

3.4 Velocity & Other Rates of Change

Position - where an object is located

$$\begin{aligned} S(t) \\ \text{or} \\ x(t) &= \frac{1}{2} g t^2 + v_0 t + s_0 \end{aligned}$$

Annotations:
- $\frac{1}{2} g t^2$: gravity
- t : time
- $v_0 t$: initial velocity
- s_0 : initial position

Velocity - how fast an object travels
(with direction)

- rate of change of position

$$\begin{aligned} \rightarrow v_{\text{avg}} &= \frac{\Delta x}{\Delta t} \\ &= \frac{x_1(t_1) - x_2(t_2)}{t_1 - t_2} \end{aligned}$$

$$\rightarrow \text{instantaneous velocity} = \lim_{\Delta t \rightarrow 0} \frac{x(t_1) - x(t_2)}{t_1 - t_2}$$

$$v(t) = x'(t)$$

velocity is derivative of position

Acceleration - rate of change of velocity

- how fast velocity changes

$$a(t) = \lim_{\Delta t \rightarrow 0} \frac{v(t_1) - v(t_2)}{t_1 - t_2}$$

$$a(t) = v'(t)$$

acceleration is the derivative
of velocity

Quick Summary:

$$x(t)$$

$$v(t) = x'(t)$$

$$a(t) = v'(t) = x''(t)$$