PRODUCT RULE

$f(x) = (3x^2)(4x^5) = 12x^7$

$f'(x) = 3x^2 \cdot 20x^4 + 4x^5 \cdot 6x \quad f'(x) = 84x^6$

$= 60x^6 + 24x^6 = 84x^6$

$\frac{d}{dx} f \cdot g = f \cdot g' + g \cdot f'$

$=$ first $\cdot$ d'2nd $+$ 2nd $\cdot$ d'1st

$f(x) = (x^6 - 3x^8 + 7)(3x^{-4} + 2x^{1/3} - 5)$

$f'(x) = \underbrace{(x^6 - 3x^8 + 7)}_{\text{1st}}\underbrace{\left(-12x^{-5} + \frac{2}{3}x^{-2/3}\right)}_{\text{d'2nd}} + \underbrace{(3x^{-4} + 2x^{1/3} - 5)}_{\text{2nd}}\underbrace{(6x^5 - 24x^7)}_{\text{d'1st}}$

September 29, 2021

QUOTIENT RULE

$$\frac{d}{dx}\frac{f}{g} = \frac{g\cdot f' - f\cdot g'}{g^2} = \frac{\text{low}\cdot d'\text{high} - \text{high}\cdot d'\text{low}}{\text{low}^2}$$

$$f(x) = \frac{4\sin x - 3x^5}{8x^{2/9} - \csc x}$$

$$f'(x) = \frac{(8x^{2/9}-\csc x)\cdot(4\cos x - 15x^4) - (4\sin x - 3x^5)\left(\frac{16}{9}x^{-7/9} + \csc x \cot x\right)}{(8x^{2/9}-\csc x)^2}$$

$$f(x) = \frac{\tan x \sec x}{\cos x}$$

$$f'(x) = \frac{\overset{\text{low}}{\cos x}\cdot \overbrace{\left[\overset{\text{1st}}{\tan x}\cdot \overset{\text{d'2nd}}{\sec x \tan x} + \overset{\text{2nd}}{\sec x}\cdot \overset{\text{d'1st}}{\sec^2 x}\right]}^{d'\text{high}} - \overset{\text{high}}{\tan x \sec x}\cdot \overset{d'\text{low}}{-\sin x}}{\cos^2 x}$$

CHAIN RULE

$$\frac{d}{dx} f\left[g\left(h(x)\right)\right] = f'\left[g(h(x))\right] \cdot g'(h(x)) \cdot h'(x)$$

$$f(x) = (7x^9 - 3x^6)^8 \qquad x^8$$

$$f(x) = 8\,(7x^9 - 3x^6)^7 \cdot (63x^8 - 18x^5) \qquad 8x^7$$

$$f(x) = \sqrt[4]{(x^7 - 5x^3)(x^4 + 9x^2)}$$

$$= \left[(x^7 - 5x^3)(x^4 + 9x^2)\right]^{1/4}$$

$$f'(x) = \frac{1}{4}\left[(x^7 - 5x^3)(x^4 + 9x^2)\right]^{-3/4} \cdot \Big[\underbrace{(x^7 - 5x^3)}_{\text{1st}}\underbrace{(4x^3 + 18x)}_{\text{d'2nd}} + \underbrace{(x^4 + 9x^2)}_{\text{2nd}}\underbrace{(7x^6 - 15x^2)}_{\text{d'1st}}\Big]$$

$$f(x)=\left[\frac{\tan x\cos x}{(x^7+3)^9(x^{11}-2x^5)^4}\right]^{89}$$

$$f'(x)=89\left[\quad '' \quad\right]^{88}\cdot\left[\frac{\overbrace{(x^7+3)^9(x^{11}-2x^5)^4}^{\text{low}}\cdot\overbrace{\left[\tan x\cdot -\sin x+\cos x\cdot\sec^2 x\right]}^{\text{d'high}} - \overbrace{(\tan x\cos x)}^{\text{high}}\cdot\overbrace{\left[(x^7+3)^9\cdot 4(x^{11}-2x^5)^3\cdot(11x^{10}-10x^4)+(x^{11}-2x^5)^4\cdot 9(x^7+3)^8\cdot 7x^6\right]}^{\text{d'low}}}{\left[(x^7+3)^9(x^{11}-2x^5)^4\right]^2}\right]$$