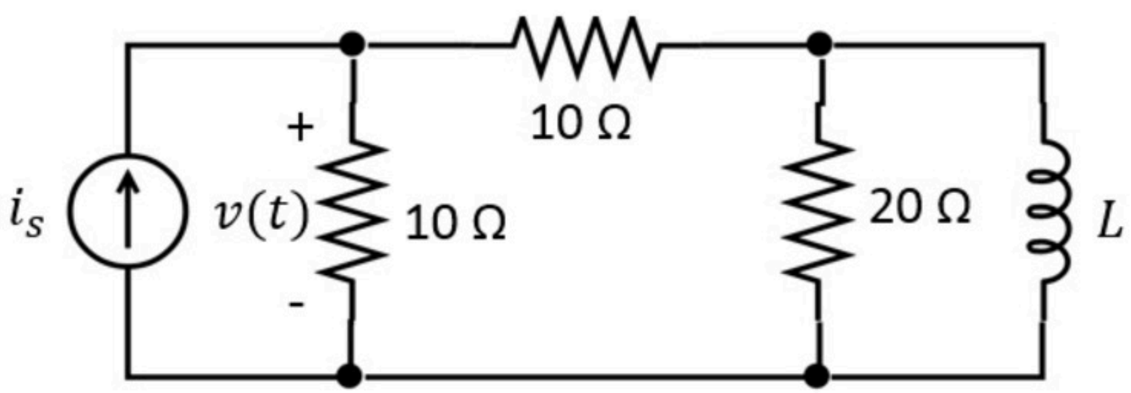
First order circuits 006

Problem has been graded.

When $t < 0$, $i_s = I_0$

When $t > 0$, $i_s = I_1$

Find $v(t) = A \cdot e^{-t/\tau} + B$ for $t > 0$



Given Variables:

I0 : 2 A

I1 : 10 A

L : 0.25 uH

Calculate the following:

A (V) :

20 ✓

B (V) :

50 ✓

tau (ns) :

25 ✓

Hint: What is the inductor current for t < 0?

When $t<0$, $i_s = I_0$

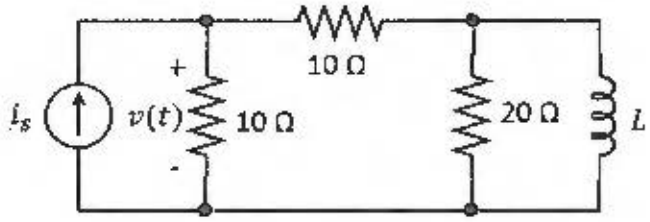
When $t>0$, $i_s = I_1$

Find $v(t) = A \cdot e^{-t/\tau} + B$ for $t>0$

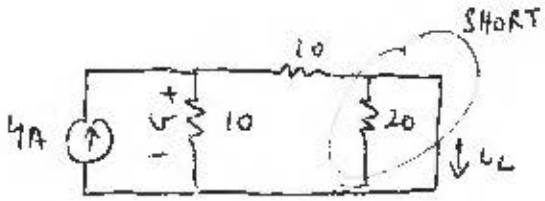
I0 : 4 A

I1 : 6 A

L : 0.25 uH



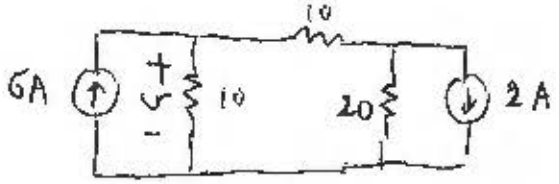
(a) $t = 0^-$



$v(0^-) = (4A) \cdot (10 // 10) = 20V$

$i_L(0^-) = (4A) \frac{10}{10+10} = 2A$

(b) $t = 0^+$



$i_L(0^+) = 2A$

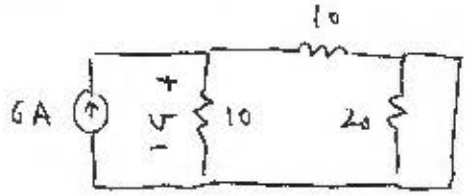
SUPERPOSITION:

$v_1 = 6 \cdot (10 // 30) = 6 \cdot \frac{30}{4} = 45V$

$v_2 = (-2) \cdot (20 // 20) \cdot \frac{1}{2} = -10V$

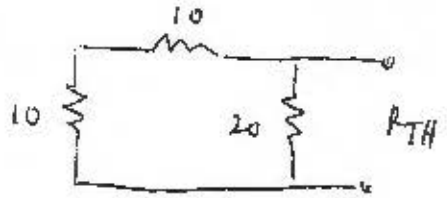
$v(0^+) = v_1 + v_2 = 35V$

(c) $t = \infty$



$v(\infty) = 6 \cdot (10 // 10) = 30V$

(d)



$R_{TH} = 20 // 20 = 10\,\Omega$

$\tau = \frac{L}{R_{TH}} = \frac{0.25 \cdot 10^{-6}}{10} = 25 \cdot 10^{-9}$

$\tau = 25$ ns

$B = v(\infty) \Rightarrow$ **B = 30 V**

$A + B = v(0^+) \Rightarrow$ **A = 5 V**