Chapter 7, Solution 7.

Assume that the switch in Fig. 7.87 has been in position A for a long time and is moved to position B at t=0. Then at t = 1second, the switch moves from B to C. Find $v_C(t)$ for t 0.

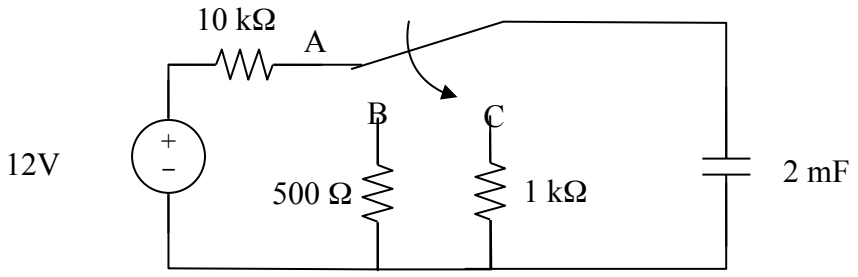

Figure 7.87
For Prob. 7.7

Solution

Step 1. Determine the initial voltage on the capacitor. Clearly it charges to 12 volts when the switch is at position A because the circuit has reached steady state.

This then leaves us with two simple circuits, the first a 500 Ω resistor in series with a 2 mF capacitor and an initial charge on the capacitor of 12 volts. The second circuit which exists from t = 1 sec to infinity. The initial condition for the second circuit will be $v_C(1)$ from the first circuit. The time constant for the first circuit is (500) (0.002) = 1 sec and the time constant for the second circuit is (1,000)(0.002) = 2 sec. $v_C(\infty) = 0$ for both circuits.

Step 1.

$$v_C(t) = \mathbf{12e^{-t}\ volts} \text{ for } 0 < t < 1 \text{ sec and } = 12e^{-1}e^{-2(t-1)} \text{ at } t = 1 \text{ sec, and}$$

$$= \mathbf{4.415e^{-2(t-1)}\ volts} \text{ for } 1 \text{ sec} < t < \infty.$$

$$\mathbf{12e^{-t}\ volts} \text{ for } 0 < t < 1 \text{ sec, } \mathbf{4.415e^{-2(t-1)}\ volts} \text{ for } 1 \text{ sec} < t < \infty.$$