

# Mathematical expressions and equations in LaTeX

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## 1 Mathematical Equations

Straight line equation:  $y = mx + c$

Quadratic equation:  $ax^2 + bx + c = 0$

$$ax^2 + bx + c = 0$$

Cubic equation:  $ax^3 + bx^2 + cx + d = 0$

$$ax^3 + bx^2 + cx + d = 0 \tag{1}$$

Formulas:  $(a + b)^2 = a^2 + 2ab + b^2$

$$(a + b)^2 + (a - b)^2 = 2(a^2 + b^2)$$

$$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$$

## 2 Symbols

Some of the math symbols are

$\alpha \quad \beta \quad \gamma \quad \delta \quad \Delta \quad \mu \quad \nu \quad \pi \quad \chi$

Arithmetic Operations are

$\leq \quad \ll \quad \gg \quad \pm \quad \times \quad \div \quad \neq$

Different arrow mark symbols

$\rightarrow \quad \Rightarrow \quad \longrightarrow \quad \Longrightarrow \quad \leftarrow \quad \Leftarrow$

Trigonometric functions:  $\sin(\omega t)$ ,  $\tan x$ ,  $\arcsin(x)$ ,  $\exp(x)$

Superscript:  $x^2 \quad x^n$  and subscript:  $x_2$

### 2.1 Average & sum symbols:

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i = \frac{1}{n} (x_1 + \cdots + x_n)$$

### 2.2 Limit:

$$\lim_{x \rightarrow \alpha} f(x)$$

### 2.3 Derivatives:

First-order derivative:

$$f'(x)$$

Second-order derivative:

$$f''(x)$$

partial second-order derivative:

$$\frac{\partial^2 f}{\partial x^2}$$

Second-order differential equation:

$$\frac{d^2 y}{dx^2} + p(x) \frac{dy}{dx} + q(x)y = f(x) \quad (2)$$

where  $p(x)$ ,  $q(x)$  and  $f(x)$  are functions of  $x$ .

$$\ddot{y} + p(x)\dot{y} + q(x)y = f(x). \quad (3)$$

## 2.4 Integral

Integral :

$$\int$$

Integral limits :

$$\int_a^b f(x)dx$$

Double integral with limits:

$$\int_a^b \int_c^d f(x, y) dx dy$$

## 2.5 Binomial coefficient:

$$\frac{n!}{k!(n-k)!} = \binom{n}{k} = {}^nC_k = C_n^k$$

## 3 No numbers in the equation

Equation with equation number:

$$y = mx + c \quad (4)$$

Equation without equation number:

$$y = mx + c$$

$$y = mx + c$$

$$y = mx + c \quad (5)$$

$$ny + b = mx^3 + cx^2 + dx + e + f \quad (6)$$

$$y = mx + c \quad (7)$$

$$ny + b = mx + c + d + e + f + g \quad (8)$$

center alignment:

$$y = mx + c \quad (9)$$

$$ny + b = mx + c + d + e + f + g \quad (10)$$

Multiple equations:

$$f(x) = x^2 + x_2 \quad (11)$$

$$g(x) = \frac{1}{x} \quad (12)$$

$$m(x) = \frac{1}{\sqrt{x}} \quad (13)$$

$$V(x) = \frac{dy}{dx} \quad (14)$$

$$V(x) = \frac{\partial y}{\partial x} \quad (15)$$

System of equations with single equation number:

$$\begin{aligned} X(z, x) &= \frac{x}{s(z)}, \quad Y(z, y) = \frac{y}{s(z)}, \\ A(z) &= \frac{A_0}{s(z)}, \quad s(z) = 1 - s_0 \int \beta(z) dz, \\ \phi(z, x, y) &= -\frac{s_0 (x^2 + y^2)}{2s(z)}, \quad Z(z) = \int \frac{\beta(z)}{2Bs(z)^2} dz, \end{aligned} \quad (16)$$

System of equations with sub equations number:

$$X(z, x) = \frac{x}{s(z)}, \quad Y(z, y) = \frac{y}{s(z)}, \quad (17a)$$

$$A(z) = \frac{A_0}{s(z)}, \quad s(z) = 1 - s_0 \int \beta(z) dz, \quad (17b)$$

$$\phi(z, x, y) = -\frac{s_0 (x^2 + y^2)}{2s(z)}, \quad Z(z) = \int \frac{\beta(z)}{2Bs(z)^2} dz, \quad (17c)$$

## 4 How to write an m x n matrix in LaTeX

pmatrix, bmatrix, vmatrix, Vmatrix are Latex environments:

- $p$  for parentheses
- $b$  for brackets
- $v$  for verts
- $B$  for braces
- $V$  for double verts

$$A_{m,n} = \begin{pmatrix} a_{1,1} & a_{1,2} & \cdots & a_{1,n} \\ a_{2,1} & a_{2,2} & \cdots & a_{2,n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m,1} & a_{m,2} & \cdots & a_{m,n} \end{pmatrix}$$

$$A = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix}$$

$$B = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}$$

$$C = \begin{matrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{matrix}$$

$$D = \begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix}$$

$$E = \left\{ \begin{matrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{matrix} \right\}$$

$$F = \left\| \begin{matrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{matrix} \right\|$$

## 5 Piecewise function

$$y = f(x) = |x| = \begin{cases} -x & x \leq 0 \\ x & x \geq 0 \end{cases} \quad (18)$$

$$g(x) = \begin{cases} x & \text{if } x \in \mathbb{Q} \\ -x & \text{if } x \notin \mathbb{Q} \end{cases}$$