

Chapter 7, Solution 66.

Using Fig. 7.131, design a problem to help other students to better understand first-order op amp circuits.

Although there are many ways to work this problem, this is an example based on the same kind of problem asked in the third edition.

Problem

For the op-amp circuit of Fig. 7.131, find v_o . Assume that v_s changes abruptly from 0 to 1 V at $t=0$. Find v_o .

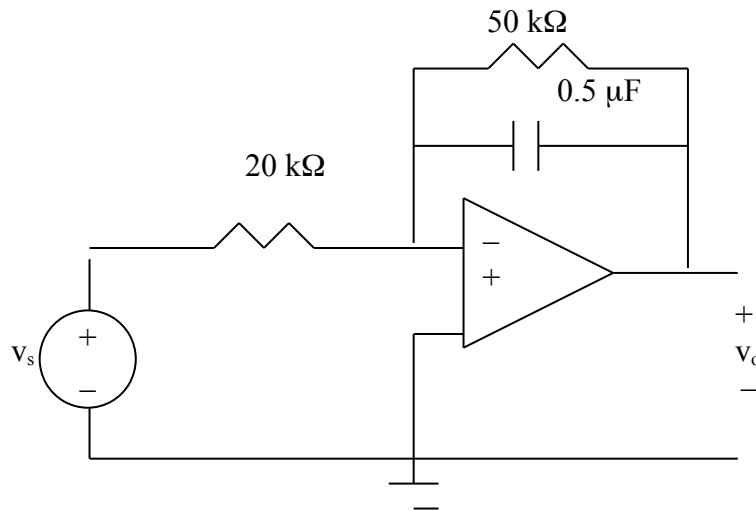


Figure 7.131 For Prob. 7.66.

Solution

For $t < 0^-$, $v_s = 0$ so that $v_o(0) = 0$

Let v be the capacitor voltage

For $t > 0$, $v_s = 1$. At steady state, the capacitor acts like an open circuit so that we have an inverting amplifier

$$v_o(\infty) = -(50\text{k}/20\text{k})(1\text{V}) = -2.5\text{ V}$$

$$\tau = RC = 50 \times 10^3 \times 0.5 \times 10^{-6} = 25\text{ ms}$$

$$v_o(t) = v_o(\infty) + (v_o(0) - v_o(\infty))e^{-t/0.025} = \underline{\underline{2.5(e^{-40t} - 1)\text{ V}}}.$$