

PRODUCT, QUOTIENT, & CHAIN RULE

PRODUCT RULE

$$f(x) = 3x^4 \cdot 4x^5 = 12x^9 \quad f'(x) = 108x^8$$

~~$$f'(x) = 12x^3 \cdot 20x^4 = 240x^7$$~~

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

1st · d'2nd + 2nd · d'1st

$$\begin{aligned} f'(x) &= 3x^4 \cdot 20x^4 + 4x^5 \cdot 12x^3 \\ &= 60x^8 + 48x^8 = 108x^8 \end{aligned}$$

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

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

QUOTIENT RULE

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

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

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

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

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

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

CHAIN RULE

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

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

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

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

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

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

$$f'(x) = 89 \left[\text{something} \right]^{88} \cdot \left[\frac{(x^7+3)^9 (x^{11}-2x^5)^9 [\tan x - \sec x + \csc x]}{(x^7+3)^9 (x^{11}-2x^5)^9} \right]$$

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

$$\left[9(x^7+3)^8 \cdot 7x^6 \right]$$

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

14/ Find $f''(x)$. — Do derivative twice.

18-19) $\frac{\text{Slope.}}{\text{Find } f'(x)}$
Plug in x

Point.
Plug in x in original
eq = y - coord.