

# LATEX BASICS

LaTeX is a markup language used to create scientific documentation.

## Document Structure

```
% Basic document structure
\documentclass{article} % Defines document type
\usepackage{amsmath}      % For advanced math features
\usepackage{graphicx}     % For including images

\title{Document Title}
\author{Author Name}
\date{\today}

\begin{document}
\maketitle

\section{Introduction}
This is the introduction.

\subsection{Subsection}
This is a subsection.

\end{document}
```

## Text Formatting

```
% Text formatting commands
\textbf{Bold Text}        % Bold formatting
\textit{Italic Text}      % Italic formatting
\underline{Underlined}    % Underlined text
\emph{Emphasized}         % Emphasized text (usually italic)
```

```
% Special text environments  
\begin{verbatim}  
Verbatim text exactly as typed  
\end{verbatim}
```

## Lists

```
% Bullet point list  
\begin{itemize}  
  \item First item  
  \item Second item  
  \item Third item  
\end{itemize}  
  
% Numbered list  
\begin{enumerate}  
  \item First item  
  \item Second item  
  \item Third item  
\end{enumerate}  
  
% Description list  
\begin{description}  
  \item[Term] Description of term  
  \item[Another] Another description  
\end{description}
```

## Comment

```
% This is a comment
```

## Basic Notation

```
%Brackets
()
[]
%addition sign
+
%substration sign
-
%multiplication sign
\times
\cdot
%division signs
/
:
% make a fraction
\frac{numerator}{denominator}
% inverse sign
^{-1}
%plus minus sign
\pm
%minus plus sign
\mp
%square root
\sqrt{}
%cube root
\sqrt[3]{}
%nth root
\sqrt[n]{}
%percent
\%
```

## Number sets

For futher explanation visit : Mathématiques ensembles des nombres.

```
% ensemble des entiers naturels  
\mathbb{N}  
% ensemble des entiers relatifs  
\mathbb{Z}  
% ensemble des décimaux  
\mathbb{D}  
% ensemble des rationnels  
\mathbb{Q}  
% ensemble des réels  
\mathbb{R}  
% ensemble des complexes  
\mathbb{C}  
% ensemble des quaternions  
\mathbb{H}  
% ensemble des octonions  
\mathbb{O}  
% ensemble des sédénions  
\mathbb{S}  
% ensemble des pathions  
\mathbb{P}  
% ensemble des chingons  
\mathbb{X}  
% ensemble des routons  
\mathbb{U}  
% ensemble des voudrons  
\mathbb{V}
```

## Quantifiers

```
% forall  
\forall  
% it exists  
\exists  
% does not exist  
\nexists
```

## Set construction

```
% Empty set  
\varnothing
```

## Set operations

```
%intersection  
\cap  
%union  
\cup  
%difference  
\setminus
```

## Figures and Tables

```
% Figure environment  
\begin{figure}[h]  
  \centering  
  \includegraphics[width=0.5\textwidth]{image.png}  
  \caption{Figure caption}  
  \label{fig:example}  
\end{figure}  
  
% Table environment  
\begin{table}[h]  
  \centering  
  \caption{Table caption}  
  \begin{tabular}{|c|c|c|c|}
```

```

\hline
Header 1 & Header 2 & Header 3 \\
\hline
Data 1 & Data 2 & Data 3 \\
\hline
\end{tabular}
\label{tab:example}
\end{table}

```

## Mathematical Environments

```

% Numbered equation
\begin{equation}
E = mc^2
\label{eq:emc}
\end{equation}

% Aligned equations
\begin{align}
a &= b + c \\
d &= e + f + g \\
h &= i + j
\end{align}

% Inline math: $E = mc^2$
% Display math: \[ E = mc^2 \]

```

## References and Citations

% Cross-references  
See Figure~\ref{fig:example} and Table~\ref{tab:example}.  
Equation~\ref{eq:emc} shows the mass-energy equivalence.

% Citations

```
This was proven by Einstein~\cite{einstein1905}.
```

```
% Bibliography (in preamble)
\usepackage{natbib}
\bibliographystyle{plain}

% Bibliography entries
\begin{thebibliography}{9}
\bibitem{einstein1905}
A. Einstein,
\emph{On the Electrodynamics of Moving Bodies},
Annalen der Physik, 1905.
\end{thebibliography}
```

## Useful Packages

```
% Essential packages
\usepackage{amsmath}           % Advanced math typesetting
\usepackage{graphicx}          % Including graphics
\usepackage{hyperref}           % Hyperlinks and PDF metadata
\usepackage{geometry}            % Page layout control
\usepackage{url}                % URL typesetting

% Additional useful packages
\usepackage{amsfonts}           % Additional math fonts
\usepackage{amssymb}             % Math symbols
\usepackage{xcolor}              % Color support
\usepackage{listings}            % Code listings
\usepackage{tabularx}            % Extended table features
```

## Footnotes and Margin Notes

```
% Footnotes
This is some text with a footnote\footnote{This is the footnote t
```

```
% Margin notes  
This text has a margin note\marginpar{Note in the margin}.
```

