MA 121 – 002

Tuesday, September 25

today: (2.1 : using $f'(x)$) ✓
(2.2 : using $f''(x)$)

1.8:

GRAV. initial vel. initial pos.

$$\boxed{s(t) = -16t^2 + 84t + 25}$$

(free falling object)

s: DIST; HT; POS (FT.)

t: TIME (SEC.)

$s(0) = 25$ FT ; $s(1) = \_\_\_\_$ FT

$s'(t) = v(t) = -16(2t) + 84(1) + 0$

$$\boxed{v(t) = -32t + 84}$$

$v(0) = 84 \frac{FT}{SEC}$; $v(1) = \_\_\_\_ \frac{FT}{SEC}$

$s''(t) = v'(t) = a(t) = -32(1) + 0 = -32 \frac{FT/SEC}{SEC}$

$\left(-32 \frac{FT}{SEC^2}\right)$

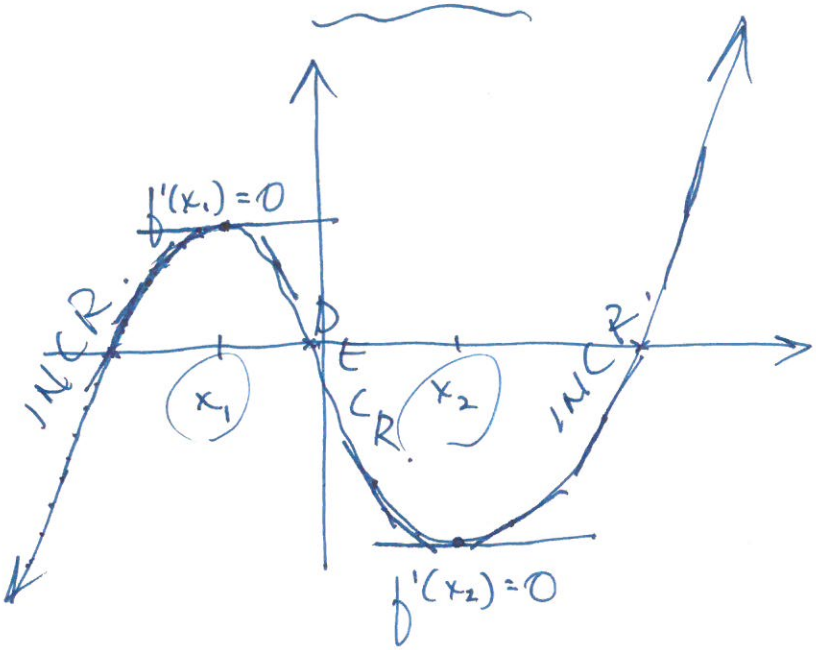
$a(0) = -32 \frac{ft/sec}{sec}$

$a(1) = -32 \frac{ft/sec}{sec}$

$s(t) = -16t^2 + 122t$

on the ground
$s(0) = 0$

2.1: USING THE DERIVATIVE:



$f'(x) = m_{TAN} =$ INSTANTANEOUS RATE OF CHANGE

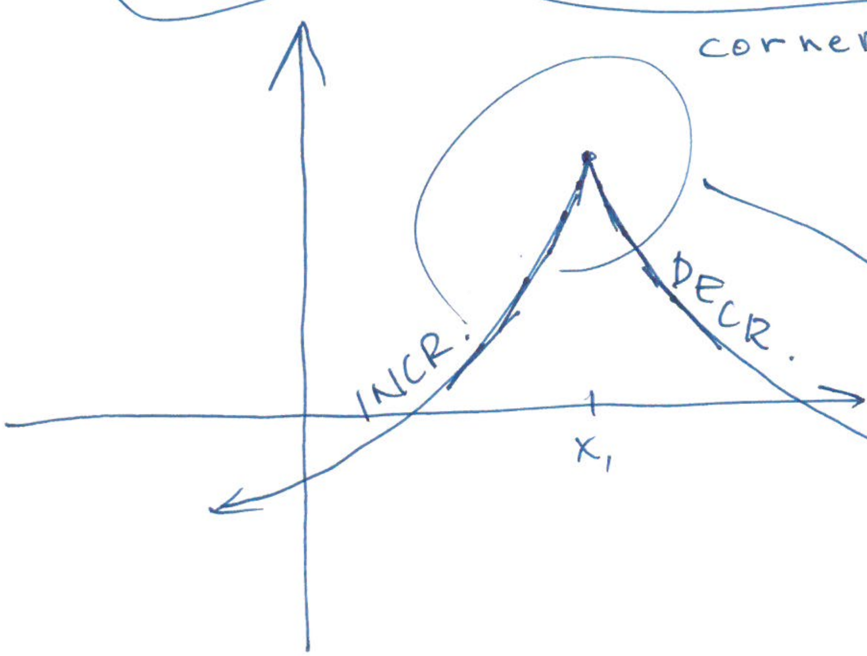
HORIZONTAL TANGENT LINE ("FLAT" PLACES)

