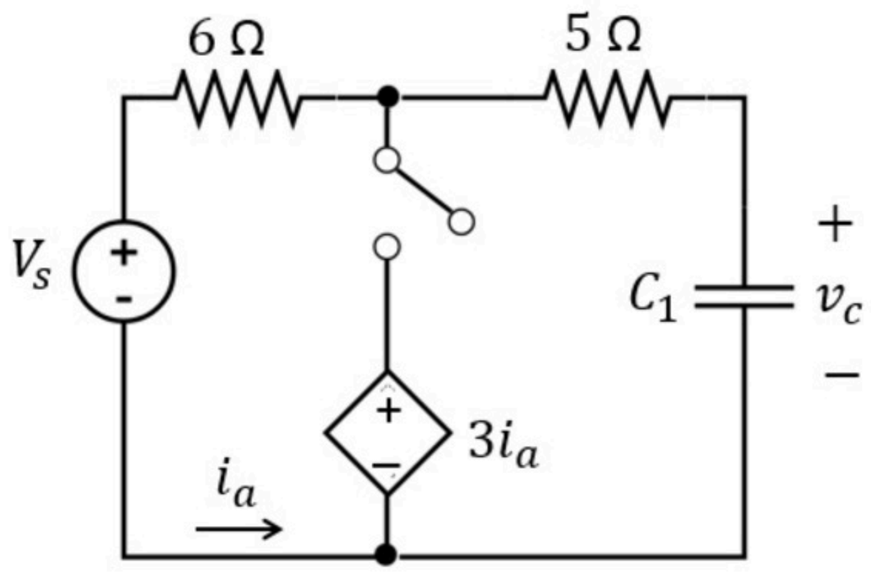
First order circuits 003

Problem has been graded.

The switch has been open for a long time before it closes at time $t = 0$.

Find the capacitor voltage $v_c = A + B \cdot e^{-t/\tau}$ for $t > 0$.



Given Variables:

Vs : 15 V

C1 : 0.1 nF

Calculate the following:

A (V) :

-15 ✓

B (V) :

30 ✓

tau (ns) :

0.5 ✓

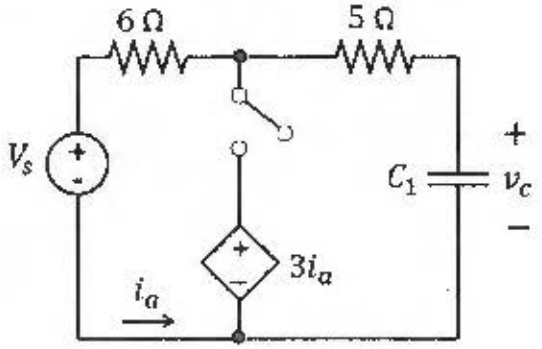
Hint: First find the capacitor voltage at t = 0-. Note where A and B are.

The switch has been open for a long time before it closes at time $t = 0$.

Find the capacitor voltage $v_c = A + B \cdot e^{-t/\tau}$ for $t > 0$.

Vs : 30 V

C1 : 0.2 nF



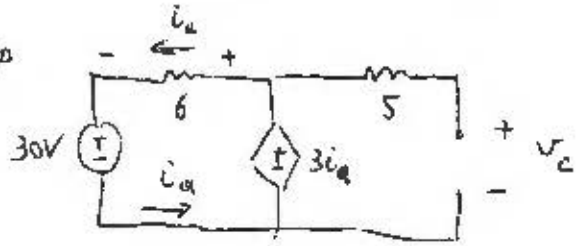
(a) $t = 0^-$

$v_c(0^-) = 30V$

$\Downarrow$

(b) $v_c(0^+) = 30V$

(c) $t = \infty$



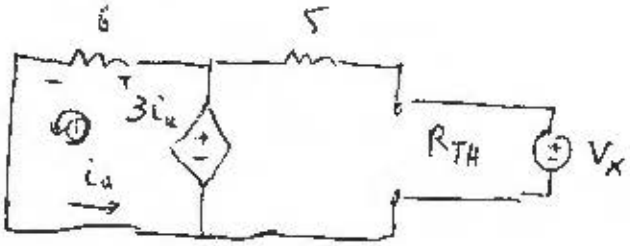
$30 + 6i_a - 3i_a = 0$

$3i_a = -30$

$i_a = -10\ A$

$\Rightarrow v_c(\infty) = 3i_a = -30V$

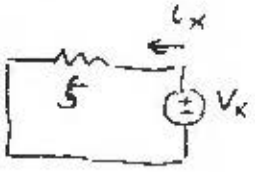
(d)



KVL ①: $3i_a - 6i_a = 0$

$\Rightarrow i_a = 0$

$\Rightarrow$



$\frac{V_x}{5} = i_x \Rightarrow R_{TH} = 5\,\Omega$

$\tau = RC = 1\ ms$

$A = v_c(\infty) \Rightarrow \boxed{A = -30V}$

$A + B = v_c(0^+) \Rightarrow \boxed{B = 60V}$