31.77. Model: Assume the battery and the connecting wires are ideal.
Visualize: Please refer to Figure P31.77.
Solve: **(a)** If the switch has been closed for a long time, the capacitor is fully charged and there is no current flowing through the right branch that contains the capacitor. So, a voltage of 60 V appears across the 60 Ω resistor and a voltage of 40 V appears across the 40 Ω resistor. That is, maximum voltage across the capacitor is 40 V. Thus, the charge on the capacitor is

$$Q_0 = \mathcal{E}C = (40\text{ V})(2.0\times10^{-6}\text{ F}) = 80\ \mu\text{C}$$

(b) Once the switch is opened, the battery is disconnected from the capacitor. The capacitor C has two resistances (10 Ω and 40 Ω) in series and discharges according to $Q = Q_0 e^{-t/RC}$. For $Q = 0.10\ Q_0$,

$$0.10\ Q_0 = Q_0 e^{-t/(50\ \Omega)(2\ \mu\text{F})} \Rightarrow \ln\left(\frac{0.10}{1}\right) = -\frac{t}{(50\ \Omega)(2\ \mu\text{F})}$$

$$\Rightarrow t = -(50\ \Omega)(2\ \mu\text{F})\ln(0.10) = 0.23\text{ ms}$$