$m_{TAN} = \boxed{0 = f'(x)}$

* $f'(x) = + \longrightarrow f(x)$ INCREASING

$f'(x) = - \longrightarrow f(x)$ DECREASING

$f(x) = x^3 + \cdots$ (polynomials)

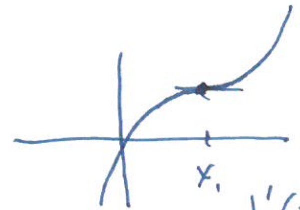


corner; cusp

(not a polynom)

$\boxed{f'(x_1) = \text{D.N.E. (undef.)}}$

VERTICAL TANGENT LINE



$f'(x_1) = 0$

1. find $f'(x)$.

2. a.) $f'(x) = 0$. ("flat" places)

   b.) $f'(x)$ D.N.E. ("steep" places)
   (where is $f'(x)$ undef)

critical values → critical points

3. use $f'(x)$ to DETERMINE where the graph is INCR/DECR.

$$\boxed{f(x) = 12 + 9x - 3x^2 - x^3}$$

cubic polynomial

$$f'(x) = 9 - 6x - 3x^2$$

(a) $9 - 6x - 3x^2 = 0$

$-1(3x^2 + 6x - 9) = 0$

$-1\underbrace{(3x-3)(x+3)}_{9x}) = 0$ $\quad -3x$

$3x - 3 = 0 \qquad x + 3 = 0$

$3x = 3 \qquad \underline{x = -3}$

$\underline{x = 1}$

$(1, f(1)) = (1, 17)$ ← "flat"

$f(1) = 12 + 9(1) - 3(1)^2 - (1)^3$

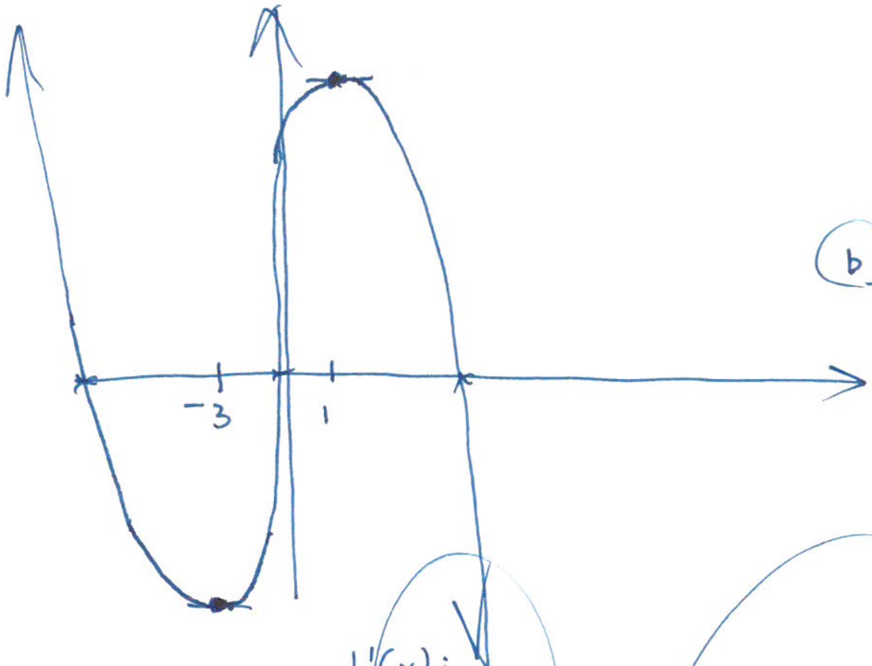
$f(1) = 12 + 9 - 3 - 1 = 17$

$f(-3) = 12 + 9(-3) - 3(-3)^2 - (-3)^3$

$f(-3) = 12 - 27 - \cancel{27} + \cancel{27}$

$f(-3) = -15$

$(-3, f(-3)) = (-3, -15)$



crit. pts:

