1 Typesetting Equations

There are two ways to typeset mathematical formulae: in-line within a paragraph, or in a separate line. In-line equations are entered between *two $ symbols* . To get equation in a separate line (that is in the **display mode**), we enclose it by $$ and $$ commands. The equation in a separate line with equation number can be done within the *equation* environment.

Example 1.1. `The equation $x+3y=2$ represents a straight line.` *will give the output*

The equation $x + 3y = 2$ represents a straight line.

Example 1.2. `The equation $$x+3y=2$$ represents a straight line.` *will give the output*

The equation

$$x + 3y = 2$$

represents a straight line.

Note.1. When we want a number (denoting the number of the equation in the chapter/section) to the single line formula, we enclose it by `\begin{equation}`and `\end{equation}` commands.

Example 1.3. *The out put of*
`Formula \begin{equation}\pi r^2\end{equation} is Area of a circle.`
is as shown below.

Formula

$$\pi r^2 \tag{1}$$

is Area of a circle.

Note.2. If we need to have equations in more than one line , we use `\begin{eqnarray}` and `\end{eqnarray}` commands with `\\` to separate the equations.

Example 1.4. *The out put of*

`The following system of equations does n't possess a solution:`

`\begin{eqnarray} x+2y=8\\x+2y=10\end{eqnarray}` *is*

The following system of equations does n't possess a solution:

$$x + 2y = 8 \tag{1}$$

$$x + 2y = 10 \tag{2}$$

Note.3. If we don't want numbers to the equations we use `\begin{eqnarray*}` and `\end{eqnarray*}` commands with `\\` to separate the equations.

Example 1.5. *The out put of*

```
The  following system of equations does n't possess a solution:
\begin{eqnarray*} x+2y=8\\x+2y=10\end{eqnarray*}
```

is

The following system of equations does n't possess a solution:

$$x + 2y = 8$$

$$x + 2y = 10$$

Note.4. If we want number to an equation and no number to another equation we use `\begin{eqnarray}` and `\end{eqnarray}` commands with the command `\nonumber` to the equation for which number is not needed.

Example 1.6. *The out put of*

```
The following system of equations does n't possess a solution:
\begin{eqnarray}
x+2y+3z=8\\
x+2y+3z=9\nonumber\\
x+2y+3z=10
\end{eqnarray}
```

is

The following system of equations does n't possess a solution:

$$x + 2y + 3z = 8 \tag{1}$$

$$x + 2y + 3z = 9$$

$$x + 2y + 3z = 10 \tag{2}$$

2 Arrays and matrices

To typeset arrays, use the array environment, that is similar to the tabular environment. Within an array environment, `&` character separates columns, `\\` starts a new line. The command `\hline` a horizontal line. Alignment of the columns is shown inside braces using characters (lcr) (l-left alignment, c - center alignment, r-right alignment) and the
| symbol is used for adding vertical lines. An example of making a table is shown below.

Example 2.1. *The latex command for the following table is as shown below*

person	*sex*	*age*
John	*male*	20
Mary	*female*	10
Gopal	*male*	30

```
\documentclass{article}
\begin{document}
$ \begin{array}{|l|cr|}\hline
person & sex & age \\
John & male & 20 \\
```

```
Mary & female & 10 \\

Gopal & male & 30 \\

\hline

\end{array} $

\end{document}
```

The first column is left justified, second is centered and the third is right justified (decided by the {|l|cr|}). If you insert a | character between c and r, it will add a vertical line between second and third columns.

Example 2.2.

