Good afternoon: warm up: Find g'(1)

$$g(x) = 2^{x^2}$$

$$g'(x) = 2^{x^2} \cdot \ln 2 \cdot 2x$$

$$g'(1) = 2^{1^2} \cdot \ln 2 \cdot 2(1)$$

$$2 \cdot \ln 2 \, (2)$$

$$\rightarrow 4 \ln 2$$

$$\ln 2^4 \rightarrow \boxed{\ln 16}$$

$$\frac{d}{dx} e^x = e^x$$

$$\frac{d}{dx} a^{\blacksquare} = a^{\blacksquare} \cdot \ln a \cdot \blacksquare'$$

assessment: Monday (practice coming Thursday)

Second warm up!

Write the equation of the line tangent to $y=x^3e^x$ at the point where $x=1$

$$y - y_1 = m(x - x_1)$$

Value @ $x=1$?

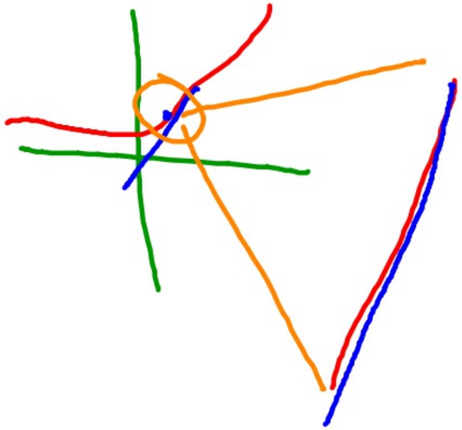
$$y(1) = 1^3 \cdot e^1 = 1 \cdot e = e \qquad (1, e)$$

Slope @ $x=1$?

$$\frac{dy}{dx} = x^3 \cdot e^x \xrightarrow{} \text{Product rule} \xrightarrow{} 3x^2e^x + x^3 \cdot e^x$$

$$\left.\frac{dy}{dx}\right|_{x=1} = 3 \cdot 1^2 \cdot e + 1^3 \cdot e^1 \rightarrow$$

$$3e + e = \underline{\underline{4e}}$$



$$\boxed{y - e = 4e(x-1)}$$

Point-slope

$$y = 4e \cdot x - 4e$$

$$\boxed{y = 4ex - 3e}$$

A few more exp and log examples:

$f(x) = \log_{10}(5x+3)$

$$\frac{1}{(5x+3)\cdot \ln 10}\cdot 5$$

$$\boxed{\frac{5}{(\ln 10)(5x+3)}}$$

$g(x) = e^{x^2}(x^2+2)$

uh...

$h(x)=5(3)^{2x}$

$$h'(x) = 5(3)^{2x}\cdot \ln 3\cdot 2$$

$$\boxed{(10)(\ln 3)(3^{2x})}$$

$$\frac{d}{dx}a^x = a^x \cdot \ln a$$

$j(x)=\ln(\sec(x))$

$$\frac{d}{dx}\log_a x = \frac{1}{x\ln a}$$

$$\frac{1}{\sec(x)}\cdot \sec(x)\cdot \tan(x)$$

$$\frac{\cancel{\sec(x)}\tan(x)}{\cancel{\sec(x)}} \boxed{= \tan(x)}$$

$$g(x) = \underbrace{e^{x^2}}_{f} \cdot \underbrace{(x^2+2)}_{g}$$

$$f'g + fg'$$

$$f': e^{x^2} \cdot 2x$$

$$g': 2x$$

$$\left[e^{x^2} \cdot 2x \cdot (x^2+2)\right] + \left[e^{x^2} \cdot 2x\right]$$

$$e^{x^2} \cdot 2x\left(x^2+2+1\right)$$

$$\boxed{e^{x^2} \cdot 2x\,(x^2+3)}$$

Your history with functions

Constant
Linear
Absolute Value
Quadratic
Cubic, Quartic, Polynomial
Rational
Exponential
Logarithmic
Trigonometric
Inverse Trigonometric

Can you take its derivative?

Inverse Trig Derivatives

First: what even is an inverse trig function??

ex/ $\sin(\theta) = \text{ratio}$

$\cos$ " "

$\tan$ " "

$\sin^{-1}(\text{ratio}) = \theta$

$\cos^{-1}($ " $)$ "

$\tan^{-1}($ " $)$ "

$\text{arcsin}($ ⋮ $)$ ⋮

$\text{arccos}($ $)$

$\text{arctan}($ $)$

Find the derivative of y=arcsin(x)

x: ratio
y: angle

invert

$\sin(y) = x$

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

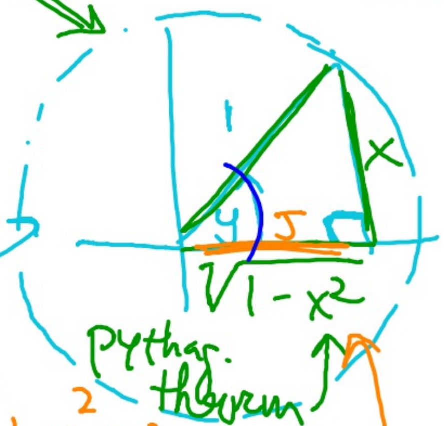
$\sin(3x) \rightarrow \cos(3x)\cdot 3$

$\frac{d}{dx}\sin(y) = \frac{d}{dx}x$

$\cos(y)\cdot\frac{dy}{dx} = 1$

$\frac{dy}{dx} = \frac{1}{\cos(y)}$

SOH CAH TOA



$J^2 + x^2 = 1^2$

$J^2 = 1 - x^2$

$J = \sqrt{1-x^2}$

$\cos(y) = \frac{\sqrt{1-x^2}}{1}$ $\frac{\text{adj.}}{\text{hyp}}$

$\cos(y) = \sqrt{1-x^2}$

$\frac{dy}{dx} = \frac{1}{\sqrt{1-x^2}}$

Inverse Trig Derivatives (the last rules to remember!!)

$$\frac{d}{dx}\left(\sin^{-1} x\right) = \frac{1}{\sqrt{1-x^2}}$$

$$\frac{d}{dx}\left(\cos^{-1} x\right) = -\frac{1}{\sqrt{1-x^2}}$$

$$\frac{d}{dx}\left(\tan^{-1} x\right) = \frac{1}{1+x^2}$$

$$\frac{d}{dx}\left(\cot^{-1} x\right) = -\frac{1}{1+x^2}$$

$$\frac{d}{dx}\left(\sec^{-1} x\right) = \frac{1}{|x|\sqrt{x^2-1}}$$

$$\frac{d}{dx}\left(\csc^{-1} x\right) = -\frac{1}{|x|\sqrt{x^2-1}}$$

Find f '(2)   if f(x)=arctan(3x)

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

$$\frac{d}{dx}\tan^{-1}(x) = \frac{1}{1+x^2}$$

$$\frac{3}{1+9x^2}$$

$$\cancel{\frac{3}{1+3x^2}}$$

Find g'(x) if g(x)=arccos(x^2)

$$g'(x) = -\frac{1}{\sqrt{1-(x^2)^2}} \cdot 2x$$

$$-\frac{2x}{\sqrt{1-x^4}}$$

We can now take derivatives of every function type!!

But, algebraically is only one of 4 lenses we view calculus

Verbally, Numerically, Algebraically, Graphically

HW
keep working on handout from yesterday
choose 6 from each of the 3 sections