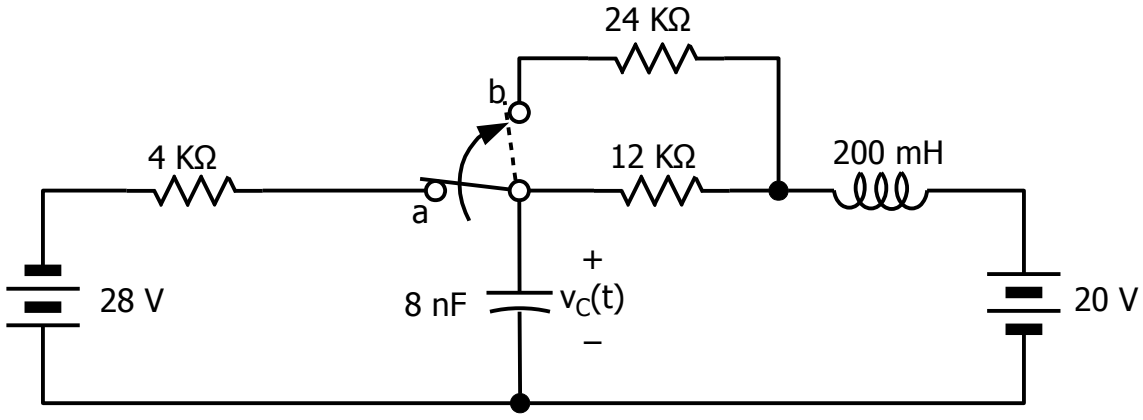
EE3 Fall 2020
Practice Problems 4



1. The switch has been in position a for a long time. All transients have died out. At t = 0, the switch moves instantaneously to position b.

   a. At $t=0^-$ (the last instant that the switch is in position a), what is the current through the capacitor?

   b. At $t=0^-$ (the last instant that the switch is in position a), what is the voltage across the capacitor? −16 V

   c. At $t=0^+$ (the first instant that the switch is in position b), the current through the capacitor is the same as in Part a. True False

   d. At $t=0^+$ (the first instant that the switch is in position b), the voltage across the inductor is the same as at $t=0^-$. True False

   e. At $t=0^+$ (the first instant that the switch is in position b), what is the voltage across the inductor?

   12 V; + at right end

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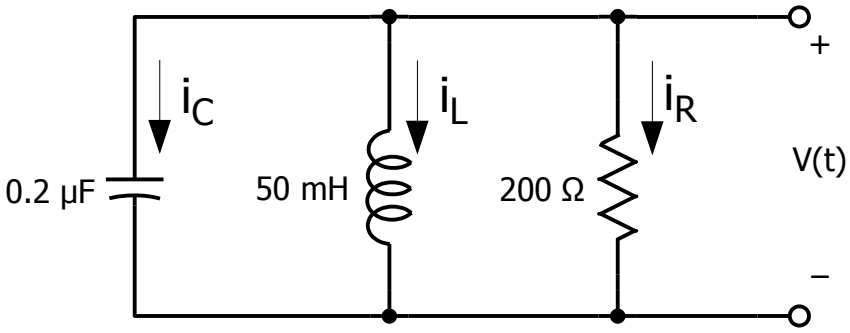
2. This is a second-order circuit. There is an initial voltage on the capacitor $v(0^-)=12$ V, and an initial current in the inductor $i_L(0^-)=30$ mA. In order to solve the differential equation for v(t), the following values must be found:
   a. $i_C(0^+)$
   b. $i_R(0^+)$
   c. $dv(t)/dt|_{t=0^+}$



Using what you know about inductors, capacitors, and KCL, find these values.

a. -90 mA
b. 60 mA
c. -450 KV/s

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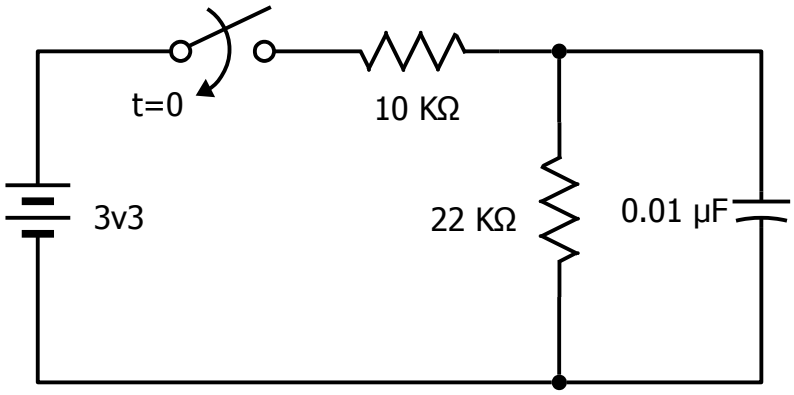

3a. Find the time constant τ of this circuit. This will require solving the differential equation for the circuit.

