More Derivatives

$f(x) = 3x^7 \cdot 5x^4 = 15x^{11}$ $\quad f'(x) = 165x^{10}$

~~$f'(x) = 21x^6 \cdot 20x^3 = 420x^9$~~

$f'(x) = 3x^7 \cdot 20x^3 + 5x^4 \cdot 21x^6$

$60x^{10} + 105x^{10}$

$= 165x^{10}$

Product Rule

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

1st d'2nd + 2nd · d'1st

$-7x^{-2/5-1}$

$$f(x) = (7x^5 + 3x^8 - 2)\left(8x - \frac{7}{\sqrt[5]{x^2}} + 9\right)$$

$$f'(x) = (7x^5 + 3x^8 - 2)\left(8 + \frac{14}{5}x^{-7/5}\right) + \left(8x - \frac{7}{\sqrt[5]{x^2}} + 9\right)(35x^4 + 24x^7)$$

Quotient Rule

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

$$f(x) = \frac{x^4 - 7x^3 + 8}{2x^5 - 17x^2}$$

$$f'(x) = \frac{(2x^5 - 17x^2)\cdot(9x^3 - 21x^2) - (x^4 - 7x^3 + 8)(10x^4 - 34x)}{(2x^5 - 17x^2)^2}$$

CHAIN RULE = for functions inside functions

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

$f(x) = (x^2 - 7x + 3)^8$

$f(x) = x^8$
$g(x) = x^2 - 7x + 3$

$f'(x) = 8(x^2 - 7x + 3)^7 \cdot (2x - 7)$

$-5y^9$

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

$f'(x) = \frac{1}{2}\left(x^2 + 3x - 5(x^2+4)^9\right)^{-1/2} \cdot \left(2x + 3 - 45(x^2+4)^8 \cdot 2x\right)$

$$f(x) = \frac{(x^5 - 9x^8 + 7)(3x^2 - 5x^5)^4}{(x^9 - 3)^{47}}$$

d'high

low

d'2nd

2nd

1st

$$f'(x) = (x^9-3)^{47} \cdot \Big[(x^5 - 4x^8 + 7) \cdot 4(3x^2 - 5x^5)^3 \cdot (6x - 25x^4) + (3x^2 - 5x^5)^4 \cdot (5x^4 - 32x^7) \Big]$$

d'1st

high

d'low

$$- \frac{(x^5 - 9x^8 + 7)(3x^2 - 5x^5)^4 \cdot 47(x^9 - 3)^{46} \cdot (9x^8)}{\big[(x^9 - 3)^{47}\big]^2}$$

$$f(x) = \big[\sin^8(x^2 - \sqrt{x} + 4)^7\big]^8$$