<u>Homework for Test #2 on Derivatives</u>

Test 2 - Wed. 9/23?

HW #5 due Friday, 9/11
- 2.1 #1-23 odd Find the derivative by the limit process
- 2.1 #29-32 all find the equation of the tangent line
- 2.1 #61-69 odd Use the alternate form to find the derivative
- 2.1 #71-79 odd Describe x-values where the function is differentiable (given graph)

HW #6 due Monday, 9/14
- 2.2 #3-51 odd Find the derivative using the basic derivative rules
- 2.2 #91-94 all; 101, 102 use the derivative to solve rate of change word problem
- 2.3 #1-53 odd, 63-69 odd, Product and quotient rules

HW #7 due Wed. 9/16
- 2.3 #75-81 all, 83-91 odd, 109-115 all Rates of change, second derivatives
- 2.4 #7-33 odd, 47-81 odd Chain rule

HW #8 due Tues. 9/22

HW #9 due Wed. 9/23
- 5.1 #45-61 odd, 71 Logarithmic functions
- 5.4 #39-57 odd Exponential functions
- 5.5 #41-55 odd Log and exp functions with other bases
- 5.8 #41-59 odd Inverse trig functions

Recommended:
Work through intuitive exercises on **Khan Academy**:
- Slope of secant lines
- Tangent lope is limiting value of secant slope
- Derivative intuition
- Visualizing derivatives
- Graphs of functions and their derivatives
- The formal and alternate form of the derivative
- Derivatives 1
- Recognizing slopes of curves
- Power rule
- Special derivatives

$$\left[2^{f(x)}\right]' = 2^{f(x)} \cdot \ln 2 \cdot f'(x)$$

$$\left[\left[f(x)\right]^2\right]' = 2 \cdot f(x) \cdot f'(x)$$

$$\left[2^{\left([f(x)]^2\right)}\right]' = 2^{f^2(x)} \cdot \ln 2 \cdot 2f(x) \cdot f'(x)$$

2.3 #80

$[0, 2\pi)$

$f(x) = \sec x$ & $g(x) = \csc x$

$\sec x \tan x = -\csc x \cot x$

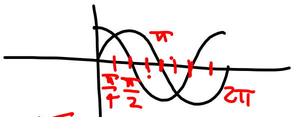
$\sec x \tan x + \csc x \cot x = 0$

$\frac{1}{\cos x} \cdot \frac{\sin x}{\cos x} + \frac{1}{\sin x} \cdot \frac{\cos x}{\sin x} = 0$

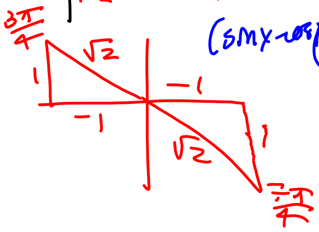
$\frac{\sin^3 x + \cos^3 x}{\cos^2 x \sin^2 x} = 0$

$0 = \frac{(\sin x + \cos x)(\sin^2 x - \sin x \cos x + \cos^2 x)}{\cos^2 x \sin^2 x}$

$\sin x + \cos x = 0$




$\frac{3\pi}{4}$ & $\frac{7\pi}{4}$




$(\sin x - \cos x)(\sin x + \cos x) = 0 \cdot (\sin x - \cos x)$

$\sin^2 x - \cos^2 x = 0$

$-\cos 2x = 0$

$\cos 2x = 0$

$2x = \frac{\pi}{2}, \frac{3\pi}{2}, \frac{5\pi}{2}, \frac{7\pi}{2}$

$x = \cancel{\frac{\pi}{4}}, \frac{3\pi}{4}, \cancel{\frac{5\pi}{4}}, \frac{7\pi}{4}$

