$6\left(x + \dfrac{dy}{dx}\right)$

$6x + 6\dfrac{dy}{dx}$

Warm Up

Differentiate the following…

$$\left(x^3 + y^5\right)^6 + 3xy = 2x^4 y^5$$

$6(x^3+y^5)^5\left(3x^2 + 5y^4\dfrac{dy}{dx}\right) + 3y + 3x\dfrac{dy}{dx} = 8x^3 y^5 + 2x^4\left(5y^4\right)\dfrac{dy}{dx}$

$18x^2(x^3+y^5)^5 + 30y^4(x^3+y^5)^5\dfrac{dy}{dx} + 3y + 3x\dfrac{dy}{dx} = 8x^3 y^5 + 10x^4 y^4 \dfrac{dy}{dx}$

$\dfrac{dy}{dx}\left[30y^4(x^3+y^5)^5 + 3x - 10x^4 y^4\right] = 8x^3 y^5 - 18x^2(x^3+y^5)^5 - 3y$

$\dfrac{dy}{dx} = \dfrac{8x^3 y^5 - 18x^2(x^3+y^5)^5 - 3y}{30y^4(x^3+y^5)^5 + 3x - 10x^4 y^4}$

Example:

Find $\dfrac{dy}{dx}$, given the curve $x^2 - 3xy = \left(5x^2 - 8y\right)^5$

$$2x - \left(3y + 3x\dfrac{dy}{dx}\right) = 5\left(5x^2 - 8y\right)^4\left(10x - 8\dfrac{dy}{dx}\right)$$

$$2x - 3y - 3x\dfrac{dy}{dx} = 50x\left(5x^2 - 8y\right)^4 - 40\left(5x^2 - 8y\right)^4\dfrac{dy}{dx}$$

$$\dfrac{dy}{dx} = \dfrac{50x\left(5x^2 - 8y\right)^4 - 2x + 3y}{-3x + 40\left(5x^2 - 8y\right)^4}$$

Homework

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1 d, f, h

2 c, d

3 c, d

5 a

6 a, b, c

Higher Order Derivatives

We can continue to find the derivatives of a derivative. We find the

- second derivative by taking the derivative of the first,
- third derivative by taking the derivative of the second ... etc

Examples:

1. Determine the higher order derivatives for $f(x)$...

$$f(x) = x^4 - 2x^3 + 3x - 5$$

$$f'(x) = 4x^3 - 6x^2 + 3$$

$$f''(x) = 12x^2 - 12x$$

$$f'''(x) = 24x - 12$$

$$f''''(x) = 24$$

$$f'''''(x) = 0$$

$$f'''(-2)$$

2. Determine $f'''(x)$ given that $f(x) = \dfrac{5}{\sqrt{2-3x}}$

$$f(x) = 5(2-3x)^{-\frac{1}{2}}$$

$$f'(x) = -\frac{5}{2}(2-3x)^{-\frac{3}{2}}(-3)$$

$$f'(x) = \frac{15}{2}(2-3x)^{-\frac{3}{2}}$$

$$f''(x) = -\frac{45}{4}(2-3x)^{-\frac{5}{2}}(-3)$$

$$f''(x) = \frac{135}{4}(2-3x)^{-\frac{5}{2}}$$

$$f'''(x) = -\frac{675}{8}(2-3x)^{-\frac{7}{2}}(-3)$$

"CAS"

3. Find the second derivative of the implicit function $xy + y^2 = 4$.

$$y + x\frac{dy}{dx} + 2y\frac{dy}{dx} = 0$$

$$\frac{dy}{dx} = \frac{-y}{x+2y}$$

$$\frac{d^2y}{dx^2} = -\frac{\frac{dy}{dx}(x+2y) + y\left(1+2\frac{dy}{dx}\right)}{(x+2y)^2}$$

$$\frac{d^2y}{dx^2} = \frac{\left(\frac{y}{x+2y}\right)(x+2y) + y\left(1-\frac{2y}{x+2y}\right)}{(x+2y)^2}$$

4. Determine the fourth derivative of $y = \cos(5x)$

HOMEWORK

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(Higher Order Derivatives)

#2, 3, 4, 5, 7 (a)