No	Input	Output
1	`$\left[` `\begin{array}{ccc}` `2&3&4\\` `22&33&44\\` `222&333&444` `\end{array}` `\right]_{3\times 3}$`	$\left[\begin{array}{ccc} 2 & 3 & 4 \\ 22 & 33 & 44 \\ 222 & 333 & 444 \end{array}\right]_{3\times 3}$
2	`$\left[` `\begin{array}{lll}` `2&3&4\\` `22&33&44\\` `222&333&444` `\end{array}` `\right]_{3\times 3}$`	$\left[\begin{array}{lll} 2 & 3 & 4 \\ 22 & 33 & 44 \\ 222 & 333 & 444 \end{array}\right]_{3\times 3}$
3	`$\left[` `\begin{array}{rrr}` `2&3&4\\` `22&33&44\\` `222&333&444` `\end{array}` `\right]_{3\times 3}$`	$\left[\begin{array}{rrr} 2 & 3 & 4 \\ 22 & 33 & 44 \\ 222 & 333 & 444 \end{array}\right]_{3\times 3}$
4	`$\left[` `\begin{array}{lcr}` `2&3&4\\` `22&33&44\\` `\end{array}` `\right]_{2\times 3}$`	$\left[\begin{array}{lcr} 2 & 3 & 4 \\ 22 & 33 & 44 \end{array}\right]_{2\times 3}$
5	`$\left(` `\begin{array}{lcr}` `2&3&4\\` `22&33&44\\` `222&333&444` `\end{array}` `\right)_{3\times 3}$`	$\left(\begin{array}{lcr} 2 & 3 & 4 \\ 22 & 33 & 44 \\ 222 & 333 & 444 \end{array}\right)_{3\times 3}$

Problem 1. *Write Latex source code for*

No.	*Name*	*Mark*
5	*Ram*	95
12	*Pooja*	85
140	*Roshan*	100

```
\begin{center}
$\begin{array}{|l|l|r|}\hline
No. & Name & Mark \\\hline
5 & Ram & 95 \\
12 & Pooja & 85 \\
140 & Roshan & 100 \\
\hline
\end{array}$
\end{center}
```

3 Mathematics Formulas

A mathematical formula appearing in a sentence is enclosed by $ and $

Command	**Output**	**Command**	**Output**
`$ a_n $`	a_n	`$a^m $`	a^m
`$\overline{0.3}$`	$\overline{0.3}$	`$0.\overline{5}$`	$0.\overline{5}$
`$\underline{1/3}$`	$\underline{1/3}$	`$0.\underline{3}$`	$0.\underline{3}$
`$a^{b^c}$`	a^{b^c}	`$2^{r^m+k}$`	2^{r^m+k}
`$\vec{a}$`	$\vec{a}$	`$\overrightarrow{a+b}$`	$\overrightarrow{a+b}$
`$\frac{2}{5}$`	$\frac{2}{5}$	`$\frac{x^2+1}{y} $`	$\frac{x^2+1}{y}$
`$\sqrt{x+y}$`	$\sqrt{x+y}$	`$\sqrt[3]{x+y}$`	$\sqrt[3]{x+y}$
`$\infty$`	∞	`$\epsilon$`	ϵ

Example 3.1.

No	Input	Output
6	`$A = \left(` `\begin{array}{ccc}` `x_1 & x_2 & \ldots \\` `y_1 & y_2 & \ldots \\` `\vdots & \vdots & \ddots \\` `\end{array}` `\right)$`	$A = \left(\begin{array}{ccc} x_1 & x_2 & \ldots \\ y_1 & y_2 & \ldots \\ \vdots & \vdots & \ddots \\ \end{array} \right)$
7	`$\left[` `\begin{array}{cccc}` `a_{11}&a_{12}&\ldots&a_{1n}\\` `a_{21}&a_{22}&\ldots&a_{2n}\\` `\vdots&\vdots&\vdots&\vdots\\` `a_{m1}&a_{m2}&\ldots& a_{mn}` `\end{array}` `\right]_{m \times n}$`	$\left[\begin{array}{cccc} a_{11} & a_{12} & \ldots & a_{1n} \\ a_{21} & a_{22} & \ldots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{m1} & a_{m2} & \ldots & a_{mn} \end{array} \right]_{m \times n}$

Problem 2. *Typeset* $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$

```
\documentclass{article}
\begin{document}
$A = \left(
\begin{array}{cc}
1&2\\
3&4
\end{array}\right)$
\end{document}
```

4 Mathematical Symbols

There are TEX commands to make almost any mathematical symbol you're like to need.

