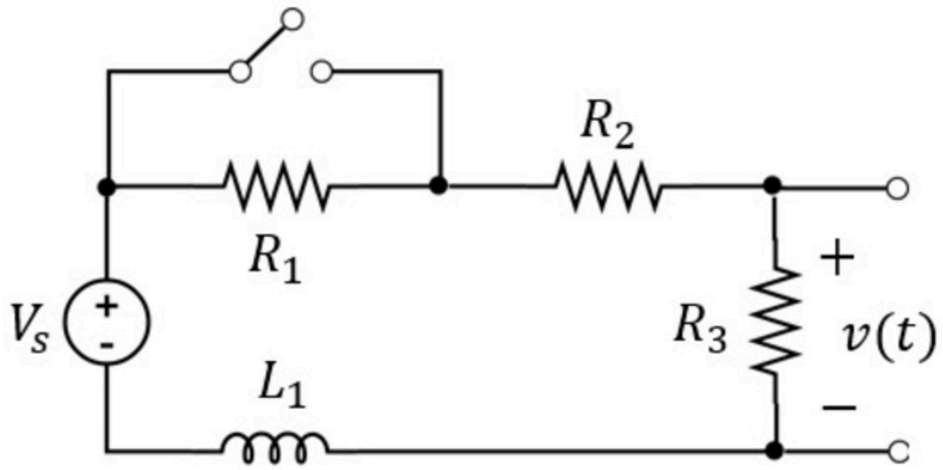
First order circuits 007

Problem has been graded.

The switch closes at time $t = 0$ and we measure

$$v(t) = 24 - 12e^{-t/2\,\mu s}\ \text{V} \qquad \text{for } t > 0$$

Find the values of R_1, R_2, and L_1.



Given Variables:

Vs : 48 V

R3 : 12 kohm

Calculate the following:

R1 (ohm) :

24000 ✓

R2 (ohm) :

12000 ✓

L1 (H) :

0.048 ✓

Hint: Consider v(inf) first. Mind the units.

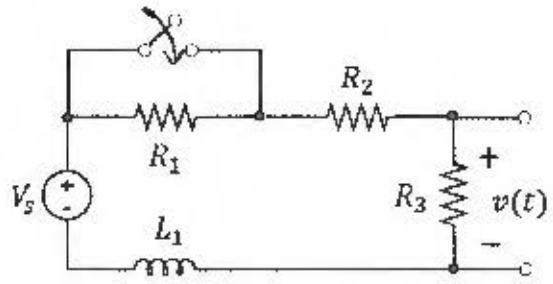
The switch closes at time $t = 0$ and we measure

$$v(t) = 24 - 12e^{-t/2\mu s}\ \text{V} \quad \text{for } t > 0$$

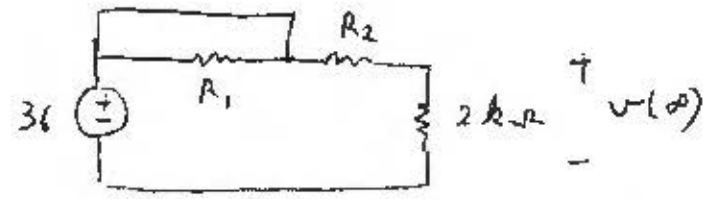
Vs : 36 V

R3 : 2 kohm

Find the values of R_1, R_2, and L_1.



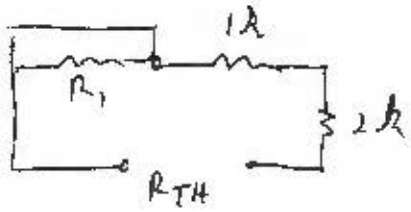
(a) $t = \infty$: $v(\infty) = 24\text{V}$.



$$v(\infty) = 36 \cdot \frac{2k}{2k + R_1}$$

$$\Rightarrow 24R_1 = 36 \cdot 2k - 24 \cdot 2k \Rightarrow R_2 = 1k\Omega \Rightarrow \boxed{R_2 = 1000\,\Omega}$$

(b)



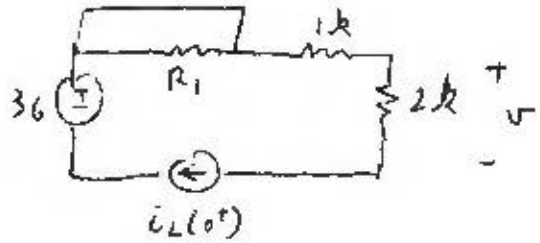
$R_{TH} = 3k\Omega$ $\quad \tau = 2\,10^{-6}\,s$

$= \tau = \frac{L_1}{R_{TH}}$

$$\Rightarrow L_1 = \tau \cdot R_{TH} = 2 \cdot 10^{-6} \cdot 3\,10^{3} = 6 \cdot 10^{-3}$$

$$\boxed{L_1 = 0.006\ \text{H}}$$

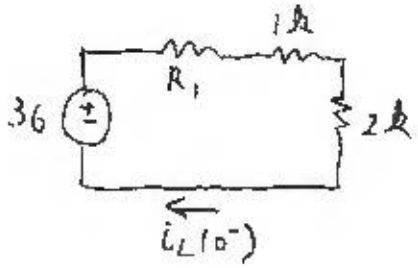
(c) $t = 0^+$. $v(0^+) = 12\text{V}$



$$v(0^+) = i_L(0^+) \cdot 2k$$

$$\Rightarrow i_L(0^+) = \frac{12}{2k} = 6\,\text{mA}$$

(d) $t = 0^-$:



$$i_L(0^-) = i_L(0^+) = 6\,10^{-3}$$

$$= \frac{36}{R_1 + 1k + 2k}$$

$$R_1 = \frac{36}{6 \cdot 10^{-3}} - 1k - 2k \qquad R_1 = 3k$$

$$\boxed{R_1 = 3000\,\Omega}$$