Calculus

Max Kasperowski

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1 Derivatives

1.1 Definition

If the derivative is defined to be $y = f(x)$, then its derivative is $f'(x) = \lim_{h\to\infty} \frac{f(x+h)-f(x)}{h}$.

Equivalent notations for the derivative of $y = f(x)$ are:

$$f'(x) = y' = \frac{df}{dx} = \frac{dy}{dx} = \frac{d}{dx}(f(x)) = Df(x)$$

Equivalent notations for the the derivative of $y = f(x)$ evaluated at $x = a$ are:

$$f'(a) = y'\Big|_{x=a} = \frac{df}{dx}\Big|_{x=a} = \frac{dy}{dx}\Big|_{x=a} = Df(a)$$

1.2 Properties

The following properties hold where $f(x)$ and $g(x)$ are differential functions and c and n are any real numbers.

1. $(cf)' = cf'(x)$
2. $(f \pm g)' = f'(x) \pm g'(x)$
3. $(fg)' = f'g + fg'$
4. $\left(\frac{f}{g}\right)' = \frac{f'g-fg'}{g^2}$
5. $\frac{d}{dx}(c) = 0$
6. $\frac{d}{dx}\left(x^n\right) = nx^{n-1}$
7. $\frac{d}{dx}\left(f\left(g(x)\right)\right) = f'\left(g(x)\right)g'(x)$

1.3 Common Derivatives

$\frac{d}{dx}(x) = 1$