Differential Calculus - Derivative Practice (most worked by students @ board)March 29, 2018

Power Rule:
$$\frac{d}{dx}[x^n] = nx^{n-1}$$

Constant Multiple Rule:
$$\frac{d}{dx}[cf(x)] = c\frac{d}{dx}[f(x)]$$

Sum & Difference:
$$\frac{d}{dx}[f(x) \pm g(x)] = f'(x) \pm g'(x)$$

Product Rule:
$$\frac{d}{dx}[f(x)g(x)] = f'(x)g(x) + f(x)g'(x)$$

Quotient Rule:
$$\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{f'(x)g(x) - f(x)g'(x)}{g^2(x)}$$

Chain Rule:
$$\frac{d}{dx}[f(g(x))] = f'(g(x))g'(x)$$

Trig Functions:

$$\frac{d}{dx}[\sin x] = \cos x \qquad \frac{d}{dx}[\tan x] = \sec^2 x \qquad \frac{d}{dx}[\sec x] = \sec x \tan x$$
$$\frac{d}{dx}[\cos x] = -\sin x \qquad \frac{d}{dx}[\cot x] = -\csc^2 x \qquad \frac{d}{dx}[\csc x] = -\csc x \cot x$$

Exponential and Logarithmic Functions:

$$\frac{d}{dx}[a^x] = a^x \ln a \qquad \frac{d}{dx}[e^x] = e^x$$
$$\frac{d}{dx}[\log_a x] = \frac{1}{x \ln a} \qquad \frac{d}{dx}[\ln x] = \frac{1}{x}$$

$f(x) = Kx^3$, tangent line : $y = x+1$

slope of 1

$Kx^3 = x+1$ $\qquad$ $3Kx^2 = 1$

$$K = \frac{x+1}{x^3}$$

$$\frac{3(x+1)\cancel{x}^2}{x^{\cancel{3}\,1}} = 1 \Rightarrow \frac{3(x+1)}{x} = 1$$

$3x+3 = x$

$2x = -3$

$x = -3/2$

$$= \frac{-3/2+1}{(-3/2)^3} = \frac{-1/2}{-27/8} = \frac{4}{27}$$

$$\left[2^{f(x)}\right]' = 2^{f(x)} \ln 2 \cdot f'(x)$$

$$\left[\left[f(x)\right]^2\right]' = 2f(x) \cdot f'(x)$$

$$\left[2^{\left([f(x)]^2\right)}\right]' = \left[2^{\left([f(x)]^2\right)} \ln 2\right] \cdot \left[2f(x)\right] \cdot \left[f'(x)\right]$$

Power functions

$$\left[x^n\right]' = nx^{n-1}$$

Exponential functions

$$\left[a^x\right]' = a^x \ln a$$

$$f(x) = \cos\left(\sqrt{\tan^2 x - 2x}\right)$$

1. $f(x) = \cot(5x^2 - 3x)$

2. $f(x) = \sqrt[3]{\csc(4x)}$

3. $f(x) = \dfrac{\sin 2x}{x^3}$

$f(x) = \ln\left[\sin\left(5x^3+2x\right)\right]$

$$f(x) = (\sec x)(5^{\sin x})$$

$$f(x) = \frac{x^2 \ln x}{\sin x}$$