Derivative of the Tangent Function

Ex.1 Evaluate $\frac{d}{dx} tan(x)$

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

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

$= \frac{d}{dx}\left(\frac{\sin x}{\cos x}\right)$

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

$\sin^2 x + \cos^2 x = 1$

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

$= \frac{1}{\cos^2 x}$

$= \sec^2 x$

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$$\frac{d}{dx}(tanx) = sec^2 x$$

Chain Rule:

Given $y = tan\left[g(x)\right]$

$$\frac{dy}{dx} = sec^2\left[g(x)\right] g'(x)$$

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Ex. Determine the first derivative for each.

(a) $f(x) = \tan(4x)$ (b) $f(x) = \sin(x)\tan(x)$

(c) $y = \tan^2(\sqrt{x})$ (d) $y = \ln(\tan(x^3))$

(a) $f'(x) = \sec^2(4x)\cdot(4)$

$= 4\sec^2(4x)$

(b) $\frac{df}{dx} = \cos x \tan x + \sin x \sec^2 x$

1 $= \cancel{\cos x}\,\frac{\sin x}{\cancel{\cos x}} + \frac{\sin x}{\cos^2 x}$ $\cos x \neq 0$

2 $= \cos x \tan x + \tan x \sec x$

$= \tan x\,(\cos x + \sec x)$

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(c) $y' = \cancel{2}(\tan\sqrt{x})\cdot(\sec^2\sqrt{x})\cdot\frac{1}{\cancel{2}}x^{-\frac{1}{2}}$

$= \frac{\tan\sqrt{x}\,\sec^2\sqrt{x}}{\sqrt{x}}$

(d) $\frac{dy}{dx} = \frac{1}{\tan x^3}\cdot(\sec^2 x^3)(3x^2)$

$= \frac{3x^2\sec^2(x^3)}{\tan(x^3)}$

$\sec^{-1}x$ inverse

$(\sec x)^{-1}$ reciprocal

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Assigned Work:

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