4.1 Greek Letters

Command	Output	Command	Output	Command	Output
\$\alpha\$	α	\$\beta\$	β	\$\gamma\$	γ
\$\lambda\$	λ	\$\sigma\$	σ	\$\psi\$	ψ
\$\theta\$	θ	\$\delta\$	δ	\$\omega\$	ω
\$\pi\$	π	\$\chi\$	χ	\$\mu\$	μ
\$\xi\$	ξ	\$\eta\$	η	\$\zeta\$	ζ
\$\Delta\$	Δ	\$\Omega\$	Ω	\$\Pi\$	Π
\$\rho\$	ρ	\$\Sigma\$	Σ	\$\nu\$	ν

4.2 Some Binary Symbols

Command	Output	Command	Output
\$\pm\$	$\pm$	\$\circ\$	$\circ$
\$\mp\$	$\mp$	\$\bullet\$	$\bullet$
\$\times\$	$\times$	\$\oplus\$	$\oplus$
\$\div\$	$\div$	\$\otimes\$	$\otimes$
\$\ast\$	$*$	\$\cdot \$	$\cdot$

4.3 Some Arrow Symbols

Command	Output	Command	Output
\$\leftarrow\$	$\leftarrow$	\$\longleftarrow\$	$\longleftarrow$
\$\Leftarrow\$	$\Leftarrow$	\$\uparrow\$	$\uparrow$
\$\rightarrow\$	$\rightarrow$	\$\Uparrow\$	$\Uparrow$
\$\Rightarrow\$	$\Rightarrow$	\$\updownarrow\$	$\updownarrow$
\$\Leftrightarrow\$	$\Leftrightarrow$	\$\Updownarrow\$	$\Updownarrow$

4.4 Some Relation Symbols

Command	Output	Command	Output	Command	Output
$\leq$	$\leq$	$\in$	$\in$	$\ll$	$\ll$
$\geq$	$\geq$	$\notin$	$\notin$	$\gg$	$\gg$
$\neq$	$\neq$	$\subset$	$\subset$	$\preceq$	$\preceq$
$\equiv$	$\equiv$	$\subseteq$	$\subseteq$	$\succeq$	$\succeq$
$\perp$	$\perp$	$\approx$	$\approx$	$\succ$	$\succ$
$\parallel$	$\parallel$	$\sim$	$\sim$	$\emptyset$	$\emptyset$
$\prec$	$\prec$	$\simeq$	$\simeq$	$\prec$	$\prec$

4.5 Some Other Symbols

Command	Output	Command	Output
$\sum$	$\sum$	$\cap$	$\cap$
$\int$	$\int$	$\bigcap$	$\bigcap$
$\oint$	$\oint$	$\cup$	$\cup$
$\Forall$	$\forall$	$\bigcup$	$\bigcup$
$\exists$	$\exists$	$\neg$	$\neg$

5 Mathematical Functions

Command	Output	Command	Output	Command	Output
$\cos$	cos	$\arccos$	arccos	$\ln$	ln
$\sin$	sin	$\arcsin$	arcsin	$\log$	log
$\tan$	tan	$\arctan$	arctan	$\sup$	sup
$\sinh$	sinh	$\tanh$	tanh	$\dim$	dim
$\cosh$	cosh	$\coth$	coth	$\min$	min
$\lim$	lim	$\exp$	exp	$\max$	max

Problem 3. *Typeset* $R = \begin{pmatrix} \sin\theta & \cos\theta \\ \cos\theta & \sin\theta \end{pmatrix}$

```
\documentclass{article}
\begin{document}
$R = \left(
\begin{array}{cc}
\sin \theta & \cos \theta\\
\cos \theta & \sin \theta
\end{array}\right)$
\end{document}
```

Example 5.1.

