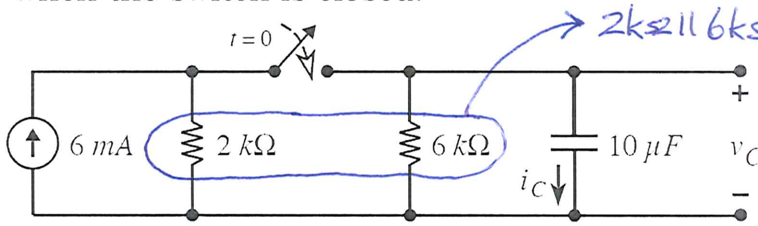
SA 2. [5 marks] Consider the following circuit which is in the steady state at $t = 0$ when the switch is closed.

$2k\Omega \| 6k\Omega = 1.5k\Omega$



(a) [3 marks] Determine the voltage across the capacitor as a function of time, $v_C(t)$, for $t > 0$. Assume $v_C(0) = 0$.

Recall: 1^{st}-order cct. response fctn: $x(t) = x(\infty) + [x(0^+) - x(\infty)]e^{-t/\tau}$

For this case: $v_C(0) = v_C(0^+) = 0$

$$v_C(\infty) = (6mA)(2k\Omega \| 6k\Omega) = 9V$$

$$\tau = R_{TH}C = (2k\Omega \| 6k\Omega)(10\mu F) = 15ms$$

$$\therefore v_C(t) = 9V + [0 - 9V]e^{-t/15ms}$$

or $\boxed{v_C(t) = 9(1 - e^{-t/15ms})V}$

(b) [2 marks] Determine the current through the capacitor as a function of time, $i_C(t)$, for $t > 0$.

Recall: Capacitor Law: $i_C = C\dfrac{dv_C}{dt}$

$$\Rightarrow i_C(t) = (10\mu F)\frac{d}{dt}\left[9(1 - e^{-t/15ms})\right]$$

$$\therefore \boxed{i_C(t) = 6e^{-t/15ms} \; mA}$$

Alternatively:

$i_C(0^+) = 6mA$

$i_C(\infty) = 0$

$\tau = 15ms$

$$\therefore i_C(t) = 0 + [6 - 0]e^{-t/\tau}$$

or $\boxed{i_C(t) = 6e^{-t/15ms} \; mA}$