

# A<sub>M</sub>S-L<sub>A</sub>T<sub>E</sub>X QUICK REFERENCE

## Packages

The main package to load is `amsmath`. More symbols are included in `amssymb`.

## Typeset

For text style (inline) math, use: `$ ... $`

For display style math, which breaks the paragraph:  
`\begin{equation} ... \end{equation}` (numbered) or  
`\[ ... \]` (non-numbered).

## Greek letters

$\alpha$	<code>\alpha</code>	$\beta$	<code>\beta</code>	$\gamma$	<code>\gamma</code>
$\delta$	<code>\delta</code>	$\epsilon$	<code>\epsilon</code>	$\varepsilon$	<code>\varepsilon</code>
$\zeta$	<code>\zeta</code>	$\eta$	<code>\eta</code>	$\theta$	<code>\theta</code>
$\vartheta$	<code>\vartheta</code>	$\iota$	<code>\iota</code>	$\kappa$	<code>\kappa</code>
$\lambda$	<code>\lambda</code>	$\mu$	<code>\mu</code>	$\nu$	<code>\nu</code>
$\xi$	<code>\xi</code>	$\pi$	<code>\pi</code>	$\varpi$	<code>\varpi</code>
$\rho$	<code>\rho</code>	$\varrho$	<code>\varrho</code>	$\sigma$	<code>\sigma</code>
$\tau$	<code>\tau</code>	$\upsilon$	<code>\upsilon</code>	$\phi$	<code>\phi</code>
$\varphi$	<code>\varphi</code>	$\chi$	<code>\chi</code>	$\psi$	<code>\psi</code>
$\omega$	<code>\omega</code>				
$\Gamma$	<code>\Gamma</code>	$\Delta$	<code>\Delta</code>	$\Theta$	<code>\Theta</code>
$\Lambda$	<code>\Lambda</code>	$\Xi$	<code>\Xi</code>	$\Pi$	<code>\Pi</code>
$\Sigma$	<code>\Sigma</code>	$\Upsilon$	<code>\Upsilon</code>	$\Phi$	<code>\Phi</code>
$\Psi$	<code>\Psi</code>	$\Omega$	<code>\Omega</code>		

To ensure a consistent style throughout the document:

```
\renewcommand{\epsilon}{\varepsilon}
\renewcommand{\theta}{\vartheta}
\renewcommand{\rho}{\varrho}
\renewcommand{\phi}{\varphi}
```

## Superscript & Subscript

$x^y$	<code>x<sup>y</sup></code>	$x^{a+b}$	<code>x<sup>{a+b}</sup></code>
$x_y$	<code>x<sub>y</sub></code>	$x_{a+b}$	<code>x_{a+b}</code>

## Root

Square root	$\sqrt{x}$	<code>\sqrt{x}</code>
N-th root	$\sqrt[N]{x}$	<code>\sqrt[N]{x}</code>

## Dots

Multiplication dot	$\cdot$	<code>\cdot</code>
Three centered dots	$\cdots$	<code>\cdots</code>
Three baseline dots	$\ldots$	<code>\ldots</code>
Three diagonal dots	$\ddots$	<code>\ddots</code>
Three vertical dots	$\vdots$	<code>\vdots</code>

## Spaces

Negative space	<code>\!</code>
Thin space	<code>\,</code>
1em space	<code>\quad</code>
2em space	<code>\qquad</code>

## Braces

```
\overbrace{ ... }~{ text over brace }
\underbrace{ ... }_{ text under brace }
```

## Accents

$\hat{a}$	<code>\hat{a}</code>	$\bar{a}$	<code>\bar{a}</code>	$\mathring{a}$	<code>\mathring{a}</code>
$\check{a}$	<code>\check{a}</code>	$\dot{a}$	<code>\dot{a}</code>	$\vec{a}$	<code>\vec{a}</code>
$\tilde{a}$	<code>\tilde{a}</code>	$\ddot{a}$	<code>\ddot{a}</code>	$\widehat{AAA}$	<code>\widehat{AAA}</code>

## Operators

<code>\sin</code>	<code>\cos</code>	<code>\arcsin</code>	<code>\arccos</code>
<code>\sinh</code>	<code>\cosh</code>	<code>\tan</code>	<code>\arctan</code>
<code>\log</code>	<code>\ln</code>	<code>\max</code>	<code>\min</code>
<code>\sup</code>	<code>\inf</code>	<code>\tanh</code>	<code>\cot</code>
<code>\sec</code>	<code>\csc</code>	<code>\det</code>	

## Modulo

$a \bmod b$	<code>a \bmod b</code>
$a \equiv b \pmod{m}$	<code>a \equiv b \pmod{m}</code>

## Fractions

```
\frac{ ... }{ ... }
```

## Symbol stacking

```
\overset{ ... }{ ... }
\underiset{ ... }{ ... }
```

First argument is the main symbol, second argument is the symbol to put over or under the main symbol.