## Footnotes and Margin Notes

```
% Logical symbols  
\forall          % Universal quantifier  
\exists, \exist % Existential quantifier  
\in, \isin      % Element of  
\notin         % Not element of  
\complement    % Complement  
  
% Set operations  
\subset         % Subset  
\emptyset, \empty % Empty set  
\mid            % Such that or divides  
  
% Logical operators  
\land          % Logical AND  
\lor           % Logical OR  
\neg, \not      % Logical NOT  
  
% Arrows and implications  
\mapsto        % Maps to  
\to            % Right arrow  
\gets          % Left arrow  
\leftrightarrow % Left-right arrow  
\implies       % Implies  
\iff           % If and only if  
\therefore     % Therefore  
\because       % Because  
  
% Set notation examples  
\{x \mid x < \tfrac{1}{2}\}  
\set{x \mid x < 5}
```

# LaTeX Mathematical Symbols Cheat Sheet

```
% LaTeX Mathematical Symbols Reference
% Common symbols and their LaTeX commands

% Quantifiers
\forall \forall           % For all
\exists \exists           % There exists
\nexists \nexists         % There does not exist

% Set Theory
\in \in                 % Element of
\notin \notin            % Not element of
\emptyset \emptyset       % Empty set
\varnothing \varnothing   % Alternative empty set
\subset \subset           % Subset
\complement \complement % Complement

% Logic Operators
\land \land              % Logical and
\lor \lor                % Logical or
\neg \neg                % Logical not
\not \not                % Alternative not

% Arrows and Implications
\rightarrow \rightarrow     % Right arrow
\implies \implies          % Implies
\leftarrow \leftarrow       % Left arrow
\leftrightarrow \leftrightarrow % Left-right arrow
\iff \iff                % If and only if
\mapsto \mapsto            % Maps to

% Set Notation Examples
\{ x \mid x < \frac{1}{2} \} % Set with mid bar
\set{x \mid x < \frac{1}{2}} % Alternative set notation
\{x \mid x < 5\} % Simple set
```

```
\set{x \leq 5} % Alternative simple set
```

## LaTeX Dirac Bra-Ket Notation

```
% Dirac Bra-Ket Notation for Quantum Mechanics
% Requires \usepackage{braket} in preamble

% Basic Bra-Ket Notation
(|          \bra{\phi}                      % Bra vector
|)          \ket{\psi}                      % Ket vector
(| )        \braket{\phi | \psi}           % Bra-ket inner product

% Scaled Bra-Ket Notation
(|      \Bra{\phi}                      % Scaled bra vector
|)      \Ket{\psi}                      % Scaled ket vector

% Matrix Elements and Expectation Values
( \phi | A | \psi )                      % Matrix element
\bra{\phi} A \ket{\psi}                  % Alternative matrix element
\braket{\phi | A | \psi}                 % Expectation value notation

% Complex Bra-Ket Example
( \phi | \frac{\partial^2}{\partial t^2} | \psi ) % Operator before
\Braket{\phi | \frac{\partial^2}{\partial t^2} | \psi } % Scaled

% Note: The braket package provides proper spacing and scaling
% for quantum mechanical notation in LaTeX
```

## LaTeX Relation Symbols

```
% LaTeX Relation Symbols and Operators
% Mathematical relation symbols and their LaTeX commands
```

```

% Equality and Equivalence
=           % Equals
\equiv      % Equivalent
\fallingdotseq % Falling dots equal
\eqcirc     % Equal with circle
\eqcolon    % Equal colon (or \minuscolon)
\eqqcolon   % Equal colon colon (or \equalscolon)
\eqsim      % Equal similar
\Equiv     % Equivalent (typo corrected: should be \equiv)

% Inequality Relations
<          % Less than
>          % Greater than
\ll        % Much less than
\gg        % Much greater than
\lessapprox % Less approximately
\lesseqtr  % Less equal greater
\lesseqgtr  % Less equal equal greater
\lessgtr   % Less greater
\lessim    % Less similar
\ggg       % Much much greater than
\gggtr    % Much greater than (alternative)

% Subset and Superset Relations
\subset     % Subset (or \sub)
\subseteqq  % Subset or equal (or \sube)
\Subset    % Double subset
\supset   % Superset
\supseteqq % Superset or equal (or \supe)
\Supset   % Double superset
\sqsubset  % Square subset
\sqsupset  % Square superset

% Order Relations
\prec      % Precedes
\precapprox % Precedes approximately
\preccurlyeq % Precedes curly equal
\preceq    % Precedes or equal
\precsim   % Precedes similar
\succ     % Succeeds

```

```
\succapprox % Succeeds approximately
\succcurlyeq % Succeeds curly equal
\succeq % Succeeds or equal
\sucessim % Succeeds similar

% Other Relations
\approx % Approximately equal
\thickapprox % Thick approximately equal
\parallel % Parallel
\perp % Perpendicular
\pitchfork % Pitchfork
\models % Models
\vDash % Double vertical bar equals
\Vdash % Double vertical bar dash
\vdash % Vertical bar dash
\asymp % Asymptotically equal
\bowtie % Bowtie
\Join % Join
```