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)
```

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

Lists

```latex
% 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

```latex
% 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|}
```

```
    \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
```

```latex
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

```latex
% 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

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

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

Footnotes and Margin Notes

```latex
% 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         % For all
∃   \exists         % There exists
∄   \nexists        % There does not exist

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

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

% Arrows and Implications
→   \to             % Right arrow
→   \implies        % Implies
←   \gets           % Left arrow
↔   \leftrightarrow % Left-right arrow
↔   \iff            % If and only if
↦   \mapsto         % Maps to

% Set Notation Examples
\[ \{x \mid x < \tfrac{1}{2}\} \]          % Set with mid bar
\set{x \mid x < \tfrac{1}{2}}              % Alternative set notat
\{x \mid x < 5\}                           % Simple set
```

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

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 be
\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
\Eguiv      % Equivalent (typo corrected: should be \equiv)

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

% Subset and Superset Relations
\subset     % Subset (or \sub)
\subseteq   % Subset or equal (or \sube)
\Subset     % Double subset
\supset     % Superset
\supseteq   % 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
\succsim    % 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
```