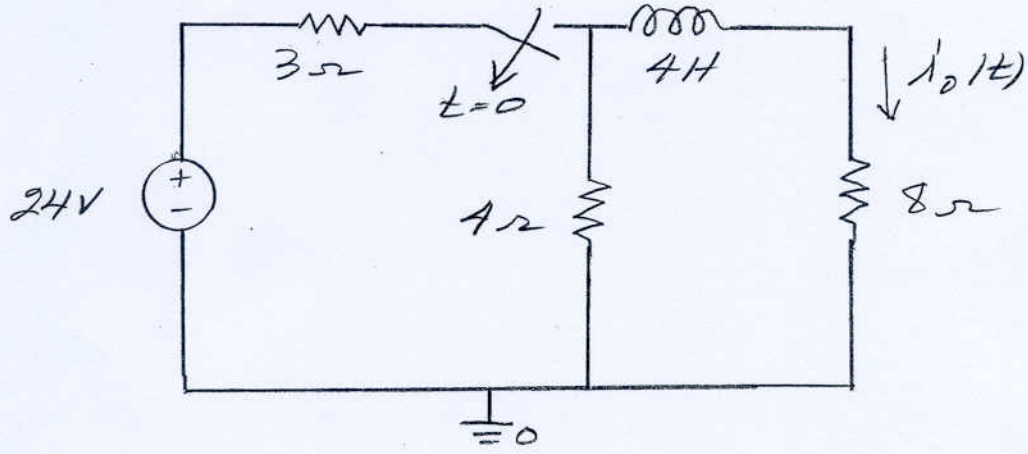
$$V_c(t) = V(0)\, e^{-\frac{t}{\tau}}$$

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

$$V_c(t) = V(t) = 4 e^{-t/12}\, u(t) \quad V$$

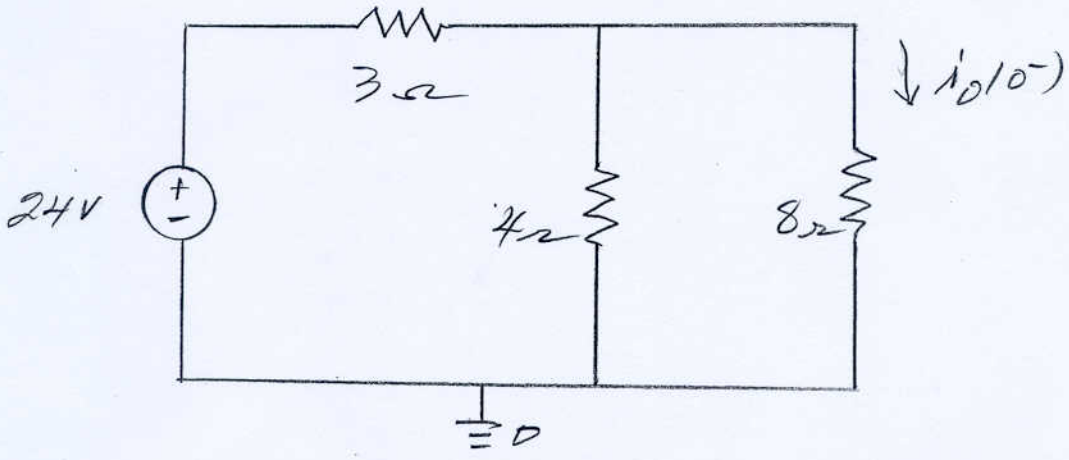
7.11

In the following ckt the switch has been closed for a very long time. It is opened at $t=0$. Find $i_o(t)$ for $t>0$



For $t<0$

Coil looks like a short circuit

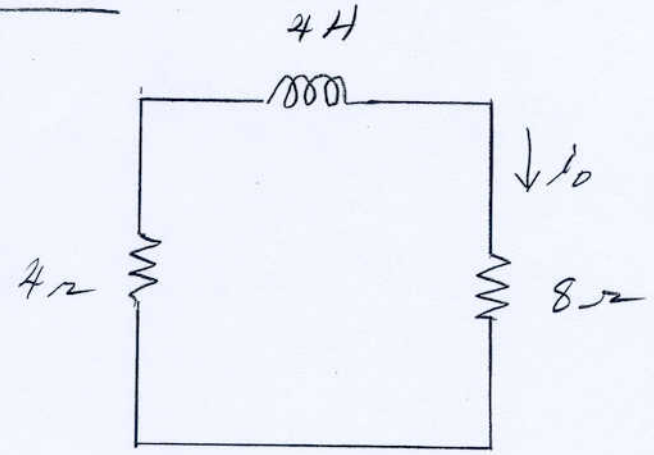


Change the 24V source and 3Ω resistor to a current source (8A) shunted by 3Ω. We have

$$i_o(0^-) = \frac{8 \times 3\|4}{3\|4 + 8} = 1.412\ A$$

7.11 cont.

