Ex:

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

**sol’n:** Since $i_L$ is an energy variable, it cannot change instantly.

$$i_L(t = 0^+) = i_L(t = 0^-) = 0 \text{A}$$

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

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

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 $t \to \infty$, the currents and voltages become constant, we have $v_L = L \frac{di}{dt} = L \cdot 0 = 0V$.

Thus, the $L$ acts like a wire.

$t \to \infty$ model:

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

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

Thus, $i_L(t \to \infty) = 0.1mA$.

Plugging values into the general soln yields

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

or

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