$x = \frac{c}{y}$

$P = \frac{c}{V} = cV^{-1}$

$P' = \frac{-c}{V^2}$

$$C = 100\left(\frac{200}{x^2} + \frac{x}{x+30}\right)$$

$$= 20000x^{-2} + 100x(x+30)^{-1}$$

$$C'(x) = -40000x^{-3} + 100(x+30)^{-1} + 100x\left(-(x+30)^{-2}\right)$$

$y = \sin x$

output is ratio of sides

input is an angle

$y = \sin^{-1} x$

output is angle

input is ratio of sides

$\sin^{-1} x =$

$\arcsin x$

$[x^n]' = nx^{n-1}$

$[cf(x)]' = c \cdot f'(x)$

$[f(x) \pm g(x)]' = f'(x) \pm g'(x)$

$[f(x)g(x)]' = f'(x)g(x) + g'(x)f(x)$

$\left[\frac{f(x)}{g(x)}\right]' = \frac{g(x)f'(x) - g'(x)f(x)}{[g(x)]^2}$

$[f(g(x))]' = f'(g(x)) \cdot g'(x)$

$[e^x]' = e^x$

$[a^x]' = a^x \cdot \ln a$

$[\ln x]' = \frac{1}{x}$

$[\log_a x]' = \frac{1}{x \ln a}$

$[\sin x]' = \cos x$

$[\cos x]' = -\sin x$

$[\tan x]' = \sec^2 x$

$[\cot x]' = -\csc^2 x$

$[\sec x]' = \sec x \tan x$

$[\csc x]' = -\csc x \cot x$

$[\arcsin x]' = \frac{1}{\sqrt{1-x^2}}$

$[\arctan x]' = \frac{1}{1+x^2}$

$[\operatorname{arcsec} x]' = \frac{1}{|x|\sqrt{x^2-1}}$

$[\arccos x]' = \frac{-1}{\sqrt{1-x^2}}$

$[\operatorname{arccot} x]' = \frac{-1}{1+x^2}$

$[\operatorname{arccsc} x]' = \frac{-1}{|x|\sqrt{x^2-1}}$

5.8

44. $f(x) = \operatorname{arcsec} 2x$

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

48. $h(x) = x^2 \arctan x$

$h'(x) = \boxed{2x \arctan x + x^2 \cdot \frac{1}{1+x^2}}$

52. $y = \ln(t^2+4) - \frac{1}{2}\arctan\frac{t}{2}$

$y' = \boxed{\frac{1}{t^2+4} \cdot 2t - \frac{1}{2} \cdot \frac{1}{1+(t/2)^2} \cdot \frac{1}{2}}$

$\frac{d}{dx}[\arcsin x] = \frac{1}{\sqrt{1-x^2}}$

$\frac{d}{dx}[\arctan x] = \frac{1}{1+x^2}$

$\frac{d}{dx}[\operatorname{arcsec} x] = \frac{1}{|x|\sqrt{x^2-1}}$

$\frac{d}{dx}[\arccos x] = \frac{-1}{\sqrt{1-x^2}}$

$\frac{d}{dx}[\operatorname{arccot} x] = \frac{-1}{1+x^2}$

$\frac{d}{dx}[\operatorname{arccsc} x] = \frac{-1}{|x|\sqrt{x^2-1}}$

$\frac{t}{2} = \frac{1}{2}t$

56. $y = x \arctan 2x - \frac{1}{4}\ln(1+4x^2)$

$$y' = \boxed{1 \cdot \arctan 2x + x \cdot \frac{1}{1+(2x)^2} \cdot 2 - \frac{1}{4} \cdot \frac{1}{1+4x^2} \cdot 8x}$$

$$\frac{d}{dx}[\arcsin x] = \frac{1}{\sqrt{1-x^2}}$$
$$\frac{d}{dx}[\arctan x] = \frac{1}{1+x^2}$$
$$\frac{d}{dx}[\text{arcsec}\, x] = \frac{1}{|x|\sqrt{x^2-1}}$$
$$\frac{d}{dx}[\arccos x] = \frac{-1}{\sqrt{1-x^2}}$$
$$\frac{d}{dx}[\text{arccot}\, x] = \frac{-1}{1+x^2}$$
$$\frac{d}{dx}[\text{arccsc}\, x] = \frac{-1}{|x|\sqrt{x^2-1}}$$

Find the second derivative

80. $f(x) = \frac{1}{x-2} = (x-2)^{-1}$

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

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

*Find the second derivative.*

82. $f(x) = \sec^2 \pi x = [\sec \pi x]^2$

$$f'(x) = 2\sec\pi x \cdot \sec\pi x \tan\pi x \cdot \pi$$
$$= 2\pi \sec^2 \pi x \tan \pi x$$
$$= (2\pi \tan\pi x)(\sec^2 \pi x)$$

$$f'(x) = (2\pi\tan\pi x)'(\sec^2\pi x) + (2\pi\tan\pi x)(\sec^2\pi x)'$$
$$= 2\pi\sec^2\pi x \cdot \pi \cdot \sec^2\pi x + 2\pi\tan\pi x \cdot 2\pi\tan\pi x \sec^2\pi x$$
$$= \boxed{2\pi^2\sec^4\pi x + 4\pi^2\tan^2\pi x \sec^2\pi x}$$