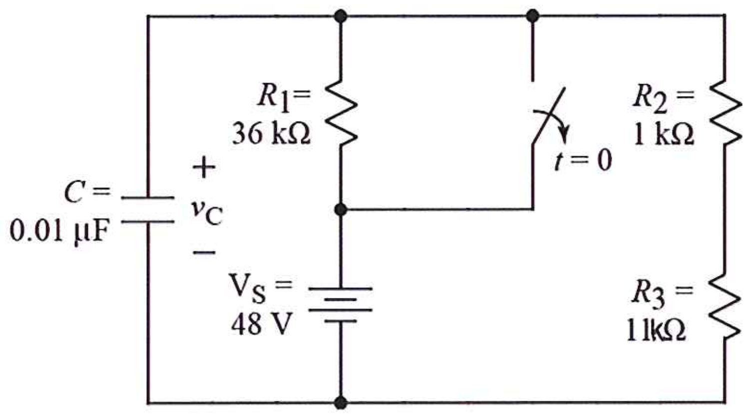
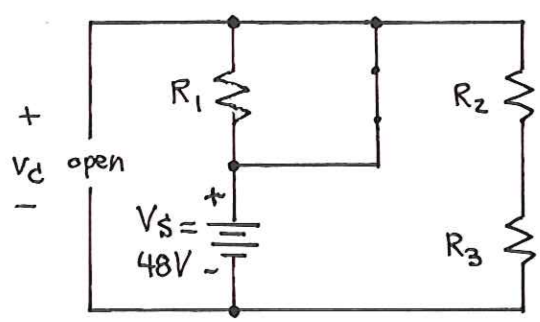
Ex:



The switch has been closed for a long time and is opened at $t = 0$.

Write the full expression for $v_C(t)$ for $t > 0$, including all the numerical constants that you find.

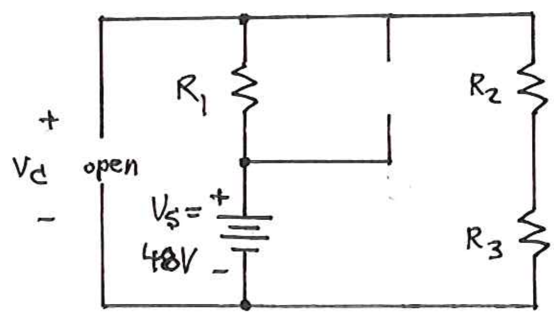
soln: For $t = 0^-$, the switch is closed and $C =$ open.



If we follow wires from the 48V source, we find they are leading directly to the C.
So $v_C(0^-) = V_S = 48V$, and $v_C(0^+) = v_C(0^-)$.

For $t \to \infty$, the switch is open and $C =$ open.

We have a V-divider formed by V_S, R_1, R_2, and R_3. $v_C = V$ across $R_2 + R_3$.



$$V_C(t\to\infty) = V_S \frac{R_2 + R_3}{R_1 + R_2 + R_3} = 48V \frac{1k\Omega + 11k\Omega}{36k\Omega + 1k\Omega + 11k\Omega}$$

or

$$V_C(t\to\infty) = 48V \frac{12k\Omega}{48k\Omega} = 12V$$

To find R_{Th} for time constant $\tau = R_{Th}C$, we look in from the terminals where C is connected and turn off V_S (= wire).

$$R_{Th} = R_1 \| (R_2 + R_3) = 36k\Omega \| (1k\Omega + 11k\Omega)$$

or

$$R_{Th} = 36k\Omega \| 12k\Omega = 12k\Omega \cdot 3\|1 = 12k\Omega \cdot \left(\frac{3}{4}\right)$$

or

$$R_{Th} = 9k\Omega \quad \text{and} \quad \tau = R_{Th}C = 9k\Omega \cdot 0.01\mu F$$

$$\tau = 90\,\mu s$$

We use the general form of solution for RC circuits:

$$V_C(t) = V_C(t\to\infty) + [V_C(0^+) - V_C(t\to\infty)]e^{-t/\tau}, \quad t>0$$

or

$$V_C(t>0) = 12V + [48V - 12V]e^{-t/90\mu s}$$

or

$$V_C(t>0) = 12V + 36V e^{-t/90\mu s}$$