

3.4 Velocity and Other Rates Day 1
 Position, Velocity, Speed, Acceleration

Position = $s(t)$ = position at time t
 Δs = displacement (Endpoint - Start Point)

$v=0$ Stopped or Change direction
 Velocity = $v(t)$ (Velocity tells the direction of the motion)
 $v(t) = s'(t)$ = Instantaneous velocity

$\frac{\Delta s}{\Delta t}$ = Average velocity
 - Velocity (+) forward
 - Velocity (-) backward

Speed = $|v(t)|$

Acceleration = $a(t) = v'(t) = s''(t)$
 * rate at which a body's velocity changes
 * measures how quickly the body picks up or loses speed.

$a(t) = \frac{dv}{dt} = \frac{d^2s}{dt^2}$

Ex 1) If $s(t) = t^3 - 3t^2 + 12t + 4$

Find $v(3)$
 $v(3) = 3(3)^2 - 6(3) + 12 = 21$

Find/does $v(t) = 0$? $3t^2 - 6t + 12 = 0$
 $3(t^2 - 2t + 4) = 0$
 $t = \frac{2 \pm \sqrt{4 - 4(1)(4)}}{2(1)} = \frac{2 \pm \sqrt{-12}}{2}$
 No place where $v(t) = 0$

Find the speed at $t = 1, 2, 3$
 $t=1$ $|3(1)^2 - 6(1) + 12| = 9$
 $t=2$ $|3(2)^2 - 6(2) + 12| = 12$

Find $a(1)$
 $a(1) = 6(1) - 6 = 0$

Ex 2) An object is thrown in the air. Its height is modeled by $h(t) = 160t - 16t^2$. feet/sec

When does it reach its highest point?

$$v(t) = 160 - 32t \quad 160 - 32t = 0 \quad 160 = 32t \quad t = 5 \text{ sec}$$

How high did it go?

$$h(5) = 160(5) - 16(5)^2 = 400 \text{ ft}$$

How long was it in the air?

$$0 = 160t - 16t^2 \quad 0 = 16t(10 - t)$$

$t=0 \quad 10-t=0 \quad t=10 \text{ s}$

What is the average velocity $[0, 2]$?

$$\frac{\Delta s}{\Delta t} = \frac{\Delta h}{\Delta t} = \frac{h(2) - h(0)}{2 - 0}$$

$$h(0) = 160(0) - 16(0)^2 = 0$$

$$h(2) = 160(2) - 16(2)^2 = 256$$

$$= \frac{256 - 0}{2 - 0} = 128 \text{ ft/sec}$$



