Chapter 7, Solution 47.

Determine $v(t)$ for $t > 0$ in the circuit in Fig. 7.114 if $v(0) = 0$.

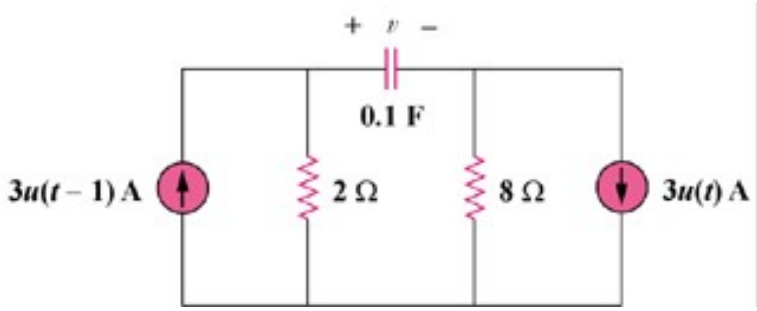

Figure 7.114
For Prob. 7.47.

Solution

For $t < 0$, $u(t) = 0$, $u(t-1) = 0$, $v(0) = 0$

For $0 < t < 1$, $\tau = RC = (2+8)(0.1) = 1$

$v(0) = 0$, $v(\infty) = (8)(3) = 24$

$$v(t) = v(\infty) + \left[v(0) - v(\infty) \right] e^{-t/\tau}$$

$$v(t) = 24\left(1 - e^{-t}\right)$$

For $t > 1$, $v(1) = 24\left(1 - e^{-1}\right) = 15.17$

$$-6 + v(\infty) - 24 = 0 \longrightarrow v(\infty) = 30$$

$$v(t) = 30 + (15.17 - 30)e^{-(t-1)}$$

$$v(t) = 30 - 14.83e^{-(t-1)}$$

Thus,

$$v(t) = \begin{cases} 24\left(1 - e^{-t}\right) \text{V}, & 0 < t < 1 \\ 30 - 14.83e^{-(t-1)} \text{ V}, & t > 1 \end{cases}$$