September 24, 2025

Punctuation Day!

Today in History:

The First Supreme Court (1789)

Muhammad completes Hegira (622)

Number of the Day: 3046

3046 = 2 x 1523

3046 is a centered heptagonal number

Fun Fact:

Des Moines has the highest per capita Jello consumption in the U.S.

Quote of the Day:

“Science is what you know. Philosophy is what you don't know.”

- Bertrand Russell

Today’s Weather:

Showers in the afternoon, high 72^{o}

Math 121

Quiz #15

Find $f'(x)$ for

$$f(x) = \frac{x^2 - 3x^4}{5x^6 + 7e^x}$$

$$f'(x) = \frac{(5x^6+7e^x)(2x-12x^3) - (x^2-3x^4)(30x^5+7e^x)}{(5x^6+7e^x)^2}$$

mpod # 15

(5) $f(x) = \dfrac{x^2+3x+5}{(3x+5)(\sqrt{x}+1)}$

$$f'(x) = \frac{[(3x+5)(\sqrt{x}+1)](2x+3) - [x^2+3x+5]\left[(3x+5)\left(\frac{1}{2}x^{-\frac{1}{2}}\right) + (\sqrt{x}+1)(3)\right]}{((3x+5)(\sqrt{x}+1))^2}$$

Pg 151

#39 $\frac{d}{dt}\left[\frac{xt-4}{t^2-x}\right]$ x IS CONST.

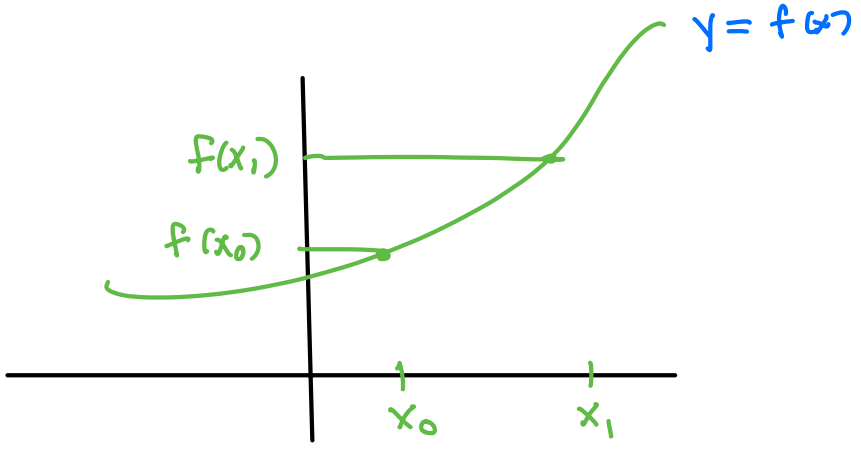
$$= \frac{(t^2-x)[x] - (xt-4)(2t)}{(t^2-x)^2}$$

MPOD #15

(7) $f(x) = \frac{x+x^2}{x^3}$

$$f'(x) = \frac{(x^3)(1+2x) - (x+x^2)(3x^2)}{(x^3)^2}$$

RATES OF CHANGE



$\Delta x = x_1 - x_0$

$\Delta y = f(x_1) - f(x_0)$

RATE OF CHANGE $= \frac{\Delta y}{\Delta x} = \frac{f(x_1)-f(x_0)}{x_1-x_0}$

$f'(x_0) = \lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x}$ = INST. RATE OF CHANGE

IF Δx IS "SMALL"