## Big operators

$$\int_a^b \quad \int_a^b \quad \sum_{k=0}^n \quad \prod_{k=0}^n \quad \lim_{x \rightarrow 0}$$

For multiple integrals:  $\iint$   $\iiint$  etc.

Closed path integral:  $\oint$

## Delimiter size

Change the delimiter size by adding one of these modifiers immediately before the delimiter itself:

`\big` `\Big` `\bigg` `\Bigg`

Let  $\LaTeX$  determine the correct size using `\left` and `\right` immediately before the opening and closing delimiters, respectively.

## Absolute value & Norm

$$|x| \quad \lvert x \rvert \quad \lVert x \rVert$$

The same can be achieved by defining new commands:

```
\usepackage{mathtools}
\DeclarePairedDelimiter{\abs}{\lvert}{\rvert}
\DeclarePairedDelimiter{\norm}{\lVert}{\rVert}
```

Use starred variants `\abs*` and `\norm*` to produce the correct delimiter height for any kind of equation.

$$|x| \quad \abs{x} \quad \left| \frac{a}{b} \right| \quad \abs*{\frac{a}{b}} \\ \lVert x \rVert \quad \norm{x} \quad \left\| \frac{a}{b} \right\| \quad \norm*{\frac{a}{b}}$$

## Arrows

$$\uparrow \quad \Uparrow \quad \downarrow \quad \Downarrow \quad \updownarrow \quad \Updownarrow \\ \leftarrow \quad \rightarrow \quad \leftrightarrow \quad \Rightarrow \quad \mapsto$$

$$\longleftarrow \quad \longrightarrow \quad \longleftrightarrow \quad \Longleftarrow \quad \Longrightarrow \quad \Longleftrightarrow \quad \longmapsto$$

## Binary relations

$$\neq \quad \leq \quad \geq \quad \equiv \quad \ll \quad \gg \quad \doteq \quad \sim \quad \simeq \quad \subset \quad \supset \quad \approx \quad \subseteq \quad \supseteq \quad \cong \quad \in \quad \ni \quad \propto \quad \mid \quad \parallel \quad \perp$$

It's possible to negate these symbols by prefixing them with `\not` (for example:  $\not\equiv$ )

## Binary operators

$$\pm \quad \mp \quad \cdot \quad \div \quad \times \quad \setminus \quad \star \quad \cup \quad \cap \quad * \quad \circ \quad \bullet \quad \oplus \quad \ominus \quad \odot \quad \oslash \quad \otimes \quad \smallsetminus$$

## Logic symbols

$$\vee \quad \wedge \quad \neg \quad \exists \quad \nexists \quad \forall \quad \Rightarrow \quad \Leftrightarrow \quad \models$$

## Other symbols

$$\infty \quad \partial \quad \emptyset \quad \nabla \quad \langle x \rangle$$

## Multi line equations

Use the `multline` environment:

```
\begin{multline} ... \end{multline}
```

To align equations, use the `align` environment.

Specify the alignment position with `&` and separate equations with `\\`:

```
\begin{align}
... &= ... \\
... &= ...
\end{align}
```

## Vectors

$$\vec{x} \quad \bm{x}$$

Best practice to easily switch between types:

```
\usepackage{bm}
\renewcommand{\vec}{\bm}
```

## Arrays

Use the `array` environment. Use `\\` to separate rows, and `&` to separate elements of each row. To produce large delimiters around the array, use `\left` and `\right` followed by the desired delimiter.

$$\left( \begin{array}{lcr} a & b & c \\ d & e & f \\ g & h & i \end{array} \right)$$

Each letter in the argument of the array represents a column:

- l left aligned text
- c centered text
- r right aligned text

## Cases

Use the `cases` environment. Use `\\` to separate different cases, and `&` for correct alignment.

$$\begin{cases} x & \text{if } x > 0 \\ 0 & \text{if } x \leq 0 \end{cases}$$

## Matrices

Use one of the following environments:

<code>matrix</code>	No delimiter
<code>pmatrix</code>	( delimiter
<code>bmatrix</code>	[ delimiter
<code>Bmatrix</code>	{ delimiter
<code>vmatrix</code>	delimiter
<code>Vmatrix</code>	delimiter

Use `\\` to separate different rows, and `&` to separate elements of each row.

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$$

To produce a small matrix, useful for inline math, use the `smallmatrix` environment:  $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ .