Calculus AB

2-2a

(Day 1)

Position

Position Function - $s(t) = \frac{1}{2}at^2 + v_0 t + s_0$

s - position (distance)

t - time

a - acceleration

v - velocity

v_0 - initial velocity

s_0 - initial position

g - gravitational constant $g = 32\ ft/sec^2$ $g = 9.8\ m/sec^2$

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

Velocity- $v(t) = s'(t) = at + v_0$

units - m/sec

Average Velocity-

$$v_{ave} = \frac{s_f - s_0}{t_f - t_0}$$

Instantaneous Velocity- $s'(t) = at + v_0$

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

$s'(t) = v(t) = at + v_0$

Acceleration- $s''(t) = a(t) = v'(t) = a$

units - m/sec^2

Average Acceleration - $a_{ave} = \frac{v_f - v_0}{t_f - t_0} = \frac{\Delta v}{\Delta t}$

Instantaneous Acceleration - $v'(t)$

$$\lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t} = \frac{dv}{dt}$$

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

$s'(t) = v(t) = at + v_0$

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

The French fort Michilimacinac looked over the Straits of Mackinac, the narrowest section of water separating the Upper and Lower Peninsula of Michigan. A cannon was located in the watch tower looking out over the lake. The cannon is mounted 64 ft. above the waterline. If the cannon fires at an initial velocity of 240 ft/sec, answer the following questions:

a) Write a function that gives the height (position) of the cannon ball as a function of time.

$s(t) = \frac{1}{2}(32)t^2 + 240t + 64$

$= -16t^2 + 240t + 64$

b) Determine the average velocity of the shot between the 2nd and 3rd seconds of flight.

$v_{ave} = \frac{640 - 480}{3 - 2} = 160\ ft/sec$

$s_2 = 480$

$s_3 = 640$

The French fort Michilimacinac looked over the Straits of Mackinac, the narrowest section of water separating the Upper and Lower Peninsula of Michigan. A cannon was located in the watch tower looking out over the lake. The cannon is mounted 64 ft. above the waterline. If the cannon fires at an initial velocity of 240 ft/sec, answer the following questions:

a) $-16t^2 + 240t + 64$ b) 160 ft/s

c) Write a function that gives the instantaneous velocity as a function of time.

$v(t) = -32t + 240$

d) Find the instantaneous velocity of $t = 2$ and $t = 3$.

$v(2) = 176$ Ft/sec

$v(3) = 144$ Ft/sec

e) Find acceleration of the shot.

$a(t) = -32$ Ft/sec^2

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a) $-16t^2 + 240t + 64$ b) 160 ft/s c) $-32t + 240$ d) 176 ft/s, 144 ft/s

e) -32 ft/s^2

f) Find how long it takes the cannonball to hit the water.

$s(t) = -16t^2 + 240t + 64$ $\quad 0 = t^2 - 15t - 4$

$0 = -16t^2 + 240t + 64$ $\quad \frac{15 \pm \sqrt{225 - 4(1)(-4)}}{2(1)}$ $\quad t = 15.26$ sec

g) Find the velocity of the shot at the instant it hits the water.

$v(15.26) = -32(15.26) + 240 = -248.32$ Ft/sec

Assignment:

Pg. 115
97 - 104 all