Derivative Applications
3.4 – Distance, Velocity, Acceleration & Other Stuff

Velocity is the derivative of distance traveled. Acceleration is the second derivative of distance traveled
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$$s(t) = distance\ at\ time\ t$$
$$v(t) = s'(t) = velocity\ at\ time\ t$$
$$a(t) = v'(t) = s''(t) = accerlation\ at\ time\ t$$

Note: Velocity always implies a direction.

Ex A: Distance, Velocity and Acceleration Applications
#1) A delivery truck is driving along a straight road, and after *t* hours its distance (in miles) east of its starting point is $s(t) = 24t^2 - 4t^3$ for 0 ≤ t ≤ 6.

a. Find the velocity of the truck after 2 hours.

b. Find the velocity of the truck after 5 hours.

c. Find the acceleration of the truck after 1 hour.

#2) A helicopter rises vertically and after *t* second its height above the ground is $s(t) = 6t^2 - t^3$ feet (0 ≤ t ≤ 6).

a. Find the velocity after 2 seconds.

b. Find the velocity after 5 seconds.

c. Find the acceleration after 1 second.

Other Applications of Second Derivative

The second derivative applies to many things in addition to acceleration. In general, the second derivative measures how the rate of change is changing. In other words, the second derivative describes whether the rate is speeding up or slowing down.

Ex B: Applications of second derivatives.
A demographer is one who studies the characteristics of human populations. Hugo, the demographer, predict that *t* years from now the population of a city will be $P(t) = 1{,}000{,}000 + 28{,}800t^{1/3}$.

a. Find P(8) and interpret your answer.

b. Find P'(8) and interpret your answer.

c. Find P''(8) and interpret your answer.