For $t > 0$



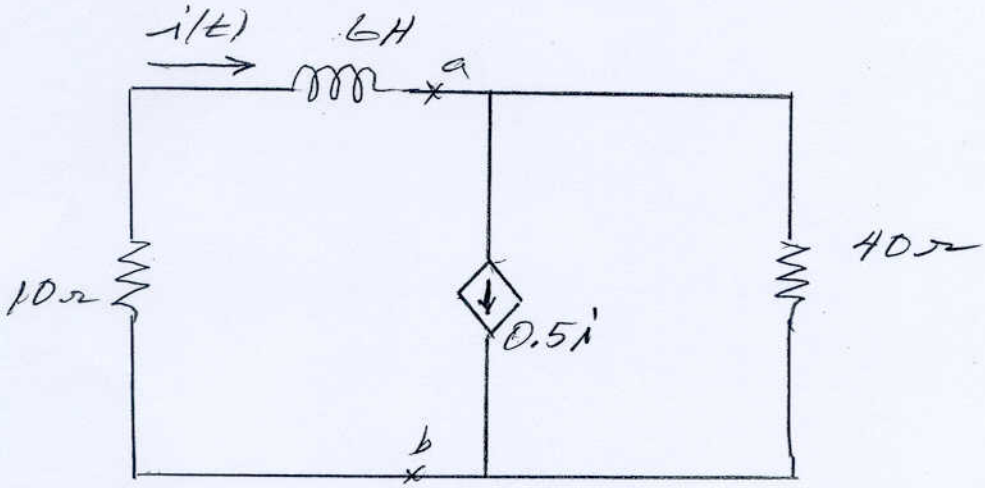
$$i_o = i_o(0^-)\, e^{-\frac{t}{\tau}}$$

$$\tau = \frac{L}{R_{eq}} = \frac{4\,H}{12\,\Omega} = \frac{1}{3}\ sec$$

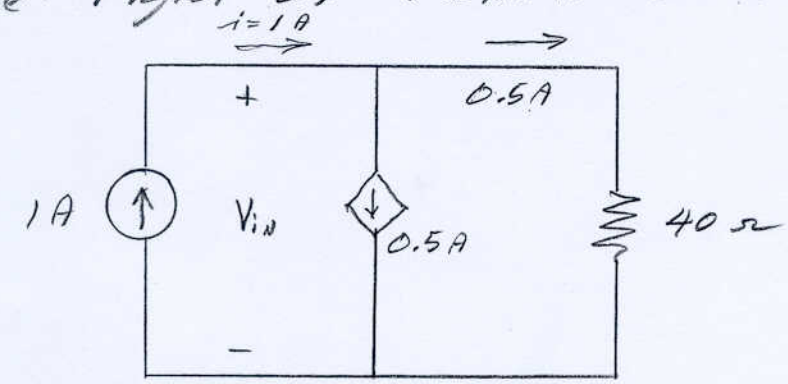
$$i_o(t) = 1.412\, e^{-3t}\, u(t)\ \ A$$

7.19

In the following circuit $i(0) = 2A$. Find $i(t)$ for $t > 0$.



Find the equivalent resistance to the right of terminals a-b.



By inspecting the circuit:

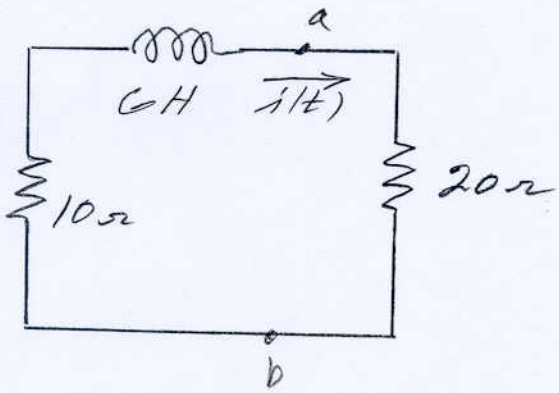
$$V_{in} = 0.5 \times 40 = 20V$$

$$V_{in} = 20V$$

$$R_{in} = \frac{V_{in}}{1} = 20\Omega$$

7.19 Method 1 (cont)

$t > 0$; equivalent ckt



$$i(t) = i(0)\, e^{-\frac{t}{\tau}}$$

$$\tau = \frac{L}{R_{eq}} \; ; \quad i(0) = 2\,A$$

$$R_{eq} = (10+20) = 30\,\Omega$$

$$L = 6\,H$$

$$\frac{L}{R} = \frac{6}{30} = \frac{1}{5} = \tau$$

$\therefore$

$$\boxed{i(t) = 2e^{-5t}\, u(t) \quad A}$$