

September 23, 2026

Redhead Appreciation Day

Today in History:

John Paul Jones victorious (1779)

Neptune is discovered (1846)

Number of the Day: 156

$$156 = 2 \times 2 \times 3 \times 13$$

A clock will strike **156** times in the course of a day.

Fun Fact:

The first couple to be shown in bed together on prime time TV were Fred and Wilma Flintstone.

Quote of the Day:

"If a man's wit be wandering, let him study the mathematics."

– Francis Bacon

Today's Weather:

Breezy with periods of rain, high 68°

Math 121

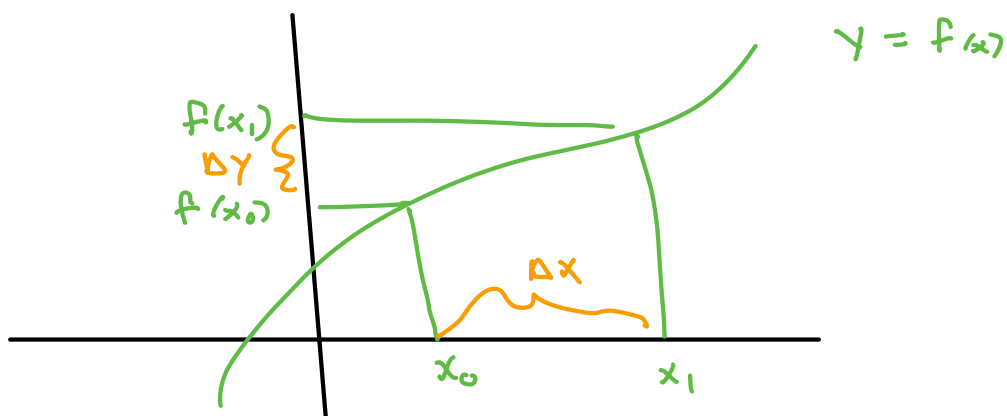
Quiz #15

Find $f'(x)$ for

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

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

RATES OF CHANGE



$$\Delta x = x_1 - x_0$$

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

AVER RATE
OF CHANGE

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

INST. RATE
OF CHANGE

$$\lim_{\Delta x \rightarrow 0} \frac{\Delta y}{\Delta x}$$

$$= \lim_{x_1 \rightarrow x_0} \frac{f(x_1) - f(x_0)}{x_1 - x_0} = f'(x_0)$$

IF Δx IS "SMALL"

