# 8.3: Acceleration

In a similar way, we can take the derivative velocity with respect to time to get acceleration, which is the second derivative of $x$ with respect to $t$ :

$$a=\frac{dv}{dt}=\frac{d^2x}{dt^2} \tag{8.3.1}$$

SI units of acceleration are meters per second squared $\left(\mathrm{m/s^2}\right)$.

*Example*. In the previous example, we found a formula for the velocity of a particle as $v(t)=10t$. The acceleration of the particle in this example is $a(t)=10\ \mathrm{m/s^2}$, a constant.

As we'll see later when we discuss gravity, all objects at the surface of the Earth will accelerate downward with the same acceleration, $9.80\ \mathrm{m/s^2}$. This important constant is called the acceleration due to gravity, and is given the symbol $g$ :

$$g=9.80\ \mathrm{m/s^2} \quad \left(=32\mathrm{ft/s^2}\right). \tag{8.3.2}$$

This value is an average for the Earth; for a more exact value of $g$, you can use Helmert's equation (Section 51.4).

The acceleration due to gravity gives rise to a common (non-SI) unit of acceleration, also called the $g$ :

$$1\ \mathrm{g}=9.80665\ \mathrm{m/s^2}. \tag{8.3.3}$$

This number is a standardized conventional value that has been adopted by international agreement.