1.11 The charge entering the positive terminal of an element is $q(t) = -30e^{-4t}$ mC. If the voltage across the element is $120e^{-2t}$ V, determine the energy delivered to the element in the time interval $0 < t < 50$ ms.

SOLUTION:

$$q(t) = 30e^{-4t}\ mC$$

$$v(t) = 120e^{-2t}\ V$$

$$W = \int_{t1}^{t2} P\,dt = \int_{t1}^{t2} Vi\,dt$$

$$i(t) = \frac{dq(t)}{dt} = -4(-30)e^{-4t}\ mA$$

$$i(t) = 120e^{-4t}\ mA$$

$$W = \int_{t1}^{t2} (120e^{-2t})(120e^{-4t}m)\,dt$$

$$W = 14.4\int_{0}^{50m} e^{-6t}\,dt$$

$$W = 14.4\left[\frac{e^{-6t}}{-6}\right]^{50m}$$

$$W = 14.4\left[\frac{e^{-6(50m)^{\infty}}}{-6} + \frac{e^{-6(0)}}{6}\right]$$

$$W = 622.04\ mJ$$