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

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

EXAMPLE

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

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

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

$$x_0 = 1 \quad x_1 = 2$$

$$\Delta x = x_1 - x_0 = 2 - 1 = 1$$

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

$$f(1) = 1$$

$$\begin{aligned} f(2) &= f(1) + \Delta y \\ &= 1 + .5 = 1.5 \end{aligned}$$

$$f(2) = \sqrt{2} = 1.41$$

$$x_0 = 4$$

$$x_1 = 5$$

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

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

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

$$\Delta y = f'(4) \Delta x = \frac{1}{4}(1) = .25$$

$$f(4) = 2 \quad f(5) \approx f(4) + \Delta y \\ = 2 + .25 = 2.25$$

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

$$x_0 = 9 \quad x_1 = 10 \quad f(x) = \sqrt{x}$$

$$f'(x) = \frac{1}{2\sqrt{x}} \quad f'(9) = \frac{1}{2\sqrt{9}} = \frac{1}{6}$$

$$\Delta y \approx f'(9) \Delta x = \frac{1}{6} \cdot 1 = .16666$$

$$f(10) \approx f(9) + \Delta y \\ = 3 + .1666 \dots = 3.1666 \dots$$

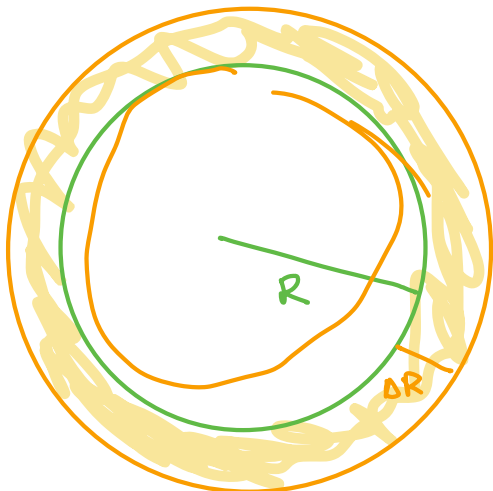
$$\sqrt{10} = 3.162$$

Example 2

$$A = \pi R^2$$

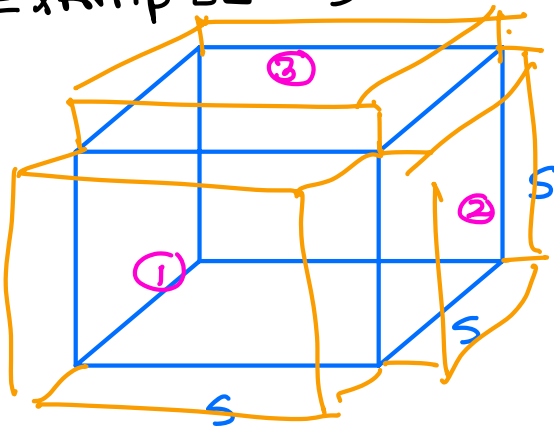
$$\frac{dA}{dR} = 2\pi R$$

$$\Delta A \approx 2\pi R \Delta R$$



$$2\pi R \Delta R$$

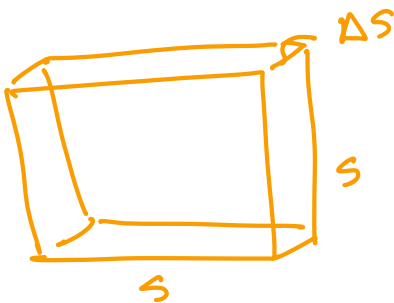
EXAMPLE 3



$$V = s^3$$

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

$$\Delta V = 3s^2 \Delta s$$



$$3s^2 \Delta s$$

MARGINAL COST

$C(x)$ IS COST TO MAKE x THINGS

$C(x+1)$ IS COST TO MAKE $x+1$ THINGS

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

COST TO MAKE
1 MORE

$$C'(x) \approx C(x+1) - C(x) \quad \text{MAR. COST}$$

$$C(x+1) \approx C(x) + C'(x)$$

EXAMPLE

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

MADE 100, How much is MAKE 101?

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

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

$$C(100) = 310,000$$

$$C(101) = 319,291.30$$

$$C(101) - C(100) = 9291.30$$

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

s_0 INITIAL HEIGHT

v_0 INITIAL VEL.

g GRAVITY

$$9.8 \text{ m/s}^2$$

$$32 \text{ ft/s}^2$$

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

EXAMPLE



WHEN DOES IT
HIT THE GROUND?

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

$$v_0 = 0$$

$$s_0 = 200$$

$$g = 9.8$$

$$s(t) = 200 - \frac{1}{2} (9.8) t^2$$

$$200 - \frac{1}{2} (9.8) t^2 = 0$$

$$t = 6.39 \text{ s}$$

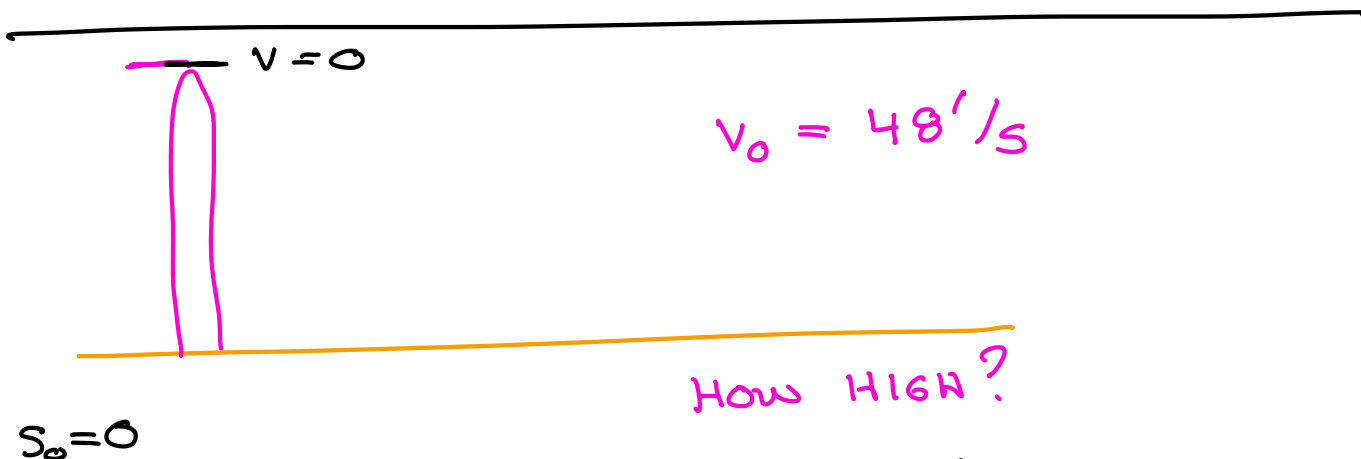
WHAT IS THE VELOCITY WHEN IT HITS?

$$s(t) = 200 - \frac{1}{2} (9.8) t^2$$

$$v(t) = -9.8 t$$

$$v(6.39) = (-9.8)(6.39)$$

$$62.6 \text{ m/s}$$



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

$$= 0 + 48 t - \frac{1}{2} 32 t^2$$

$$= 48 t - 16 t^2$$

$$v = \frac{ds}{dt} = 48 - 32 t = 0$$

$$t = \frac{3}{2}$$

$$s\left(\frac{3}{2}\right) = 48\left(\frac{3}{2}\right) - 16\left(\frac{3}{2}\right)^2$$
$$= 36 \text{ ft}$$