

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 $K = mv^2/2 = m\mathbf{v} \cdot \mathbf{v}/2$:

$$\mathcal{P} = \frac{dK}{dt} \quad (28.3.1)$$

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

Now using Eq. (7.3.14), we get

$$\mathcal{P} = m \mathbf{v} \cdot \frac{d\mathbf{v}}{dt} \quad (28.3.3)$$

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

$$\mathcal{P} = \mathbf{F} \cdot \mathbf{v} \quad (28.3.4)$$

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