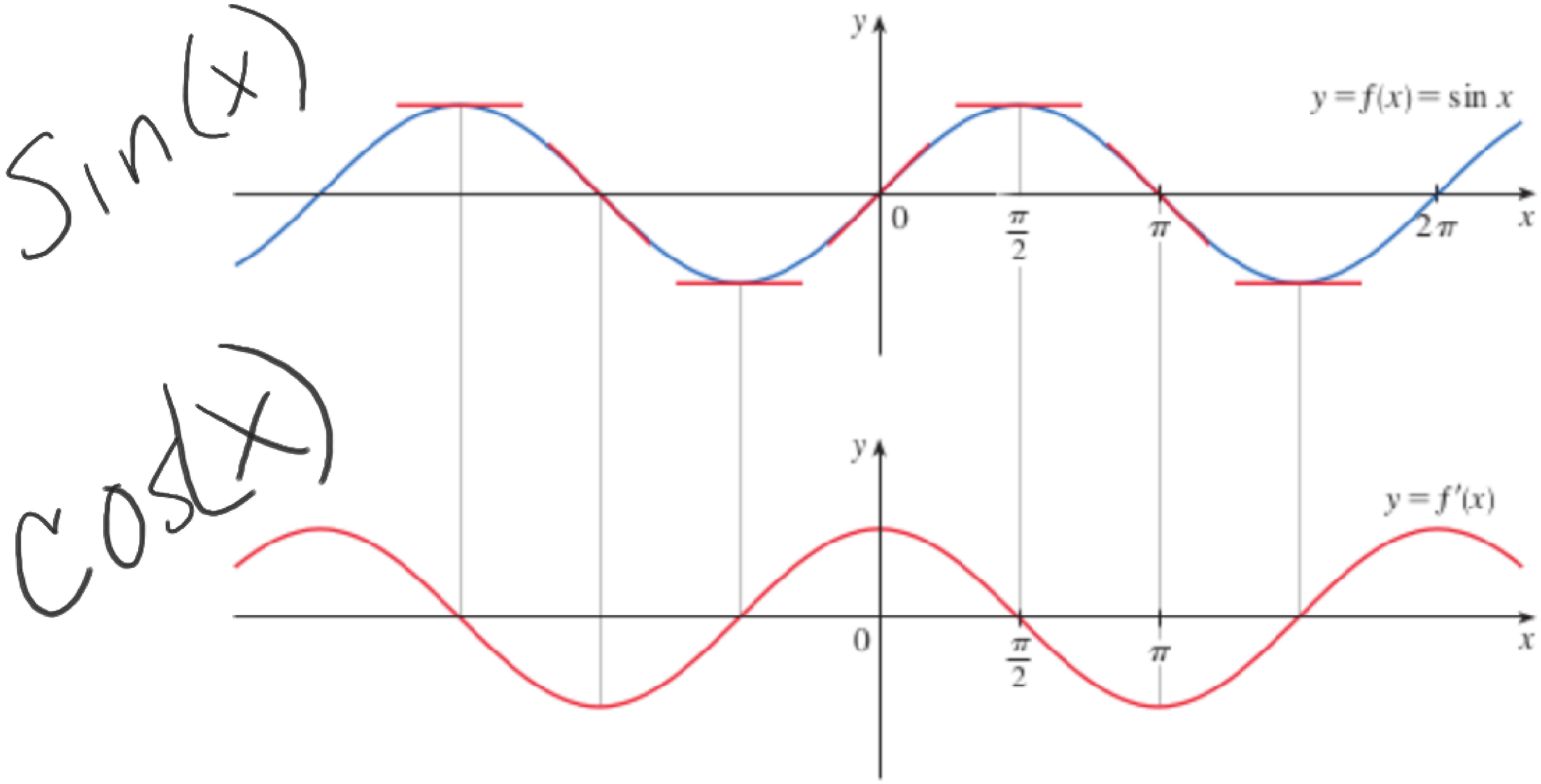
Figure 1.



$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h} = \lim_{h \to 0} \frac{\sin(x+h) - \sin x}{h}$$

$$\sin(x+h) = \sin x \cos h + \cos x \sin h$$

$$\lim_{h \to 0} \frac{\sin x \cos h + \cos x \sin h - \sin x}{h}$$

$$\lim_{h \to 0} \frac{\sin x \cos h - \sin x}{h} + \frac{\cos x \sin h}{h}$$

$$\lim_{h\to 0} \frac{\sin x\cos h - \sin x}{h} + \frac{\cos x \sin h}{h}$$

$$\lim_{h\to 0} \underline{\sin x}\,\boxed{\left(\frac{\cos h - 1}{h}\right)} + \underline{\cos x}\,\boxed{\left(\frac{\sin h}{h}\right)}$$

$$\sin x \lim_{h\to 0}\left(\frac{\cos h - 1}{h}\right) + \cos x \lim_{h\to 0}\frac{\sin h}{h}$$

$$\sin x\,(0) + \cos x\,(1)$$

$$f(x) = \sin x \qquad f'(x) = \cos x$$

$$\lim_{\theta \to 0} \frac{\sin\,\theta}{\theta} = 1$$

$$\lim_{\theta \to 0} \frac{\cos\,\theta - 1}{\theta} = 0$$

Differentiate $y = x^2 \sin x$ $\quad y' =$

$f(x) = x^2 \quad f'(x) = 2x$

$g(x) = \sin x \quad g'(x) = \cos x$

$$y' = (2x)\sin x + (\cos x)(x^2)$$

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

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

Find the 27 th derivative of $\cos\ x$

$y = \sin x$

$y' = \cos x$ (1)

