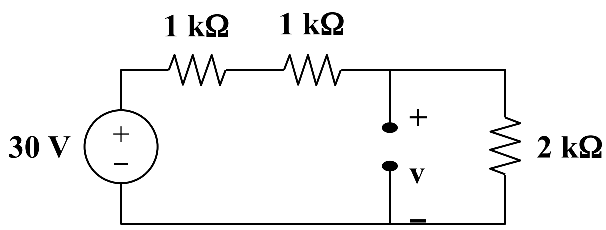
Chapter 7, Solution 50.

For the capacitor voltage,

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

$$v(0) = 0$$

For t > 0, we transform the current source to a voltage source as shown in Fig. (a).



(a)

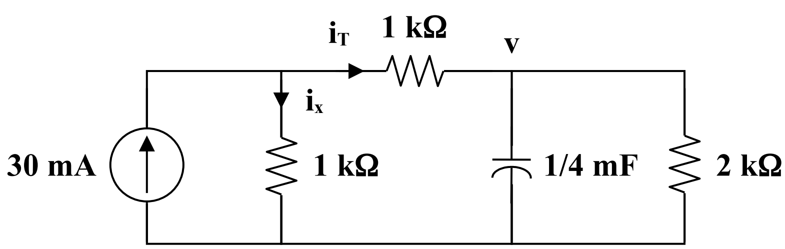
$$v(\infty) = \frac{2}{2+1+1}(30) = 15\text{ V}$$

$$R_{th} = (1+1) \parallel 2 = 1\text{ k}\Omega$$

$$\tau = R_{th}C = 10^3 \times \frac{1}{4} \times 10^{-3} = \frac{1}{4}$$

$$v(t) = 15\left(1 - e^{-4t}\right), \quad t > 0$$

We now obtain i_x from v(t). Consider Fig. (b).



(b)

$$i_x = 30\text{ mA} - i_T$$

But $\quad i_T = \dfrac{v}{R_3} + C\dfrac{dv}{dt}$

$$i_T(t) = 7.5\left(1 - e^{-4t}\right)\text{ mA} + \frac{1}{4} \times 10^{-3}\,(-15)(-4)e^{-4t}\text{ A}$$

$$i_T(t) = 7.5\left(1 + e^{-4t}\right)\text{ mA}$$

Thus,

$$i_x(t) = 30 - 7.5 - 7.5e^{-4t}\text{ mA}$$

$$i_x(t) = \mathbf{7.5\left(3 - e^{-4t}\right)mA, \quad t > 0}$$