Chapter 7, Solution 71.

For the op amp circuit in Fig. 7.136, suppose $v(0) = 0$ and $v_s = 3V$. Find $v(t)$ for $t > 0$.

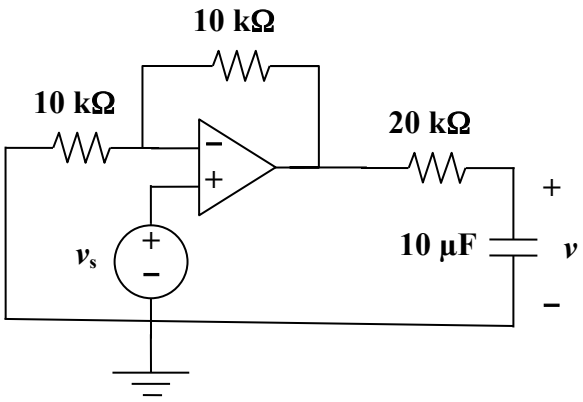
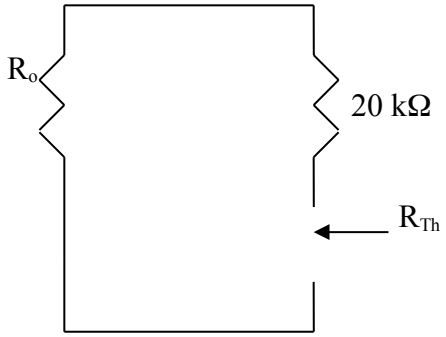


Figure 7.136
For Prob. 7.71.

Solution

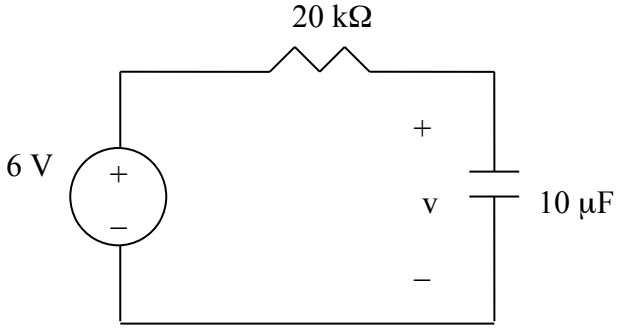
We temporarily remove the capacitor and find the Thevenin equivalent at its terminals. To find R_{Th}, we consider the circuit below.



Since we are assuming an ideal op amp, $R_o = 0$ and $R_{Th} = 20k\Omega$. The op amp circuit is a noninverting amplifier. Hence,

$$V_{Th} = (1 + \frac{10}{10})v_s = 2v_s = 6V$$

The Thevenin equivalent is shown below.



Thus,

$$v(t) = 6(1 - e^{-t/\tau}), t > 0$$

where $\tau = R_{TH}C = 20x10^{-3}x10x10^{-6} = 0.2$

$v(t) = \mathbf{6(1-e^{-5t})\ V}$ for all $t > 0$.