(1, 17) & (-3, -15)

(b) ~~$f'(x)$ D.N.E.~~

~~$9 - 6x - 3x^2 = f'(x)$~~

$f'(x) = -(3x-3)(x+3)$

(3) $f'(x)$:

$f'(-4) = \text{NEG}$	$f'(0) = \text{POS}$	$f'(2) = \text{NEG}$
$f(x)$ DECR	$f(x)$ INCR.	$f(x)$ DECR

$x = -3$, $x = 1$

$f'(-4) = (-)(-)(-) = \text{NEG}$

$f'(0) = (-)(-)(+) = \text{POS}$

$f'(2) = (-)(+)(+) = \text{NEG}$

non-polynomial

$f(x) = \underline{1} - x^{2/3}$

(1) $f'(x) = 0 - \frac{2}{3}x^{-1/3} = \dfrac{-2}{3 \cdot x^{1/3}} = \dfrac{-2}{3 \cdot \sqrt[3]{x}}$

$\frac{0}{4} = \frac{0}{7} = \frac{0}{11} = 0$

(2) a.) $f'(x) = 0$

$\dfrac{-2}{3 \cdot \sqrt[3]{x}} \neq 0$

$(-2 \neq 0)$

__no__ "flat" places

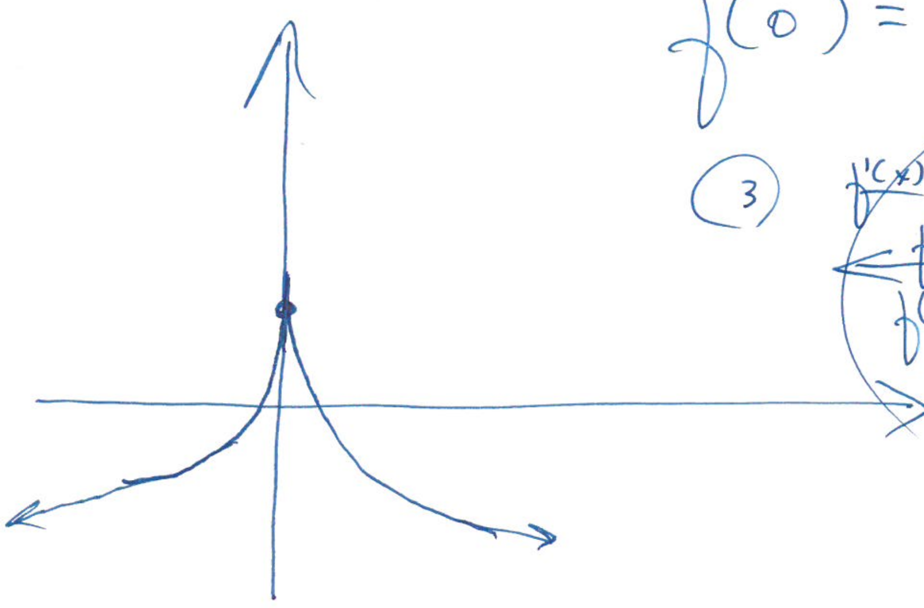
b.) $f'(x)$ undef.

$\dfrac{-2}{3 \cdot \sqrt[3]{x}}$ undef when $3 \cdot \sqrt[3]{x} = 0$

when $x = 0$

$(0, f(0)) = (0, 1)$ ← VERTICAL TANGENT LINE THERE

$f(0) = 1 - 0^{2/3} = 1$



(3) $f'(x)$:

$f'(-1) = +$ | $f'(1) = -$

$f(x)$ INCR. | $f(x)$ DECR

$x = 0$

$f'(-1) = \dfrac{-2}{3\sqrt[3]{-1}} = +$

$f'(1) = \dfrac{-2}{3 \cdot \sqrt[3]{1}} = -$

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TEST #1 RESULTS

A's : 38

B's : 37

C's : 47

D's : 27

F's : 63

AVE: 68.74