28.3: Vector Equation

Eq. (28.1.4) is valid in one dimension; we can develop an analogous equation in two or three dimensions by noting that the kinetic energy $K = mv^2/2 = m\mathbf{v} \cdot \mathbf{v}/2$:

$$\mathcal{P} = \frac{dK}{dt} \tag{28.3.1}$$

$$= \frac{d}{dt}\left(\frac{1}{2} m\mathbf{v} \cdot \mathbf{v}\right). \tag{28.3.2}$$

Now using Eq. (7.3.14), we get

$$\mathcal{P} = m\mathbf{v} \cdot \frac{d\mathbf{v}}{dt} \tag{28.3.3}$$

and so, since $\mathbf{F} = md\mathbf{v}/dt$,

$$\mathscr{P} = \mathbf{F} \cdot \mathbf{v} \tag{28.3.4}$$