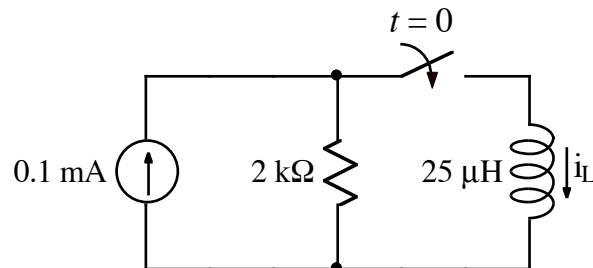


Ex:



After being open for a long time, the switch closes at $t = 0$. $i_L(t = 0^-) = 0A$. Find $i_L(t)$ for $t > 0$.

sol'n: Since i_L is an energy variable, it cannot change instantly.

$$\therefore i_L(t = 0^+) = i_L(t = 0^-) = 0A$$

This is one of the values we need for the general solution that describes $i_L(t)$:

$$i_L(t) = i_L(t \rightarrow \infty) + [i_L(t = 0^+) - i_L(t \rightarrow \infty)] e^{-t/\tau}$$

where $\tau = L/R_{Th}$.

Note: R_{Th} is the Thevenin equivalent resistance seen looking into the terminals where L is connected. Since the circuit seen looking into the terminals is a Norton equivalent, and $R_N = R_{Th}$, we have

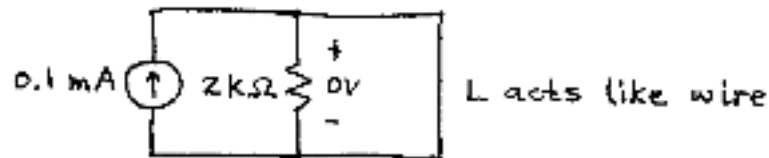
$$R_{Th} = 2k\Omega \quad \text{and} \quad \tau = \frac{25\mu H}{2k\Omega} = 12.5 \text{ ns}$$

The value we lack for a complete sol'n is $i_L(t \rightarrow \infty)$. To find this value, we

employ the idea that, as $t \rightarrow \infty$, the currents and voltages become constant, we have $v_L = L \frac{di}{dt} = L \cdot 0 = 0 \text{ V}$.

Thus, the L acts like a wire.

$t \rightarrow \infty$ model:



Since the $2 \text{ k}\Omega$ resistor is shorted out, it has 0 V across, meaning that the current in the $2 \text{ k}\Omega$ is $0 \text{ V} / 2 \text{ k}\Omega = 0 \text{ A}$.

\therefore All the 0.1 mA from the source flows thru the L .

Thus, $i_L(t \rightarrow \infty) = 0.1 \text{ mA}$.

Plugging values into the general sol'n yields

$$i_L(t) = 0.1 \text{ mA} + [0 - 0.1 \text{ mA}] e^{-t/12.5 \text{ ns}}$$

$$\text{or } i_L(t) = 0.1 \text{ mA} [1 - e^{-t/12.5 \text{ ns}}]$$