PRODUCT RULE

Power Rule = a) all exponents in numerator
b) all terms are added & subtracted.

$f(x) = 3x^2 \cdot 4x^5$

$= 12x^7$

$f'(x) = 84x^6$

~~$f'(x) = 6x \cdot 20x^4$~~

~~$= 120x^5$~~

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

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

$= 84x^6$

PRODUCT RULE

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

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

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

$f'(x) = \underbrace{(x^6 - 3x^8 + 7)}_{1st}\underbrace{\left(-12x^{-5} + \frac{2}{5}x^{-4/5}\right)}_{d'2nd} + \underbrace{\left(3x^{-4} + 2x^{1/5} - 5\right)}_{2nd}\underbrace{(6x^5 - 21x^7)}_{d'1st}$

Quotient Rule

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

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

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

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

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

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

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

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

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

Chain Rule

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

$$f(x) = (7x^9 - 3x^5)^8$$

$$f'(x) = 8(7x^9 - 3x^5)^7 \cdot (63x^8 - 15x^4)$$

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

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

$$f'(x) = \frac{1}{4}[(x^7 - 5x)(x^4 + 9x^2)]^{-3/4} \cdot [(x^7 - 5x)(4x^3 + 18x) + (x^4 + 9x^2)(7x^6 - 5)]$$

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

low · d'high − high · d'low, all over low²

$$f'(x) = \frac{(x^7+3)^9 (x^{11}-2x^5)^4 \cdot [\tan x(-\sin x) + \cos x \sec^2 x] - (\tan x \cos x)\cdot[(x^7+3)^9 \cdot 4(x^{11}-2x^5)^3 \cdot (11x^{10}-10x^4) + (x^{11}-2x^5)^4 \cdot 9(x^7+3)^8 \cdot 7x^6]}{[(x^7+3)^9 (x^{11}-2x^5)^4]^2}$$

(1st = $(x^7+3)^9$; d'2nd = $4(x^{11}-2x^5)^3 \cdot (11x^{10}-10x^4)$; 2nd = $(x^{11}-2x^5)^4$; d'1st = $9(x^7+3)^8 \cdot 7x^6$)