More Chain Rule

$f(x) = \cos(3x^2 - 7x)$

$f'(x) = -\sin(3x^2 - 7x) \cdot (6x - 7)$

$f(x) = \tan^8(x^5 - 3x^4) = [\tan(x^5 - 3x^4)]^8$

$f'(x) = 8\tan^7(x^5 - 3x^4) \cdot \sec^2(x^5 - 3x^4) \cdot (5x^4 - 12x^3)$

$f(x) = \tan(x^5 - 3x^4)^8$

$f'(x) = \sec^2(x^5 - 3x^4)^8 \cdot 8(x^5 - 3x^4)^7 \cdot (5x^4 - 12x^3)$

$$f(x) = \csc^5(\cot(3x^7))$$

$$f'(x) = 5\csc^4(\cot(3x^7)) \cdot -\csc(\cot 3x^7)\cot(\cot 3x^7) \cdot -\csc^2(3x^7) \cdot 21x^6$$

$$f(x) = \csc^5 x \cdot (\cot(3x^7))$$

$$f'(x) = \csc^5 x \cdot -\csc^2(3x^7) \cdot 21x^6 + \cot(3x^7) \cdot 5\csc^4 x \cdot -\csc x \cot x$$

$$f(x) = \sec^6(x^7 - 3x^2) \cdot \left(\frac{(x^4 - 7x^8)^9}{\cot(7x - 4x^3)^{11}}\right)$$

1st

d'hgt

(ow)

$$f'(x) = \sec^6(x^7 - 3x^2) \cdot \left[\frac{\cot(7x-4x^3)^{11} \cdot 9(x^4-7x^8)^8 \cdot (4x^3 - 56x^7)}{\text{d 2nd}}\right.$$

$$\left. - \frac{(x^4-7x^8)^9 \cdot -\csc^2(7x-4x^3)^{11} \cdot 11(7x-4x^3)^{10} \cdot (7-12x^2)}{\cot^2(7x-4x^3)^{11}}\right]$$

$$+ (\text{shift}) \cdot 6\sec^5(x^7-3x^2)\sec(x^7-3x^2)\tan(x^7-3x^2) \cdot (7x^6 - 6x)$$

DIFFERENTIALS

- Derivatives
- Differentiation

$y = f(x)$

$\frac{dy}{dx} = \frac{\Delta y}{\Delta x}$

differentials

Find dy.

$y = x^3 - 3x^2 + 7$

$dx \frac{dy}{dx} = (3x^2 - 6x)\,dx$

$dy = (3x^2 - 6x)\,dx$

Find dy if $y = x^7 - 3x^2 + 1$ and x changes from 1.2 to 1.25

$dx = 0.05$

$\frac{dy}{dx} = (7x^6 - 6x)\,dx$

$dy = (7(1.2)^6 - 6(1.2))\,0.05$

≈ 0.685

The radius of a sphere is measured to be 20 in. with a possible error of ± 0.3 in. Estimate the possible error in the Volume.

$$V = \frac{4}{3}\pi r^3$$

$$dV = 4\pi r^2 dr$$

$$dV = 4\pi(20)^2(\pm 0.3)$$

$$= \pm 150.8 \text{ in}^3$$

$$\% \text{ error} = \frac{\text{theo} - \text{actual}}{\text{the}}$$

$$\frac{\Delta r}{r} = \frac{dr}{r} = \frac{\pm 0.3}{20}$$

$$= 0.015$$

$$= 1.5\%$$

% error of Vol.

$$\frac{dV}{V} = \frac{4\pi r^2 dr}{\frac{4}{3}\pi r^3} = 3 \cdot \frac{dr}{r}$$

$$= 3(1.5\%)$$

$$= 4.5\%$$

$\frac{4}{4} \cdot \frac{3}{4}$

Dome of a silo $r = 12$ ft.

Coat of a paint = 0.002 ft thick

$dr = 0.002$

Estimate the Volume of the paint.

$$V = \frac{2}{3}\pi r^3$$

$$dV = 2\pi r^2 dr$$

$$= 2\pi (12)^2 (0.002) = 1.81 \text{ ft}^3$$