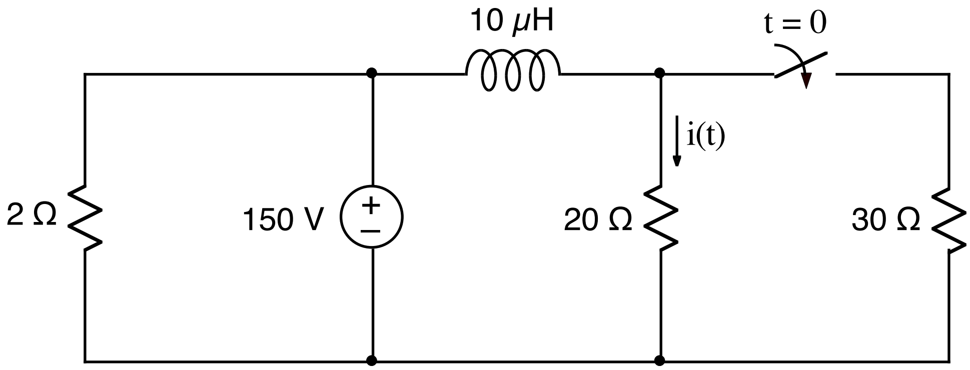
Ex:

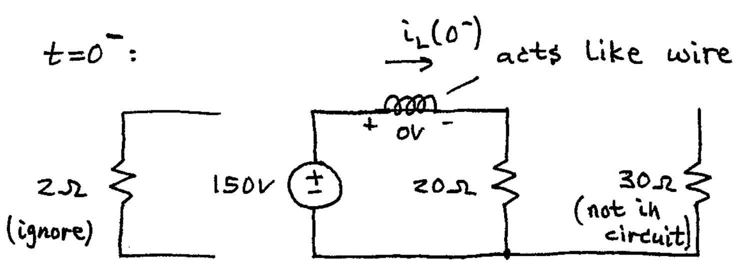


After being closed for a long time, the switch closes at t = 0.

Find i(t) for t > 0.

Sol'n: At $t=0^-$, switch is open and L = wire. We note that the 2Ω resistor is a 2nd circuit across the 150V source and may be ignored.

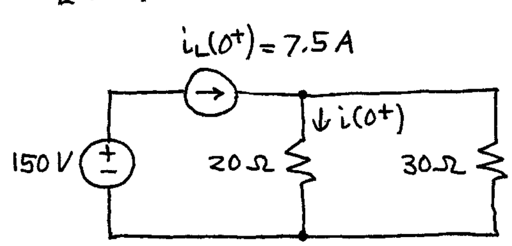
$t=0^-$:



$$i_L(0^-) = \frac{150\,V}{20\,\Omega} = 7.5\,A$$

At $t=0^+$, switch is closed and we model L as current source with $i_L(0^+) = i_L(0^-) = 7.5\,A$.

$t=0^+$:

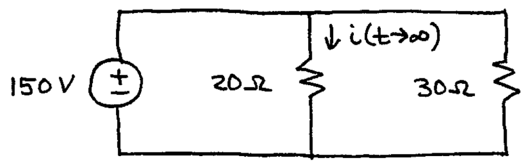


We have a current divider.

$$i(0^+) = i_L(0^+) \cdot \frac{30\,\Omega}{20\,\Omega + 30\,\Omega} = 7.5\,A \cdot \frac{3}{5} = 4.5\,A$$

As $t \to \infty$, switch is closed and L = wire.

$t \to \infty$:

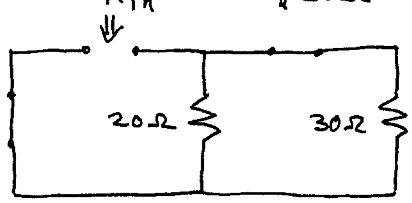


We have 150V across the 20Ω resistor.

$$i(t \to \infty) = \frac{150\,V}{20\,\Omega} = 7.5\,A$$

The time constant is $\frac{L}{R_{Th}}$ where we look into the circuit from the terminals where L is attached. We can find R_{Th} by turning off the 150V source and seeing what R value we have looking into the circuit from the terminals where L is attached.

$R_{Th} = 20\,\Omega \| 30\,\Omega$



Note: switched is closed since $t > 0$.

$$R_{Th} = 20\,\Omega \| 30\,\Omega = 12\,\Omega$$

The time constant is $\dfrac{L}{R_{Th}} = \dfrac{10\,\mu H}{12\,\Omega} = \dfrac{5}{6}\,\mu s$.

We plug values into the general form of solution:

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

$$i(t>0) = 7.5A + \left[4.5A - 7.5A\right] e^{-t/\frac{5}{6}\mu s}$$

or $i(t>0) = 7.5A - 3Ae^{-t/\frac{5}{6}\mu s}$