$\frac{d}{dx}(\sec x) = \frac{d}{dx}\left(\frac{1}{\cos x}\right)$

$= \frac{0 \cdot \cos x - (-\sin x)\cdot 1}{\cos^2 x}$

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

$\frac{d}{dx}(\sec x) = \tan x \cdot \sec x$.

$\frac{d}{dx}(\csc x) = \frac{d}{dx}\left(\frac{1}{\sin x}\right) = \frac{0\cdot\sin x - \cos x \cdot 1}{\sin^2 x}$

$= \frac{-\cos x}{\sin^2 x} = \frac{-\cos x}{\sin x}\cdot\frac{1}{\sin x} = -\cot x \cdot \csc x$

Sep 26-4:27 PM

$\frac{d}{dx}(\sin x) = \cos x$ $\quad \frac{d}{dx}(\tan x) = \sec^2 x$

$\frac{d}{dx}(\cos x) = -\sin x$ $\quad \frac{d}{dx}(\cot x) = -\csc^2 x$

$\frac{d}{dx}(\sec x) = \sec x \tan x$ $\quad \frac{d}{dx}(\csc x) = -\csc x \cot x$.

E.g. Let $f(x) = \csc x + x\tan x$. Find $f'(x)$.

$f'(x) = -\csc x \cot x + 1\cdot\tan x + x\sec^2 x$

$= -\csc x \cot x + \tan x + x\sec^2 x$.

Sep 26-4:30 PM

$f(x) = \cot x$. Find the equation of the tangent line to the graph of f at $x = \frac{\pi}{4}$.

$f'(x) = -\csc^2 x$

$f'\left(\frac{\pi}{4}\right) = -\csc^2\left(\frac{\pi}{4}\right) = -\frac{1}{\sin^2\left(\frac{\pi}{4}\right)} = -\frac{1}{\left(\frac{\sqrt{2}}{2}\right)^2} = -\frac{1}{\frac{1}{2}}$

$= -2$.

Slope $= -2$.

Point $\left(\frac{\pi}{4}, 1\right)$

Equation of the tangent line: $y - 1 = -2\left(x - \frac{\pi}{4}\right)$

$y = -2x + \frac{\pi}{2} + 1$

Sep 26-4:33 PM

Higher-order derivatives of $y = \sin x$ and $y = \cos x$.

$y = \sin x$.

$\frac{dy}{dx} = \cos x$ $\quad \frac{d^3y}{dx^3} = -\cos x$ $\quad \frac{d^{243}y}{dx^{243}} = -\cos x$

$\frac{d^2y}{dx^2} = -\sin x$ $\quad \frac{d^4y}{dx^4} = \sin x$

$\frac{d^{2016}y}{dx^{2016}} = \sin x$; $\frac{d^{2017}y}{dx^{2017}} = \cos x$

In general, $\frac{d^n y}{dx^n}$ where $y = \sin x$. look at remainder. Divide n by 4.

Sep 26-4:36 PM

$y = \cos x$

$\frac{dy}{dx} = -\sin x$ $\quad \frac{d^3y}{dx^3} = \sin x$

$\frac{d^2y}{dx^2} = -\cos x$ $\quad \frac{d^4y}{dx^4} = \cos x$.

$\frac{d^n y}{dx^n}$

Sep 26-4:41 PM