Problem 1.2

Determine the current flowing through an element if the charge flow is given by

(a) $q(t) = (3)\ \text{mC}$

(b) $q(t) = (4t^2 + 20t - 4)\ \text{C}$

(c) $q(t) = (15e^{-3t} - 2e^{-18t})\ \text{nC}$

(d) $q(t) = 5t^2(3t^3 + 4)\ \text{pC}$

(e) $q(t) = 2e^{-3t}\sin(20\pi t)\ \mu\text{C}$

Solution

Take the derivative of charge $q(t)$ in order to get the current $i(t)$.

(a) $$i(t) = \frac{dq}{dt} = \frac{d}{dt}(3)\ \text{mC} = 0$$

(b) $$i(t) = \frac{dq}{dt} = \frac{d}{dt}(4t^2 + 20t - 4)\ \text{C} = (8t + 20)\ \frac{\text{C}}{\text{s}}$$

(c) $$i(t) = \frac{dq}{dt} = \frac{d}{dt}(15e^{-3t} - 2e^{-18t})\ \text{nC} = (-45e^{-3t} + 36e^{-18t})\ \frac{\text{nC}}{\text{s}}$$

(d) $$i(t) = \frac{dq}{dt} = \frac{d}{dt}(15t^5 + 20t^2)\ \text{pC} = (75t^4 + 40t)\ \frac{\text{pC}}{\text{s}}$$

(e) $$i(t) = \frac{dq}{dt} = \frac{d}{dt}(2e^{-3t}\sin 20\pi t)\ \mu\text{C} = e^{-3t}(-6\sin 20\pi t + 40\pi\cos 20\pi t)\ \frac{\mu\text{C}}{\text{s}}$$