WARMUP!!

We know that d/dx sinx = cosx and d/dx cosx = -sinx.

Use this information (along with product/quotient rules where necessary) to derive the derivatives of tanx, cotx, secx, and cscx.

$$y = \tan x = \frac{\sin x}{\cos x}$$

$$y' = \frac{\cos x \cdot \cos x - \sin x(-\sin x)}{\cos^2 x}$$

$$= \frac{\cos^2 x + \sin^2 x}{\cos^2 x} = \frac{1}{\cos^2 x} = \sec^2 x$$

$$y = \sec x = \frac{1}{\cos x}$$

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

$$= \frac{\sin x}{\cos x} \cdot \frac{1}{\cos x} = \sec x \tan x$$

(25) $f(x) = \dfrac{3-2x-x^2}{x^2-1}$

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

$$= \frac{-2x^2-2x^3+2+2x-6x+4x^2+2x^3}{(x^2-1)^2}$$

$$= \frac{2x^2-4x+2}{(x^2-1)^2} = \frac{2(x-1)(x-1)}{(x^2-1)^2}$$

$$(x+1)(x-1)(x+1)(x-1)$$

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

25a $f(x) = \dfrac{3-2x-x^2}{x^2-1} = \dfrac{(-x+1)(x+3)}{(x+1)(x-1)}$

$= \dfrac{-(x+3)}{x+1}$

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

$= \dfrac{2}{(x+1)^2}$

(27) $f(x) = x\left(1 - \frac{4}{x+3}\right)$

$= x - \frac{4x}{x+3} = \frac{x^2+3x-4x}{x+3}$

$= \frac{x^2-x}{x+3}$

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

(31) $h(s) = (s^3 - 2)^2 = s^6 - 4s^3 + 4$

$h'(s) = 6s^5 - 12s^2$

(35) $f(x) = (3x^3 + 4x)(x - 5)(x + 1)$

$= (3x^3 + 4x)(x^2 - 4x - 5)$

$\ddots$

(33) $f(x) = \dfrac{2 - \frac{1}{x}}{x - 3} = \dfrac{2x - 1}{x^2 - 3x}$

$\therefore$

2.3b The rest of Trig and higher order derivatives!!

ESSENTIAL LEARNING TARGETS

At the end of this lesson, you will be able to:

- calculate derivatives of selected functions including trigonometric
- repeat the differentiation process to find higher order derivatives
- express higher order derivatives using the various methods of correct notation

In a nutshell,

If $y = \sin x$, then $y' = \cos x$

If $y = \cos x$, then $y' = -\sin x$

If $y = \sec x$, then $y' = \sec x \tan x$

If $y = \csc x$, then $y' = -\csc x \cot x$

If $y = \tan x$, then $y' = \sec^2 x$

If $y = \cot x$, then $y' = -\csc^2 x$

What do all of the functions that begin with 'c' have in common?

You Try!!

ex) y = xtanx - 3xsecx, find y'

$y' = \tan x + x\sec^2 x - 3\sec x - 3x\sec x\tan x$

ex) $y = \dfrac{\cot x}{x}$, find dy/dx

$y' = \dfrac{x(-\csc^2 x) - \cot x}{x^2}$

$= \dfrac{-x\csc^2 x - \cot x}{x^2}$

a) -5 b) infinity c) -5 d) DNE e) 1 f) 1 g) 4
h) 1 i) -2 j) -2 k) und l) -2

Higher Order Derivatives

If $y = 2x^5 + x^4 - 3x^3 - 8x^2 + 10x - 12$, find y''''

$y' = 10x^4 + 4x^3 - 9x^2 - 16x + 10$

$y'' = 40x^3 + 12x^2 - 18x - 16$

$y''' = 120x^2 + 24x - 18$

$\boxed{y'''' = 240x + 24}$

Notation: $y' = \frac{dy}{dx}$ $y'' = \frac{d^2y}{dx^2}$ $y''' = \frac{d^3y}{dx^3}$ ...

$y'' = \frac{d}{dx}\frac{dy}{dx}$

$y''' = \frac{d}{dx}\frac{d^2y}{dx^2}$

$y^{(5)} = \frac{d^5y}{dx^5} = y^{(5)}$

$f''''(x) = f^{(5)}(x) = f^{V}(x)$

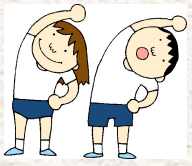
You try!

ex) If $y = 3x\sec x$, find d^2y/dx^2

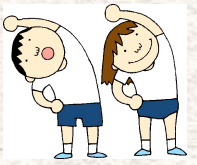
$$y' = 3\sec x + 3x\sec x\tan x$$

$$\frac{d^2y}{dx^2} = 3\sec x\tan x + 3\sec x\tan x + 3x\sec x\tan x\cdot\tan x + 3x\sec x\cdot\sec^2 x$$

$$= 6\sec x\tan x + 3x\sec x\tan^2 x + 3x\sec^3 x$$



REVIEW!!



1) What does $\frac{f(x+h)-f(x)}{h}$ represent? — slope of secant

2) What is a derivative? — slope of tangent

3) What is the derivative of a constant? — 0

4) What does $\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ represent? — derivative (slope of tangent)

5) $\frac{d(x^3)}{dx}=?$ — $3x^2$

6) What is f '(3) if f(x) = $4x^2$? — f '(x) = 8x; f '(3) = 24

7) What is the derivative of cosx? — -sinx

8) What is $\frac{d(7\sin\theta)}{d\theta}$? — 7cosθ

What have we learned?

- Can I state the derivatives of all six trig functions?
- Can I apply product/quotient rules to these derivatives?
- Can I recognize the notation for higher order derivatives and evaluate them correctly?