$y'' = -\sin x$ (2)

$y^{(3)} = -\cos x$ (3)

$y^{(4)} = \sin x$ (4)

$\frac{27}{4} = 6\ r\ 3$

3rd $= -\cos x$

$\boxed{27^{th} = -\cos x}$

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

$$f(x) = \sin x \qquad f'(x) = \cos x$$

$$g(x) = \cos x \qquad g'(x) = -\sin x$$

$$y' = \frac{\underbrace{(\cos x)(\cos x)}_{\cos^2 x} - \underbrace{(-\sin x)(\sin x)}_{+\sin^2 x}}{\cos^2 x} \quad \cos^2 x + \sin^2 x = 1$$

$$y' = \frac{1}{\cos^2 x} = \boxed{\sec^2 x}$$

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

$$\frac{d}{dx}(\csc\ x) = -\csc\ x \cot\ x$$

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

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

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

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

Differentiate $f(x) = \dfrac{\sec x}{1+\tan x}$. For what values of x does the graph of f have a horizontal tangent?

$m(x) = \sec x \quad m'(x) = \sec x \tan x$

$n(x) = 1 + \tan x \quad n'(x) = \sec^2 x$

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

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

$$= \frac{\sec x(\tan x + \boxed{\tan^2 x - \sec^2 x})}{(1+\tan x)^2}$$

$\sec^2 x = \tan^2 x + 1$

$\sec^2 x - \tan^2 x = 1$

$\tan^2 x - \sec^2 x = \boxed{-1}$

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

$\sec x(\tan x - 1)$

$\tan x = 1$

$$\boxed{x = \frac{\pi}{4} + n\pi}$$

Find $\lim_{x\to 0} \frac{\sin 7x}{4x} \cdot \frac{7}{7}$

$$\lim_{\theta \to 0} \frac{\sin \theta}{\theta} = 1$$

$$\lim_{x\to 0} \frac{7\sin 7x}{4\cdot 7x} = \frac{7}{4} \boxed{\lim_{x\to 0} \frac{\sin 7x}{7x}} = 1$$

$$\lim_{x\to 0} \frac{\sin 7x}{4x} = \boxed{\frac{7}{4}}$$

Calculate $\lim_{x \to 0} x \cot x$ $\rightarrow$ $\dfrac{x \cos x}{\sin x}$

$$\boxed{\lim_{x \to 0} \frac{\sin x}{x} = 1}$$

$$\frac{\frac{x \cos x}{x}}{\frac{\sin x}{x}} = \frac{\cos x}{\sin x / x} = \frac{1}{1} = \boxed{1}$$

$g(x) = 3x + \boxed{x^2 \cos x}$

$m(x) = x^2 \quad m'(x) = 2x$

$n(x) = \cos x \quad n'(x) = -\sin x$

$g'(x) = 3 + \left[(2x)(\cos x) + (-\sin x)(x^2)\right]$

$$\boxed{g'(x) = 3 + 2x\cos x - x^2 \sin x}$$

$$f(t) = \frac{\cot t}{e^t}$$

$m(x) = \cot x \qquad m'(x) = -\csc^2 x$

$n(x) = e^x \qquad n'(x) = e^x$

$$f'(x) = \frac{(-\csc^2 x)(e^x) - (e^x)(\cot x)}{(e^x)^2}$$

$$\boxed{f'(x) = \frac{-\csc^2 x - \cot x}{e^x}}$$

$$y = x + \sin x, \qquad (\pi, \pi)$$

(-1)

$y' = 1 + \cos x$ $\quad x = \pi \quad y' = 1 + \cos \pi$

$y' = 0$

Tangent Line

$y = 0x + b \rightarrow \boxed{y = \pi}$

$\pi = 0\pi + b$

$\pi = b$

$f(x) = e^x \cos x$, find $f'(x)$ and $f''(x)$

$$\boxed{\begin{aligned} m(x) &= e^x & m'(x) &= e^x \\ n(x) &= \cos x & n'(x) &= -\sin x \end{aligned}}$$

$$f'(x) = e^x \cos x + (-\sin x)(e^x)$$

$p(x) = \sin x$

$p'(x) = \cos x$

$$f'(x) = \boxed{e^x \cos x} - \boxed{e^x \sin x}$$

$$f''(x) = \left[e^x \cos x - e^x \sin x\right] - \left[e^x \sin x + e^x \cos x\right]$$

$$\boxed{f''(x) = -2e^x \sin x}$$

$$e^x(\cos x - \sin x)$$

$m(x) = e^x$ $\quad m'(x) = e^x$

$n(x) = \boxed{\cos x}\boxed{-}\boxed{\sin x}$ $\quad n'(x) = -\sin x + (-\cos x)$

$$e^x(\cancel{\cos x} - \sin x) + e^x(-\sin x - \cancel{\cos x})$$

$$\boxed{-2e^x \sin x}$$