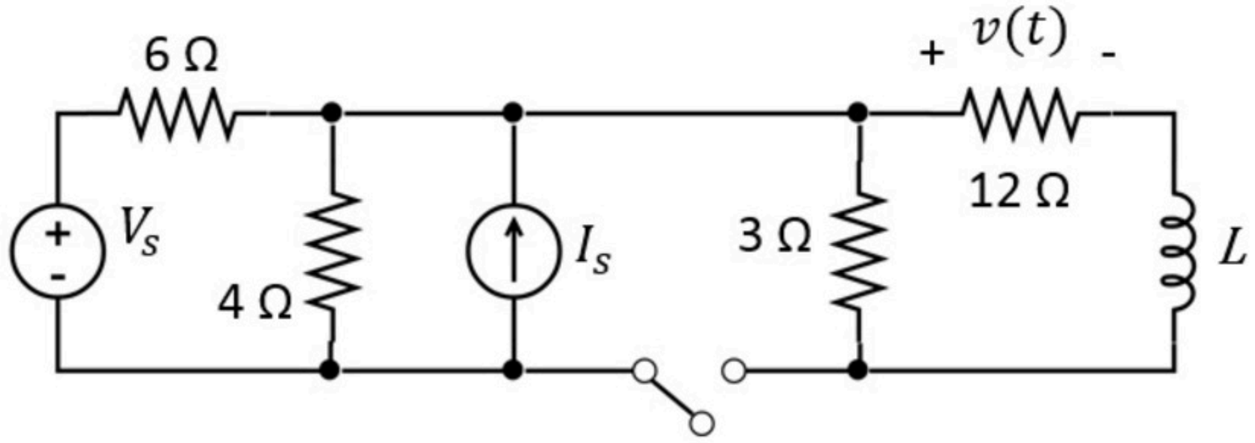
First order circuits 005

Problem has been graded.

The switch has been closed for a long time before it opens at $t = 0$. After the switch opens, find the resistor voltage $v(t) = A \cdot e^{-t/\tau} + B$.



Given Variables:

Vs : 28 V

Is : 2 A

L : 1.5 mH

Calculate the following:

A (V) :

8 ✓

B (V) :

0 ✓

tau (ms) :

0.1 ✓

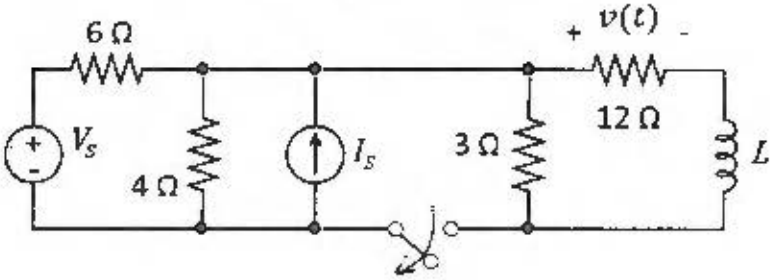
> Hint: What is the current iL for t < 0?

The switch has been closed for a long time before it opens at $t = 0$. After the switch opens, find the resistor voltage $v(t) = A \cdot e^{-t/\tau} + B$.

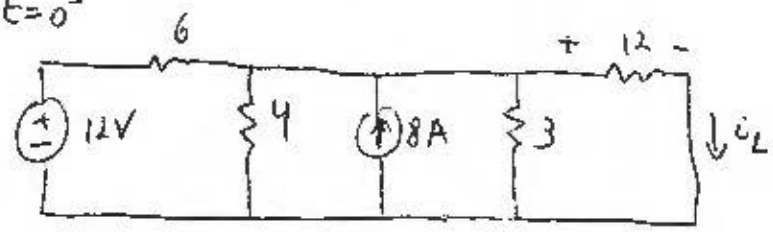
Vs : 12 V

Is : 8 A

L : 15 mH



(a) $t = 0^-$



$i_L(0^-) = 1\,A \qquad v(0^-) = 12\,V$

SUPERPOSITION

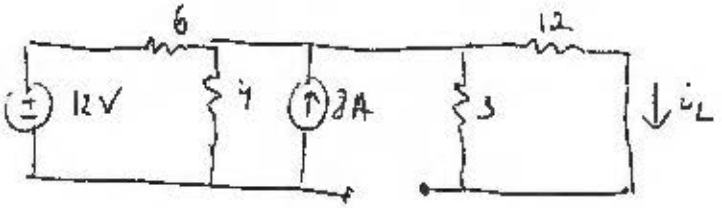
$$i_{L_1} = \frac{12}{6 + 4\|3\|12} \cdot \frac{4\|3}{4\|3 + 12}$$

$$= \frac{1}{5}\,A$$

$$i_{L_2} = \frac{6\|4\|3}{6\|4\|3 + 12} \cdot 8 = \frac{4}{5}\,A$$

(b) $t = 0^+$: $i_L(0^+) = 1\,A \Rightarrow v(0^+) = 12\,V$

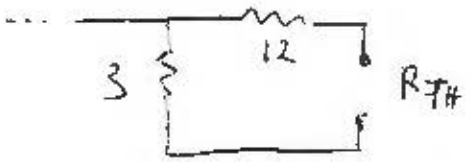
(c)



$i_L(\infty) = 0\,A$

$v(\infty) = 0\,V$

(d)



$R_{TH} = 15\,\Omega$

$$\tau = \frac{L}{R_{TH}} = \frac{15 \cdot 10^{-3}}{15} = 10^{-3}\,s$$

$\boxed{\tau = 1\,ms}$

$B = v(\infty) \Rightarrow \boxed{B = 0\,V}$

$A + B = v(0^+) \Rightarrow \boxed{A = 12\,V}$