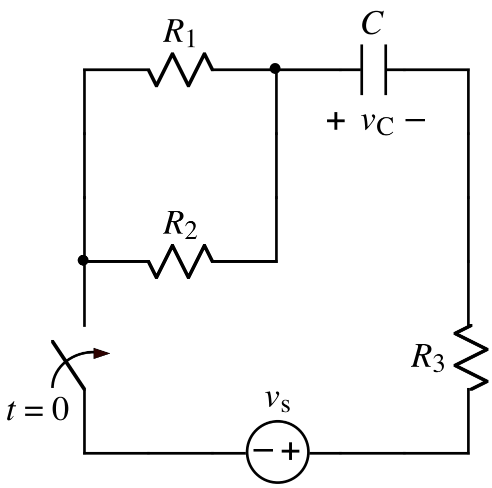
HOMEWORK 12 Solution Prob 3

Ex:



After being open for a long time, the switch closes at $t = 0$, and $v_C(t = 0^-) = 4$ V.

Write an expression for $v_C(t > 0)$ in terms of R_1, R_2, R_3, v_s, $v_C(t = 0^-)$, and C.

SOL'N: We use the general form of solution for *RC* circuits:

$$v_C(t > 0) = v_C(t \to \infty) + [(v_C(0^+) - v_C(t \to \infty)]e^{-t/(R_{Th}C)}$$

For $t = 0^+$ the voltage on the capacitor is the same as at $t = 0^-$:

$$v_C(t = 0^+) = v_C(t = 0^-) = 4 \text{ V}$$

As t approaches infinity, the switch is closed and the capacitor acts like an open circuit. Since no current flows, the voltage drops across all the resistors are zero. All of the voltage is dropped across the capacitor.

$$v_C(t \to \infty) = -v_s$$

The value of R_{Th} is the value of resistance seen from the terminals where the C is connected (with the C removed). Since there is only an independent source in the circuit, we may turn off the v_s source and determine the value of R_{Th}:

$$R_{Th} = R_3 + R_1 \| R_2$$

Substituting symbolic values, we have our answer:

$$v_C(t > 0) = -v_s + [4 \text{ V} + v_s]e^{-t/(R_3 + R_1 \| R_2)C}$$