1.12 The charge entering the positive terminal of an element is given by the expression $q(t) = -12e^{-2t}$ mC. The power delivered to the element is $p(t) = 2.4e^{-3t}$ W. Compute the current in the element, the voltage across the element, and the energy delivered to the element in the time interval $0 < t < 100$ ms.

SOLUTION:

$$q(t) = -12\,e^{-2t} \text{ mC}$$

$$p(t) = 2.4\,e^{-3t} \text{ W}$$

$$i(t) = \frac{dq(t)}{dt}$$

$$i(t) = 2(-12)e^{-2t} \text{ m}$$

$$i(t) = 24\,e^{-2t} \text{ mA}$$

$$W = \int_{t1}^{t2} p(t)\,dt = \int_{0}^{100m} 2.4\,e^{-3t}\,dt$$

$$W = \frac{2.4}{-3}\,e^{-3t}\Big]_{0}^{100m}$$

$$W = \frac{2.4}{-3}\left[e^{-3(100m)} - e^{-3(0)}\right]$$

$$W = 207.35 \text{ mJ}$$

$$V(t) = \frac{P(t)}{i(t)}$$

$$V(t) = \frac{2.4\,e^{-3t}}{24\,e^{-2t}\,m}$$

$$V(t) = 100\,e^{-t} \text{ V}$$