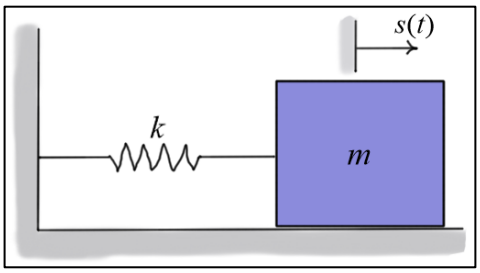
Elementary Dynamics – Example #1: (Rectilinear Motion)



Given: $s(t) = A_0 \sin(\omega_0 t)$ … (A_0 and ω_0 are constants)

Find: $v(t)$ … the velocity of m

$a(t)$ … the acceleration of m

Solution:

$$v(t) = \frac{ds}{dt} = \frac{d}{dt}\left(A_0 \sin(\omega_0 t)\right) = A_0 \left(\cos(\omega_0 t)\right)\omega_0 = A_0\,\omega_0 \cos(\omega_0 t)$$

$$a(t) = \frac{dv}{dt} = \frac{d}{dt}\left(A_0\,\omega_0 \cos(\omega_0 t)\right) = A_0\,\omega_0 \left(-\sin(\omega_0 t)\right)\omega_0 = -A_0\,\omega_0^2 \sin(\omega_0 t)$$

Aside: (chain rule)

$$\frac{d}{dt}\left(\sin(\theta)\right) = \cos(\theta)\cdot\frac{d\theta}{dt}$$

$$\frac{d}{dt}\left(\cos(\theta)\right) = -\sin(\theta)\cdot\frac{d\theta}{dt}$$