Application of the Derivative

Position Function: The function s that gives the position (relative to the origin) of an object as a function of time.

Δt represents a period of time

Δs represents distance change

Note: $\Delta s = s(t + \Delta t) - s(t)$

Rate = __________

Average Velocity = *Change in Distance* / *Change in Time* = $\frac{\Delta s}{\Delta t}$

Using the Derivative: Allows us to find the ***instantaneous velocity*** *(velocity)* at any time *t.*

If *s* = *s(t)* is the position function for an object moving along a straight line, then the velocity of the object at time *t* is:

$$v(t) = \lim_{\Delta t \to 0} \frac{s(t + \Delta t) - s(t)}{\Delta t} = s'(t)$$

Speed of an object is: $|v(t)| = |s'(t)|$

Free-Falling objects under the influence of gravity

Position: $s(t) = \frac{1}{2}gt^2 + v_0 t + s_0$

Where s_0 = initial height

v_0 = initial velocity of the object

g = the acceleration due to gravity (-32 ft/sec or -9.8 m/sec)

Example: At time *t* = *0*, a diver jumps from a diving board that is 32 ft. above the water. The position of the diver is given by $s(t) = -16t^2 + 16t + 32$ where s is measured in ft. and t is measured in sec.

(a) When does the diver hit the water?

(b) What is the diver's velocity at impact?