3b. Then, find only the Thévenin resistance R_{th} of the circuit to the left of the capacitor (consider the capacitor to be the load).

3c. Then, compute R_{th}*C and compare to the τ from 3a.

Time constant $\tau = 6.875\text{e-}5$ s

$R_{th} \cdot C = 6.875\text{e-}5$ s

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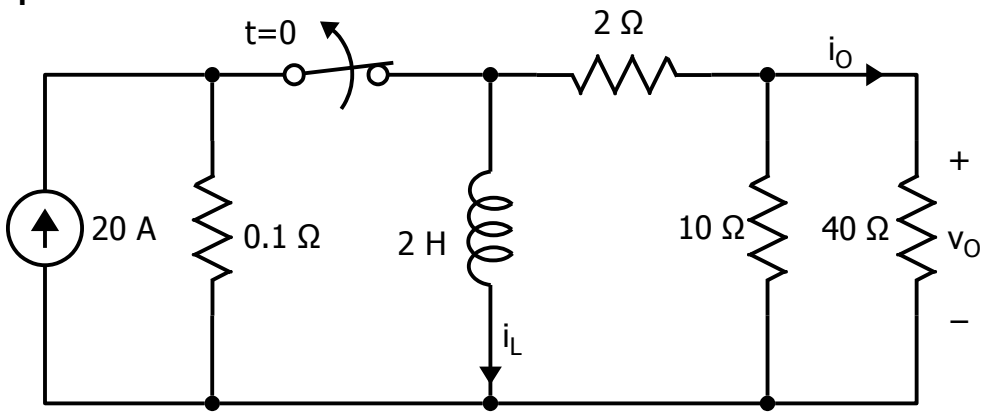
4. The switch has been in the position shown for a long time. Find:
   a. $i_L(0^+)$
   b. $i_O(0^+)$
   c. $v_O(0^+)$
   d. τ for $t=0^+$
   e. $i_L(0^+)$ for all $t>0$
   (HINT: refer to the Lecture 4 video at 22 minutes.)



a. $i_L(0^+) = 20\ \text{A}$
b. $i_O(0^+) = -4\ \text{A}$
c. $v_o(0^+) = -160\ \text{V}$
d. $\tau = 0.2\ \text{s}$
e. $i_L(t) = 20e^{-5t}$

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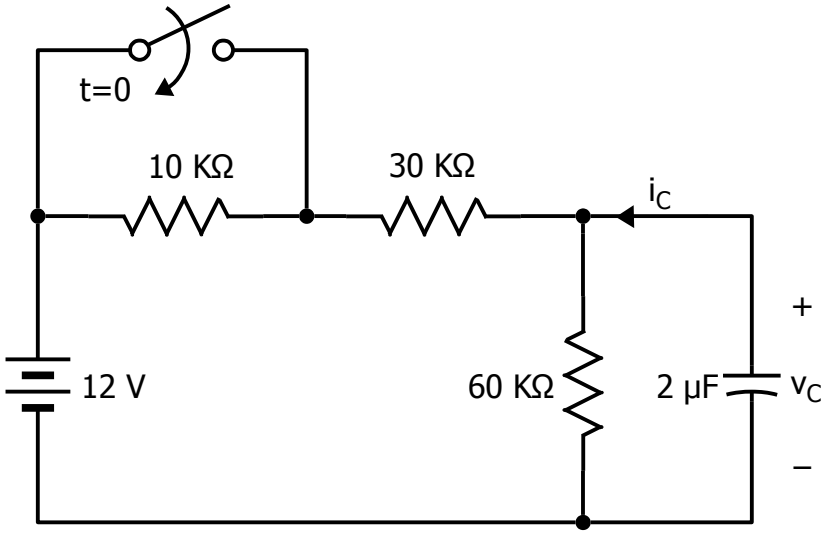
5. The switch has been open for a long time. Find:
   a. $v_C(0^-)$
   b. $v_C(0^+)$
   c. $v_C(\infty)$
   d. $i_C(0^-)$
   e. $i_C(0^+)$



e. 0.04 mA