

LaTeX Workshop: Writing Math in LaTeX

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Writing Math in LaTeX

LaTeX is ideal for writing complex math equations, symbols, and formulas. Let's explore some advanced features and techniques.

1. Aligning Equations

The `align` environment helps align multi-line equations:

$$x^2 + y^2 = z^2 \tag{1}$$

$$E = mc^2 \tag{2}$$

$$a + b = c + d \tag{3}$$

You can also suppress numbering on specific lines using `nonumber`:

$$\begin{aligned} x^2 + y^2 &= z^2 \\ a + b &= c + d \end{aligned} \tag{4}$$

2. Advanced Math Symbols with `amssymb`

The `amssymb` package provides access to various advanced math symbols:

$$\therefore, \because, \infty, \sum_{i=1}^n i, \Rightarrow, \Longrightarrow$$

You can also write set theory symbols like:

$$A \cup B, \quad A \cap B, \quad \mathbb{R}, \quad \mathbb{N}$$

3. Matrices and Vectors

LaTeX can handle matrices and vectors using the `\bmatrix` or `\pmatrix` environments. Here's an example of a 2x2 matrix:

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

And a vector:

$$\mathbf{v} = \begin{pmatrix} v_1 \\ v_2 \\ v_3 \end{pmatrix}$$

You can use other delimiters like parentheses or vertical lines for determinants:

$$\det(A) = \begin{vmatrix} a & b \\ c & d \end{vmatrix}$$

4. Derivatives and Integrals

To write derivatives, integrals, and partial derivatives, you can use the following syntax:

Derivatives:

$$\frac{dy}{dx}, \quad \frac{d^2y}{dx^2}$$

Partial Derivatives:

$$\frac{\partial y}{\partial x}, \quad \frac{\partial^2 y}{\partial x^2}$$

Integrals:

$$\int_0^1 x^2 dx, \quad \int_{-\infty}^{\infty} e^{-x^2} dx$$

Multiple Integrals:

$$\iint_D f(x, y) dx dy$$

5. Limits and Summations

Limits and summations are easy to write in LaTeX:

Limits:

$$\lim_{x \rightarrow 0} \frac{1}{x}, \quad \lim_{n \rightarrow \infty} a_n$$

Summation:

$$\sum_{n=1}^{\infty} \frac{1}{n^2}$$

Product:

$$\prod_{i=1}^n x_i$$

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6. Piecewise Functions

Piecewise functions can be written using the `cases` environment:

$$f(x) = \begin{cases} x^2 & \text{if } x > 0 \\ -x & \text{if } x \leq 0 \end{cases}$$

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7. Multiline Equations with Numbering

For equations that span multiple lines and require custom numbering, use the `align` environment:

$$f(x) = x^2 + 2x + 1 \tag{1}$$

$$g(x) = \sin(x) + \cos(x) \tag{2}$$

$$h(x) = e^x \tag{3}$$

You can also use the `multline` environment when you want to split a long equation over multiple lines, where the first line is left-aligned and the last line is right-aligned:

$$f(x) = x + x^2 + x^3 + \cdots + x^n +$$

$$y + y^2 + y^3 + \cdots + y^n \tag{5}$$

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8. Custom Operators

You can define your own custom operators using the `DeclareMathOperator` command:

Foo

$$(x) = x^2 + 1$$

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9. Bold Math Symbols with `\bm`

Use the `\bm` package to create bold mathematical symbols, which is especially useful for vectors and matrices:

$$\mathbf{Ax} = \mathbf{b}$$

You can also bold specific symbols like Greek letters:

$$\boldsymbol{\alpha}, \quad \boldsymbol{\beta}$$

10. Fractions and Continued Fractions

You can write fractions and continued fractions easily in LaTeX:

Regular Fraction:

$$\frac{a}{b}$$

Continued Fraction:

$$a_0 + \frac{1}{a_1 + \frac{1}{a_2 + \frac{1}{a_3 + \ddots}}}$$

11. Spacing in Math Mode

To adjust the spacing between elements in math mode, you can use the following commands:

$$a\,b \quad a\,b \quad a \, b \quad a \quad b$$

- `\,` for thin space. - `\;` for medium space. - `\quad` for wide space. - `\qquad` for extra wide space.

12. The `\cases` Environment

The `\cases` environment can also be used for writing systems of equations:

$$\begin{cases} x + y = 10 \\ x - y = 5 \end{cases}$$