DERIVATIVE RULES

PRODUCT RULE

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

$f'(x) = \cancel{6x \cdot 20x^4}$

$\cancel{= 20x^5}$

$f(x) = 12x^7$

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

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

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

$= 84x^6$

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

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

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

$f'(x) = (x^6 - 3x^8 + 7)(-12x^{-5} + \tfrac{2}{3}x^{-2/3}) + (3x^{-4} + 2x^{1/3} - 5)(6x^5 - 24x^7)$

QUOTIENT RULE

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

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

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

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

CHAIN RULE

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

$$f(x) = \left(7\underline{x^9 - 3x^5}\right)^8$$

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

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

$$f'(x) = \frac{1}{4}\left[(x^7 - 5x^3)(x^4 + 9x^7)\right]^{-3/4} \cdot \left[(x^7 - 5x^3)(4x^3 + 63x^6) + (x^4 + 9x^7)(7x^6 - 15x^2)\right]$$

$$f(x) = \left[\frac{\tan x \cos x}{(x^7+3)^9 (x^{11}-2x^5)^4}\right]^{19}$$

$$f'(x) = 19\left[\frac{\tan x \cos x}{(x^7+3)^9(x^{11}-2x^5)^4}\right]^{18} \cdot$$

low   *d' high*

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

high   *1st*   *d' 2nd*   *d' low 2nd*

$$-\tan x \cos x \cdot \left[(x^7+3)^9 \cdot 4(x^{11}-2x^5)^3 \cdot (11x^{10}-10x^9) + (x^{11}-2x^5)^4 \cdot\right.$$

d' 1st

$$9(x^7+3)^8 \cdot 7x^6$$

$$\left[(x^7+3)^9 (x^{11}-2x^5)^4\right]^2$$