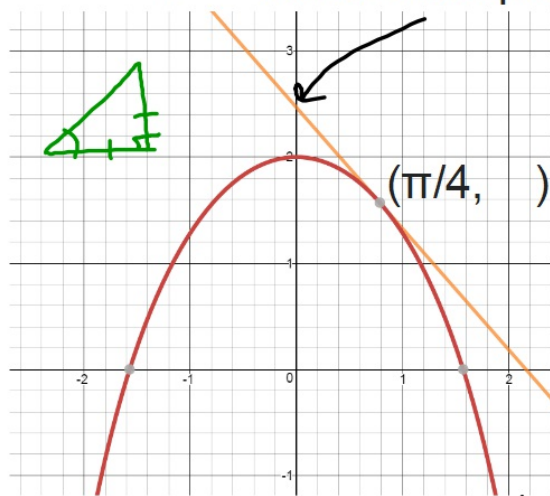


Warm up: 1 Write the equation of this line



$$y = \frac{2x}{\tan x}$$

$$y' = \frac{2(\frac{\pi}{4})}{\tan(\frac{\pi}{4})} = \frac{\frac{\pi}{2}}{1} = \frac{\pi}{2}$$

$$y - \frac{\pi}{2} = \square \left(x - \frac{\pi}{4}\right)$$

$$f: 2x \quad f': 2$$

$$g: \tan x \quad g': \sec^2 x$$

$$\frac{2 \tan x - 2x \sec^2 x}{\tan^2 x}$$

$$\left. \frac{dy}{dx} \right|_{x=\frac{\pi}{4}} = \frac{2(1) - 2(\frac{\pi}{4}) \sec^2(\frac{\pi}{4})}{(\tan \frac{\pi}{4})^2}$$

$$2 - \frac{\pi}{2} \cdot \sec^2(\frac{\pi}{4})$$

$$\frac{2 - \frac{\pi}{2}(2)}{2 - \pi}$$

$$\left[ \frac{1}{\cos(\frac{\pi}{4})} \right]^2 \rightarrow \left[ \frac{1}{\frac{\sqrt{2}}{2}} \right]^2 \rightarrow \left[ \frac{2}{\sqrt{2}} \right]^2 = 2$$

$$y - \frac{\pi}{2} = (2 - \pi) \left(x - \frac{\pi}{4}\right)$$

$$y - 1.57 = -1.146 \left(x - \frac{\pi}{4}\right)$$

Which of these doesn't belong?

$$f(x) = x^2 \sin(x)$$

$$h(x) = \sin(x^2)$$

$$g(x) = \frac{\sin x}{x^2}$$

$$j(x) = x^2 - \sin x$$

## The Chain Rule (very important!!!)

What is the derivative of  $y=\sin(x^2)$ ? Is it... $y'=\cos(2x)$ ??

<https://www.youtube.com/watch?v=DoZEpCqeYEU>

<https://www.desmos.com/calculator/d68amu80pp>

<https://youtu.be/YG15m2VwSjA?t=8m42s>

[https://youtu.be/S0\\_qX4VJhMQ?t=2m36s](https://youtu.be/S0_qX4VJhMQ?t=2m36s)

So, no, the derivative is not so simple.

First, note that  $y = \sin(x^2)$  is a *composite function*

### REVIEW

Suppose  $f(x) = x^2$  and  $g(x) = 5x - 3$

1. Find  $f(g(x))$  (don't simplify)  $(5x - 3)^2$

2. Simplify  $f(g(x))$   $25x^2 - 30x + 9$

3. Find  $\frac{d}{dx} f(g(x))$   $50x - 30$



So, if  $f=x^2$  and  $g=5x-3$

$$f(g(x)) = (5x-3)^2 = 25x^2-30x+9$$

Derivative of  $f(g(x))$  would be  $50x - 30$

$$50x - 30$$


$$10(5x-3)$$

$$2 \cdot 5(5x-3)'$$

$$2(5x-3)' \cdot 5$$



## The Chain Rule

$$\frac{d}{dx} [f(g(x))] = f'(g(x)) \cdot g'(x)$$


The diagram illustrates the chain rule with three icons. The first icon, located under the function  $f$ , shows a group of people celebrating. The second icon, under the inner function  $g(x)$ , also shows a group of people celebrating. A red arrow points from the second icon to the third icon, which shows a person riding a horse. This visualizes the relationship where the derivative of the outer function is evaluated at the inner function, and then multiplied by the derivative of the inner function.



Find  $f'(x)$  for  $f(x) = (5x-3)^2$

$$\frac{d}{dx} f(g(x)) = f'(g(x)) \cdot g'(x)$$

$$f' = 2(5x-3)' \cdot 5$$
$$= 10(5x-3)$$

Find  $h'(x)$  for  $h(x) = (5x-3)^{100}$

$$h'(x) = 100(5x-3)^{99} \cdot 5$$

$$500(5x-3)^{99}$$



Find  $dy/dx$  where  $y = \sec(\underline{3x^2+2})$

$$\frac{d}{dx} \sec(\underline{3x^2+2})$$

$$\sec(\underline{3x^2+2}) + \tan(\underline{3x^2+2}) \cdot 6x$$

$$\frac{d}{dx} \sec(\dots) = \sec(\dots) \tan(\dots)$$





Differentiate:  $y = [\cos(4x-3)]^{50}$

$$\frac{dy}{dx} = \underbrace{50}_{\text{green}} \underbrace{[\cos(4x-3)]^{49}}_{\text{orange}} \cdot \underbrace{-\sin(4x-3)}_{\text{orange}} \cdot \underbrace{4}_{\text{green}}$$
$$= \underline{200} \sin(4x-3) [\cos(4x-3)]^{49}$$



HW due Friday

frontside: #1-<sup>12</sup>~~10~~ pick ~~8~~ 10

~~backside: #451-467 pick any 8~~

R. Kelly - Remix to Ignition