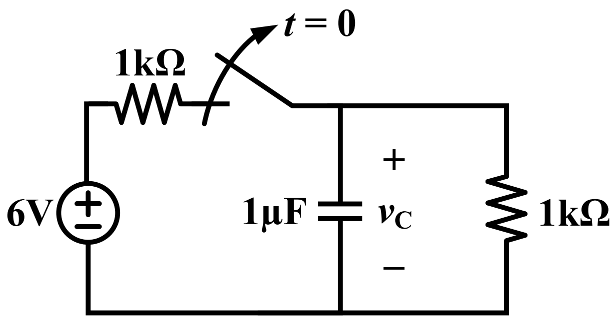
電路學(EE2210)第六次隨堂考

2013年11月6日
時間：10 分鐘
Close Book

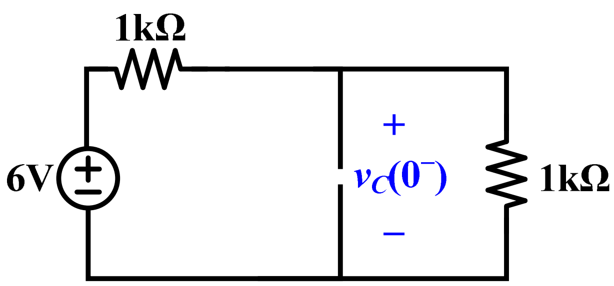
學號：________________________________

姓名：________________________________

For the circuit as shown in the following figure, the switch has been closed for a long time before opening at t = 0. Find the voltage across the capacitor $v_C(0^+)$ and its first derivative $\frac{dv_C(0^+)}{dt}$, i.e. right after the switch opens.



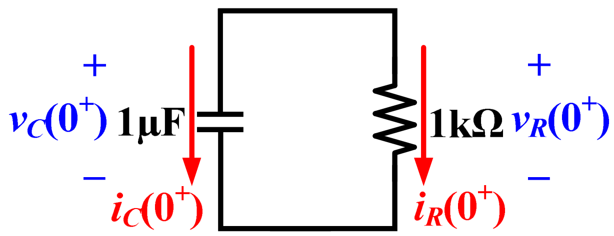
Solution:
Because the switch has been closed for a long time before t = 0, the capacitor can be regarded as open, as shown in the following circuit.



The voltage drop across the capacitor can be found from the voltage divider circuit.

$$v_C(0^+) = v_C(0^-) = 6 \times \frac{1\text{k}}{1\text{k} + 1\text{k}} = 3\text{V}$$

Immediately after the switch is opened at t = 0, the equivalent circuit become



The voltage drop across the resistor is $v_C(0^+)$= $v_C(0^-)$=3 V, thus the current go through the resistor is

$$i_R(0^+) = \frac{v_R(0^+)}{1\,\text{k}\Omega} = \frac{v_C(0^+)}{1\,\text{k}\Omega} = \frac{3\,\text{V}}{1\,\text{k}\Omega} = 3\,\text{mA}$$

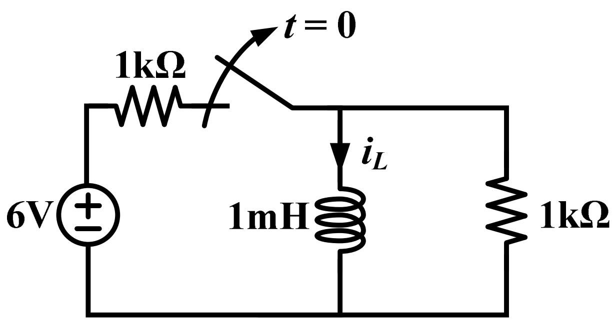
and

$$i_C(0^+) = -i_R(0^+) = -3\,\text{mA}$$

From element relation for capacditor, $i_C = C\frac{dv_C}{dt}$, we have

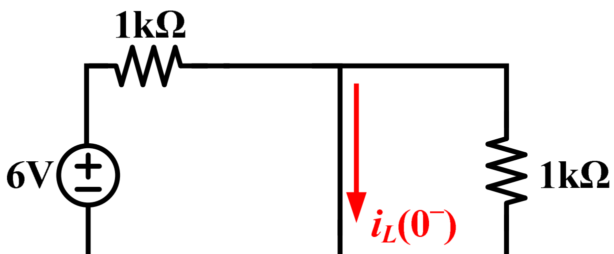
$$\frac{dv_C(0^+)}{dt} = \frac{i_C(0^+)}{C} = \frac{-3\,\text{mA}}{1\,\mu\text{F}} = -3000\,\text{V/sec}\,.$$

For the circuit as shown in the following figure, the switch has been closed for a long time before opening at t = 0. Find the current pass through the inductor $i_L(0^+)$ and its first derivative $\frac{di_L(0^+)}{dt}$, i.e. right after the switch opens.



Solution:

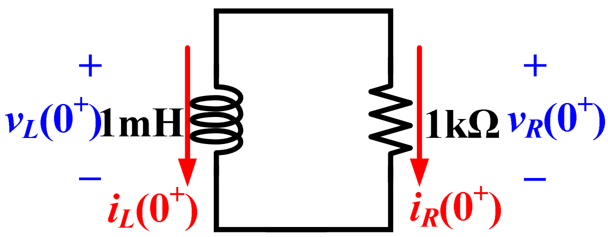
The switch has been closed for a long time before t = 0, the inductor can be regarded as short circuit for the terminal, as shown as the following circuit.



The current pass through the inductor is simply the current through the left-hand side 1 kΩ resistor.

$$i_L(0^+) = i_L(0^-) = \frac{6\,\text{V}}{1\,\text{k}\Omega} = 6\,\text{mA}$$

After the switch is opened at t = 0, the circuit become



The current pass through the resistor is $i_L(0^+)= i_L(0^-)$=6 mA and the voltage drop across the resistor is

$$v_R(0^+) = -i_L(0^+)\times 1\,\text{k}\Omega = -6\text{ mA}\times 1\,\text{k}\Omega = -6\text{ V}$$

and

$$v_L(0^+) = v_R(0^+) = -6\text{ V}$$

From element relation for inductor, $v_L = L\dfrac{di_L}{dt}$, we have

$$\frac{di_L(0^+)}{dt} = \frac{v_L(0^+)}{L} = \frac{-i_L(0^+)\times 1\text{k}}{1\text{m}} = \frac{-6\text{m}\times 1\text{k}}{1\mu} = -6000\text{ A/sec}$$

$v_C(0^+)$ = 3V, $\dfrac{dv_C(0^+)}{dt}$ = –3000V/sec,

$i_L(0^+)$ = 6mA, $\dfrac{di_L(0^+)}{dt}$ = –6000A/sec.