Spring 2008

EECS70A / CSE 70A Network Analysis I
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Homework # 5 solution

Chapter 7, Solution 4.

For t<0, $v(0^-)$=40 V.

For t >0. we have a source-free RC circuit.

$$\tau = RC = 2x10^3 x10x10^{-6} = 0.02$$

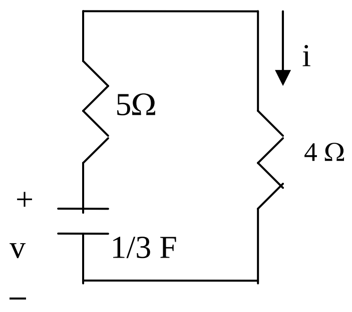
$$v(t) = v(0)e^{-t/\tau} = \underline{40e^{-50t}\ \text{V}}$$

Chapter 7, Solution 5.

Let v be the voltage across the capacitor.
For t <0,

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

For t >0, we have a source-free RC circuit as shown below.



$$\tau = RC = (4+5)\frac{1}{3} = 3s$$

$$v(t) = v(0)e^{-t/\tau} = 16e^{-t/3}$$

$$i(t) = -C\frac{dv}{dt} = -\frac{1}{3}(-\frac{1}{3})16e^{-t/3} = \underline{1.778e^{-t/3}\ \text{A}}$$

Chapter 7, Solution 12.

When t < 0, the switch is closed and the inductor acts like a short circuit to dc. The 4 Ω resistor is short-circuited so that the resulting circuit is as shown in Fig. (a).

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

Since the current through an inductor cannot change abruptly,

$$i(0) = i(0^-) = i(0^+) = 4 \text{ A}$$

When t > 0, the voltage source is cut off and we have the RL circuit in Fig. (b).

$$\tau = \frac{L}{R} = \frac{2}{4} = 0.5$$

Hence,

$$i(t) = i(0)e^{-t/\tau} = \underline{\mathbf{4e^{-2t}\ A}}$$

Chapter 7, Solution 17.

$$i(t) = i(0)e^{-t/\tau}, \qquad \tau = \frac{L}{R_{eq}} = \frac{1/4}{4} = \frac{1}{16}$$

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

$$v_o(t) = 3i + L\frac{di}{dt} = 6e^{-16t} + (1/4)(-16)2e^{-16t}$$

$$v_o(t) = \underline{-2e^{-16t}\ u(t)V}$$

Chapter 7, Solution 44.

$$R_{eq} = 6 \,||\, 3 = 2\,\Omega, \tau = RC = 4$$

$$v(t) = v(\infty) + \left[\, v(0) - v(\infty)\right] e^{-t/\tau}$$

Using voltage division,

$$v(0) = \frac{3}{3+6}(30) = 10 \text{ V}, \quad v(\infty) = \frac{3}{3+6}(12) = 4 \text{ V}$$

Thus,

$$v(t) = 4 + (10 - 4)\; e^{-t/4} \;= 4 + 6\; e^{-t/4}$$

$$i(t) = C\frac{dv}{dt} = (2)(6)\left(\frac{-1}{4}\right)e^{-t/4} \;=\; \underline{\mathbf{-3e^{-0.25t}\ A}}$$

Chapter 7, Solution 54.

(a) Before t = 0, i is obtained by current division or

$$i(t) = \frac{4}{4+4}(2) = \underline{\mathbf{1\ A}}$$

After t = 0,

$$i(t) = i(\infty) + \left[\, i(0) - i(\infty)\right] e^{-t/\tau}$$

$$\tau = \frac{L}{R_{eq}}, \quad R_{eq} = 4 + 4 \,||\, 12 = 7\,\Omega$$

$$\tau = \frac{3.5}{7} = \frac{1}{2}$$

$$i(0) = 1, \quad i(\infty) = \frac{4 \,||\, 12}{4 + 4 \,||\, 12}(2) = \frac{3}{4+3}(2) = \frac{6}{7}$$

$$i(t) = \frac{6}{7} + \left(1 - \frac{6}{7}\right)e^{-2t}$$

$$i(t) = \underline{\mathbf{\frac{1}{7}\left(6 - e^{-2t}\right) A}}$$

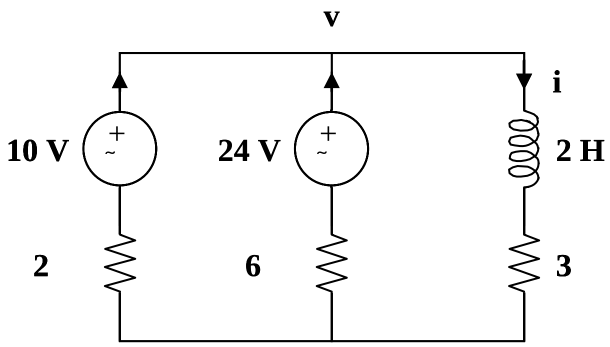
(b) Before t = 0, $i(t) = \dfrac{10}{2+3} = \underline{\mathbf{2\ A}}$

After t = 0, $R_{eq} = 3 + 6 \,||\, 2 = 4.5$

$$\tau = \frac{L}{R_{eq}} = \frac{2}{4.5} = \frac{4}{9}$$

$$i(0) = 2$$

To find $i(\infty)$, consider the circuit below, at $t \;\; = \;\;$ when the inductor becomes a short circuit,



$$\frac{10 - v}{2} + \frac{24 - v}{6} = \frac{v}{3} \longrightarrow v = 9$$

$$i(\infty) = \frac{v}{3} = 3 \text{ A}$$

$$i(t) = 3 + (2 - 3)\, e^{-9t/4}$$

$$i(t) = \underline{\mathbf{3 - e^{-9t/4}\ A}}$$