2.4 Trig.

$$f(x) = \sin x$$

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

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

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

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

$$= \sin x \lim_{h\to 0} \frac{\cos h - 1}{h} + \cos x \underbrace{\lim_{h\to 0} \frac{\sin h}{h}}_{=1}$$

$$\lim_{h\to 0} \frac{\cos h - 1}{h} \cdot \frac{\cos h + 1}{\cos h + 1}$$

$$= \lim_{h\to 0} \frac{\cos^2 h - 1}{h(\cos h + 1)}$$

$$= -\lim_{h\to 0} \frac{\sin h}{h} \frac{\sin h}{\cos h + 1}$$

$$= -(1)\frac{0}{2}$$

$$= 0$$

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

$$\boxed{(\sin x)' = \cos x}$$

Ex $y = x^2 - \sin x$

$y' = 2x - \cos x$

Ex $y = \frac{x^2}{u} \frac{\sin x}{v}$ $\qquad (uv)' = u'v + v'u$

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

Ex $y = \frac{\sin x}{x}$ $\qquad \left(\frac{u}{v}\right)' = \frac{u'v - v'u}{v^2}$

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

Ex $y = 5x + \cos x$

$y' = 5 - \sin x$

Ex $y = \sin x \cos x$ $\qquad = \frac{1}{2} \sin 2x$

$y' = \cos^2 x - \sin^2 x$ $\qquad y' = \cos 2x$

$= \cos 2x$

Ex $y = \frac{\cos x}{1 - \sin x}$

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

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

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

$= \underline{\frac{1}{1 - \sin x}}$

$$(\tan x)' = \left(\frac{\sin x}{\cos x}\right)'$$

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

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

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

$$= \sec^2 x$$

Ex $y = \sec x$ y''??

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

$$y'' = (\sec x)' \tan x + (\tan x)' \sec x$$

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

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

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4 $y = \csc x \cot x$

$$y' = (-\csc x \cot x)\cot x + (-\csc^2 x)(\csc x)$$

($(\csc x)'$)

$$= -\csc x \cot^2 x - \csc^3 x$$

(d) $y = t^2 - \sec t + 1$

$$y' = 2t - \sec t \tan t$$

27 $f(\theta) = \tan\theta - \cot\theta$

$$f'(\theta) = \sec^2\theta + \csc^2 x$$

Ex $s(t) = -\frac{1}{2}gt^2 + v_0 t + s_0$

$s(t) = \overbrace{600t - 16t^2}$

$g = 9.8 \text{ m/sec}^2$
$= 32.2 \text{ ft/sec}^2$
$\frac{1}{2}g = 16$

$v(t) = 600 - 32t = 0$

$t = \frac{600}{32} = 5 \text{ sec}$

a) $s(5) = 3{,}000 - 16(25)$
$= 2{,}600 \text{ ft.}$

$s(t) = 160t - 16t^2$

$d = 256$

$160t - 16t^2 = 256$

$-16t^2 + 160t - 256 = 0.$

$t^2 - 10t + 16 = 0$

$t = 2, 8 \text{ sec.}$

$v(t) = 160 - 32t$

$v(2) = 160 - 64 = 96 \text{ ft/sec}$

$v(8) = 160 - 256 = -96$

$y = f(g(x)) = f(u)$

$\frac{dy}{dx} = \frac{dy}{du}\frac{du}{dx}$

$(u^n)' = n u' u^{n-1}$

$y = (\overbrace{3x^2+1}^{u})^2$

$y' = 2(\overbrace{6x}^{u'})(3x^2+1)^{n-1}$

$= 12x(3x^2+1$