Boise State University
Electrical Engineering Department

EE 210: Circuits I

Solution 1

$$v = L\frac{di}{dt} \longrightarrow L = \frac{v}{di/dt} = \frac{160\text{x}10^{-3}}{\frac{(100-50)\text{x}10^{-3}}{2\text{x}10^{-3}}} = \underline{6.4\ \text{mH}}$$

Solution 2

$$v = L\frac{di}{dt} \longrightarrow i = \frac{1}{L}\int_0^t i\,dt + i(0)$$

$$i = \frac{1}{200\text{x}10^{-3}}\int_0^t (3t^2 + 2t + 4)dt + 1$$

$$= 5(t^3 + t^2 + 4t)\Big|_0^t + 1$$

$$i(t) = \underline{\mathbf{5t^3 + 5t^2 + 20t + 1\ A}}$$

Solution 3

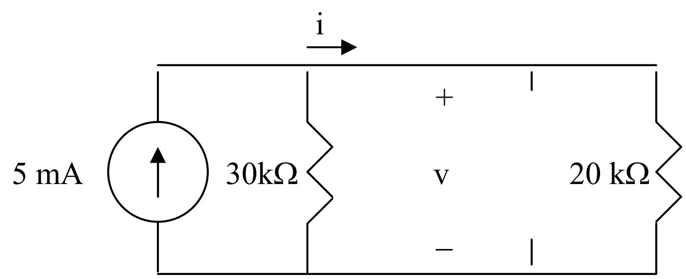
$$w = L\int_{-\infty}^{t} i\,dt = \frac{1}{2}Li^2(t) - \frac{1}{2}Li^2(-\infty)$$

$$= \frac{1}{2}\text{x}80\text{x}10^{-3}\text{x}\left(60\text{x}10^{-3}\right)^2 - 0$$

$$= \underline{\mathbf{144\ \mu J}}$$

Solution 4

Under steady-state, the inductor acts like a short-circuit, while the capacitor acts like an open circuit as shown below.



Using current division,

i = (30k/(30k+20k))(5mA) = **3 mA**

v = 20ki = **60 V**

Solution 5

(a) $L_{eq} = 20//(4+6) = 20x10/30 = \underline{6.667\ mH}$

Using current division,

$$i_1(t) = \frac{10}{10+20} i_s = \underline{e^{-t}\ mA}$$

$$i_2(t) = \underline{2e^{-t}\ mA}$$

(b) $v_o = L_{eq}\frac{di_s}{dt} = \frac{20}{3}x10^{-3}(-3e^{-t}x10^{-3}) = \underline{-20e^{-t}\ \mu V}$

(c) $w = \frac{1}{2}Li_1^2 = \frac{1}{2}x20x10^{-3}xe^{-2}x10^{-6} = \underline{1.3534\ nJ}$

Solution 6

R = 10 +20//(20+30) =10 + 40x50/(40 + 50)=32.22 kΩ

$$\tau = RC = 32.22X10^3 X100X10^{-12} = \underline{3.222\ \mu S}$$

Solution 7

For t < 0, the switch is closed so that

$$v_o(0) = \frac{4}{2+4}(6) = 4\ V$$

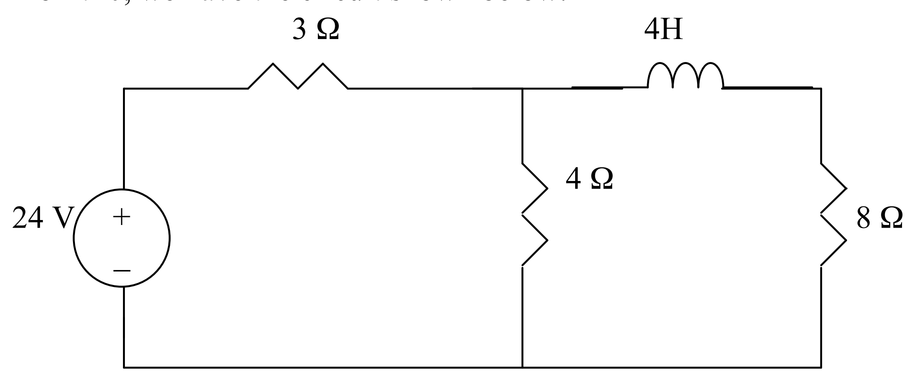
For t >0, we have a source-free RC circuit.

$\tau = RC = 4x10^3 \text{ x } 0.05x10^{-3} = 0.2$

$v_o(t) = 4e^{-5t}$ V for all t > 0.

Solution 8

For t<0, we have the circuit shown below.



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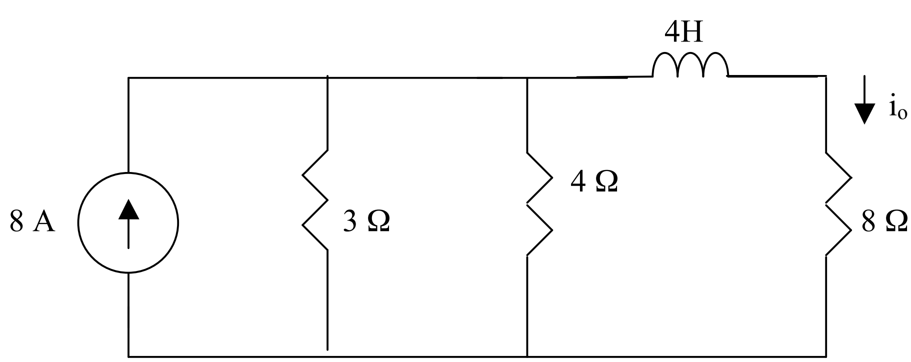

3//4= 4x3/7=1.7143

$$i_o(0^-) = \frac{1.7143}{1.7143 + 8}(8) = 1.4118 \text{ A}$$

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

$$\tau = \frac{L}{R} = \frac{4}{4+8} = 1/3$$

$$i_o(t) = i_o(0)e^{-t/\tau} = \underline{1.4118e^{-3t} \text{ A}}$$