$$\frac{\Delta y}{\Delta x} \approx f'(x_0)$$

$$\Delta y \approx f'(x_0)\Delta x$$

EXAMPLE 1 $f(x) = \sqrt{x}$

$f(x)$ CHANGE IF x GOES FROM 1 TO 2

$$\Delta y \approx f'(x_0)\Delta x$$

$$f'(x) = \frac{1}{2}x^{-\frac{1}{2}} \qquad f'(1) = \frac{1}{2}$$

$$\Delta y \approx \frac{1}{2}\Delta x \qquad \Delta x = 2-1 = 1$$

$$\Delta y \approx \frac{1}{2}(1) = .5$$

$f(1) = \sqrt{1} = 1$

$f(2) = \sqrt{2} = 1.414.$

$f(2) - f(1) = .414$

WHAT IS THE CHANGE IN $f(x)$ IF x GOES FROM $4 \to 5$

$\Delta y \approx f'(x_0)\,\Delta x$

$f'(x) = \frac{1}{2\sqrt{x}}$ $\qquad f'(4) = \frac{1}{2\sqrt{4}} = \frac{1}{4}$

$\Delta y \approx \frac{1}{4}\Delta x$ $\qquad x \to 4 - 5$

$\Delta x = 5 - 4 = 1$

$\Delta y \approx \frac{1}{4}(1) = .25$

$f(4) = \sqrt{4} = 2$

$f(5) = \sqrt{5} = 2.236$

$f(5) - f(4) = .236$

WHAT IS THE CHANGE IF $x \to 1 - 9$

$\Delta y \approx f'(x_0)\Delta x$

$f'(x) = \frac{1}{2\sqrt{x}}$ $\qquad f'(1) = \frac{1}{2}$

$\Delta x = 9 - 1 = 8$

$\Delta y = \frac{1}{2}\Delta x$

$\Delta y = \frac{1}{2}(8) = 4$

$f(1) = 1$

$f(9) = 3$

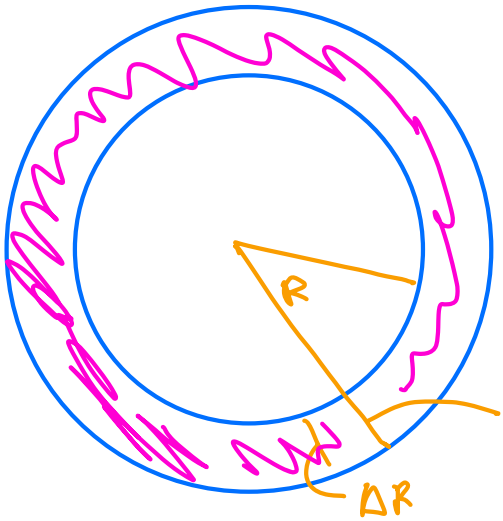
$f(9) - f(1) = 3 - 1 = 2$

EXAMPLE 2 CIRCLE

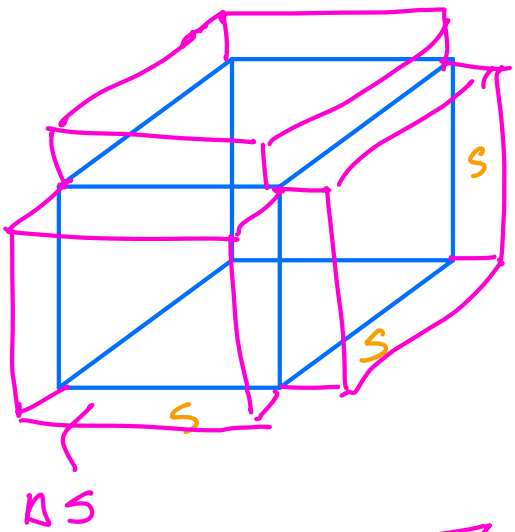
$A = \pi R^2$ $\qquad A' = 2\pi R$

$\frac{dA}{dR} = 2\pi R$

$\Delta A = 2\pi R\,\Delta R$



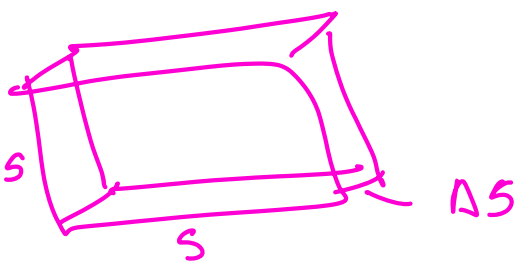
$2\pi R\,\Delta R$



$V = s^3$

$\frac{dV}{ds} = 3s^2$

$\Delta V \approx 3s^2\,\Delta s$



$3s^2\,\Delta s$

MARIGINAL COST

$C(x)$ COST TO MAKE x WIDGES

$C(x+1)$ COST TO MAKE ONE MORE

$$C'(x) \approx \frac{C(x+1) - C(x)}{x+1-x} = C(x+1) - C(x)$$

$$C(x+1) = C(x) + C'(x)$$

EXAMPLE $C(x) = .3x^3 + x^2$

MAKE 100 UNITS

HOW MUCH MORE TO MAKE 101

$$C'(x) = .9x^2 + 2x$$

$$C'(100) = .9(100)^2 + 2(100) = 9200$$

$$C(100) = (.3)(100)^3 + (100)^2 = 310{,}000$$

$$C(101) \approx C(100) + C'(100) = 310{,}000 + 9200$$

$$= 319{,}200$$

$$C(101) = (.3)(101)^3 + (100)^2 = 319\,291.30$$

$$C(101) - C(100) = 319{,}291.30 - 310{,}000$$

$$= 9291.3$$

$$S(t) = S_0 + V_0 t - \frac{1}{2} g t^2$$

S_0 INITIAL HEIGHT

V_0 INITIAL VEL.

g GRAVITY $\quad 9.8\ m/s^2$

$32\ ft/s^2$

$$\frac{ds}{dt} = v_0 - gt = v(t) \quad \text{VEL.}$$