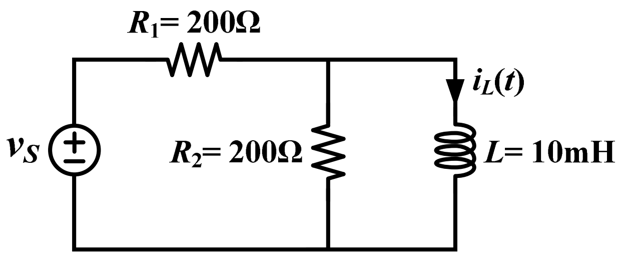
電路學(EE2210)第七次隨堂考

2013年11月13日
時間：10 分鐘
Close Book

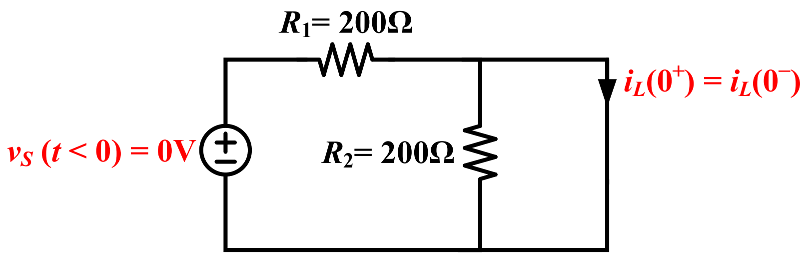
學號：______________________________

姓名：______________________________

For the circuit as shown, assume v_S is a 10V step at t = 0, i.e. $v_S(t)$ = 10V$u(t)$, find $i_L(0^+)$, $i_L(\infty)$, the time constant (τ), and the zero state response $i_L(t)$. Sketch the zero state response $i_L(t)$ for $t \geq 0$.

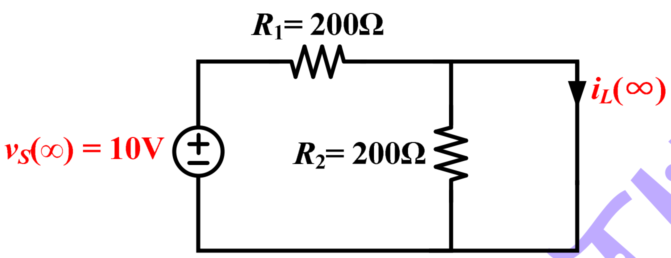


Solution:
We can find the zero state response for $i_L(t)$ with the following steps.
1. Find the initial value (at t = 0), the inductor should be regarded as a short circuit with a stable 0V voltage input signal that is applied at t < 0.



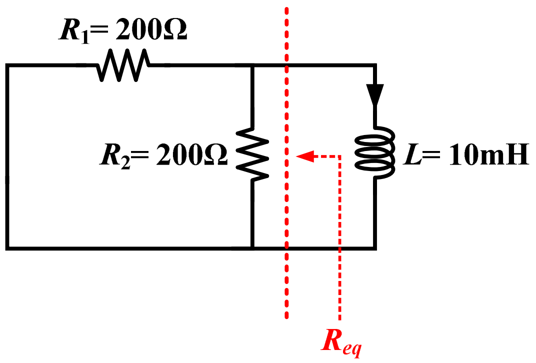
$$\Rightarrow i_L(0^+) = i_L(0^-) = \frac{v_S(t<0)}{R_1} = \frac{0}{200} = 0\text{A}\,.$$

2. To find the final value (at $t = \infty$), the inductor should be regarded as a short circuit with a stable 10V voltage input signal.



$$\Rightarrow i_L(\infty) = \frac{v_S(\infty)}{R_1} = \frac{10}{200} = 50\text{mA}\,.$$

3. Before determining the time constant, we need to set the independent source to zero, and find the equivalent resistance (R_{eq}) connected with the inductor's terminal.



$$\Rightarrow \tau = \frac{L}{R_{eq} = (R_1 \| R_2)} = \frac{10\text{m}}{100} = 10^{-4}(\text{sec})$$

4. Finally, we can get the complete response for $i_L(t)$ by intuitive method.

$$i_L(t) = 50(1 - e^{-\frac{t}{10^{-4}}})\text{mA}\,.$$

$i_L(0^+)$ = _________ 0 _________, $i_L(\infty)$ = _________ 50mA _________,Time constant (τ) = _________ 10^{-4}sec _________,

$i_L(t)$ = __________________ $50(1 - e^{-\frac{t}{10^{-4}}})$mA _____________________,

Sketch the zero state response $i_L(t)$ for $t > 0$: