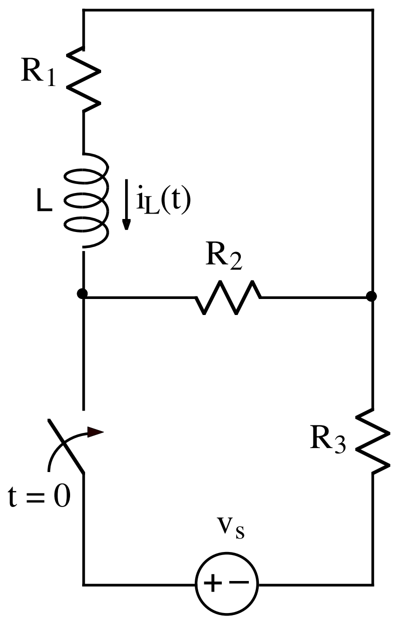
Ex:

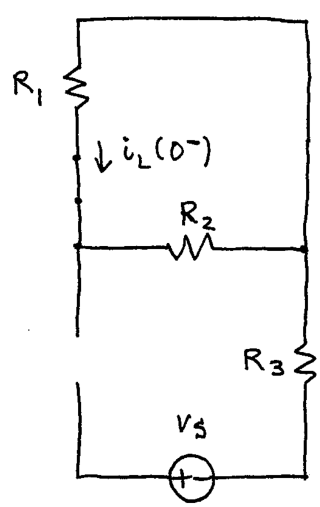


a) Write an expression for $i_L(t = 0^+)$

b) Write an expression for $i_L(t > 0)$ in terms of R_1, R_2, R_3, v_s, and L.

Sol'n: a) $i_L(0^+) = i_L(0^-)$

At $t = 0^-$, L acts like wire.
Switch is open at $t = 0^-$.



There is no power source in the R_1, R_2 loop, and v_S is disconnected.
$\therefore\ i_L(0^-) = 0A$

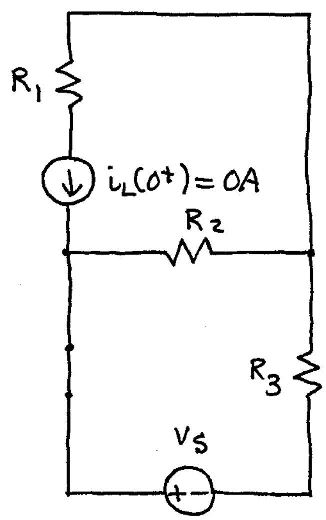
Thus, $i_L(0^+) = i_L(0^-) = 0A$

b) For $i_L(t>0)$, we use the general form of sol'n for RL problems:

$$i_L(t>0) = i(t\to\infty) + [i_L(0^+) - i_L(t\to\infty)]e^{-t/L/R_{Th}}$$

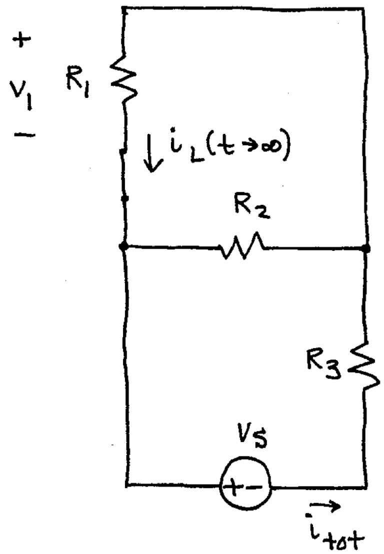
$t=0^+$: We model L as i-src with value $i_L(0^+) = i_L(0^-) = 0\,A$.

Switch is closed.



Since the quantity we are looking for is $i_L(0^+)$, we do not have to solve the circuit, but this is the circuit we would use.

$t\to\infty$: L acts like wire
Switch is closed



We can calculate i_{tot} as

$$i_{tot} = \frac{-v_s}{R_1 \| R_2 + R_3}$$

Then we can use a current divider to find $i_L(t\to\infty)$:

$$i_L(t\to\infty) = i_{tot} \cdot \frac{R_2}{R_1 + R_2}$$

$$i_L(t\to\infty) = \frac{-v_s}{R_1 \| R_2 + R_3} \cdot \frac{R_2}{R_1 + R_2}$$

Another way to calculate i_{tot} is to write $R_1 \| R_2$ in a different way:

$$R_1 \| R_2 = \frac{R_1}{1 + \frac{R_1}{R_2}}$$

Then we use a voltage divider formula:

$$v_1 = -v_S \frac{\dfrac{R_1}{1 + R_1/R_2}}{\dfrac{R_1}{1+R_1/R_2} + R_3}$$

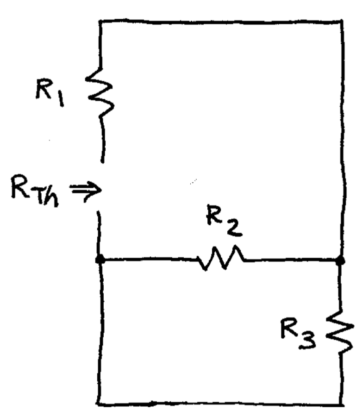
$$v_1 = -v_S \frac{R_1}{R_1 + R_3(1 + R_1/R_2)}$$

We divide v_1 by R_1 to find $i_L(t \to \infty)$:

$$i_L(t \to \infty) = -\frac{v_S}{R_1 + R_3(1 + R_1/R_2)}$$

This answer is equivalent to our previous answer

R_{Th}: We turn off the v_S source and look in from the terminals where L is connected. Switch is closed.



$$R_{Th} = R_1 + R_2 \| R_3$$