DO NOW

3.2 Basic Differentiation Rules - Day 4

Rates of change -

derivative → slope - rate of change

*Can determine rate of change for one variable with respect to another.

Ex: Population growth
Production rates
Velocity

Average velocity - slope as you know it
↳ slope of secant line

$$\text{Avg Vel} = \frac{y_2 - y_1}{x_2 - x_1} \quad \text{OR} \quad \frac{s(t+\Delta t) - s(t)}{\Delta t}$$

where $s = s(t)$ = is the position function (given)

s → position (height) of object
t → time

Instantaneous Velocity - or Velocity
↳ slope of tangent line

$$\text{Velocity} = v(t) = s'(t)$$

$s(t)$ = position function
$s'(t)$ = velocity function - 1st derivative

Speed of an object - absolute value of the velocity

Velocity is: + → going up or right
− → going down or left

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

where: $s(t)$ → position/height of object
t → time
v_0 → initial velocity
s_0 → initial height
g → acceleration due to gravity
$-32\ \text{ft/sec}^2$
$-9.8\ \text{m/sec}^2$

Falling object on earth → $s(t) = -16t^2 + v_0 t + s_0$

Example: A ball is dropped from 144 ft.

a. Write the position and velocity functions for the ball.

$s(t) = -16t^2 + v_0 t + s_0$
$s(t) = -16t^2 + 0t + 144$ $\quad v_0 = 0$

$$s(t) = -16t^2 + 144$$
$$v(t) = s'(t) = -32t$$

$s(t) = h(t) = -16t^2 + 144$
$v(t) = h'(t) = -32t$

b. Determine the average velocity on the interval [1, 2]

$$\frac{h(2)-h(1)}{2-1}$$

$$\frac{[-16(2)^2+144]-[-16(1)^2+144]}{1}$$

$-64 + 16 = -48$ ft/sec

$s(t) = h(t) = -16t^2 + 144$
$v(t) = h'(t) = -32t$

c. Find the instantaneous velocities when $t = 1$ and $t = 2$.

$v(1) = h'(1) = -32(1)$

-32 ft/sec at 1 sec

$v(2) = h'(2) = -32(2)$

-64 ft/sec at 2 sec

$s(t) = h(t) = -16t^2 + 144$
$v(t) = h'(t) = -32t$

d. Find the time required for the coin to reach ground level.

$s(t) = -16t^2 + 144$

$0 = -16t^2 + 144$

$0 = -16(t^2 - 9)$

$0 = -16(t+3)(t-3)$

$t = -3, 3$

3 seconds

reject -3 ← time not negative

e. Find the velocity of the coin at impact.

$v(t) = h'(t) = -32t$

$v(3) = -32(3)$

-96 ft/sec

HOMEWORK

pg 138 - 139; 83 - 89, 93 - 96

* 94 → note 108 is not the height