Output	Input	Output	Input
$\sum_{i=0}^{n}$	`$\sum_{i=0}^n$`	$\int_0^{\pi} f(x)dx$	`$\int_0^\pif(x)dx$`
$\sum_{i=0}^{n} x_i$	`$\sum_{i=0}^nx_i$`	$\int_0^{\infty} f(x)dx$	`$\int_0^\infty f(x)dx$`
$\sum_{i=0}^{n} x_{i+1}$	`$\sum_{i=0}^nx_{i+1}$`	$\int_0^{\pi} \sin x dx$	`$\int_0^\pi\sin xdx$`
$\sum_{i=0}^{n} x_i + 1$	`$\sum_{i=0}^nx_i+1$`	$\prod_{\epsilon}$	`$\prod_\epsilon$`
$\sum_{j=0}^{n} j^2$	`$\sum_{j=0}^j2$`	$\prod_{i=0}^{n}$	`$\prod_{i=0}^n$`
$\sum_{i=0}^{n} f(i)$	`$\sum_{i=0}^nf(i)$`	$\prod_{i=0}^{n} x_i$	`$\prod_{i=0}^nx_i$`
$\int_a^b f(x)dx$	`\int_a^bf(x)dx`	$\prod_{i=0}^{n} x_i + 1$	`$\prod_{i=0}^nx_i+1$`

Example 5.2.

Output	LaTex Code
$\sin x + \arctan y$	`$\sin x+\arctan y$`
$\sin x + \cos y$	`$\sin x+\cos y$`
$\sin^2 x + \cos^2 x = 1$	`$\sin^2x+\cos^2x=1$`
$\sin^2 x = \frac{1-\cos 2x}{2}$	`$\sin^2x=\frac{1-\cos2x}{2}$`

Example 5.3.

Output	Input
$\sqrt{x^2+y^2}$	`$\sqrt{x^2+y^2}$`
$\sqrt[3]{x^2+y^2}$	`$\sqrt[3]{x^2+y^2}$`
$\sqrt[3]{x^2+\sqrt{y}}$	`$\sqrt[3]{x^2+\sqrt y}$`
$\sqrt[3]{x^2+\sqrt{y}+1}$	`$\sqrt[3]{x^2+\sqrt y+1}$`
$\sqrt[3]{x^2+\sqrt{y+1}}$	`$\sqrt[3]{x^2+\sqrt {y+1}}$`
$\lim_{x\rightarrow a}$	`$\lim_{x \rightarrow a}$`
$\displaystyle\lim_{x\rightarrow a}$	`$\displaystyle\lim_{x \rightarrow a}$`
$\sum_{i=0}^{n}(x_i+1)$	`$\sum_{i=0}^n(x_i+1)$`
$\int_0^{\frac{1}{2}}f(x)dx$	`$\int_0^\frac{1}{2}f(x)dx$`
$\displaystyle\int_0^{\frac{1}{2}}f(x)dx$	`$\displaystyle\int_0^\frac{1}{2}f(x)dx$`
$\int_0^{\frac{\pi}{2}}\sin xdx$	`$\int_0^\frac{\pi}{2}\sin xdx$`
$\prod_{i=0}^{n}x_{i+1}$	`$\prod_{i=0}^nx_{i+1}$`
$\prod_{i=0}^{n}(x_i+1)$	`$\prod_{i=0}^n(x_i+1)$`
$n!=1\cdot 2\cdot 3\cdots(n-1)\cdot n$	`$n!=1\cdot 2\cdot 3 \cdots (n-1)\cdot n$`
$A \quad B \qquad C$	`$A\quad B\qquad C $`

Problem 4. *Typeset* $\Big((x+1)(x-2)\Big)^2$

The above form is obtained by typing

```
\documentclass{article}
\begin{document}
$\Big((x+1)(x-2)\Big)^2$
\end{document}
```

6 Mathematical Operators

Command	Output
`$\frac{dy}{dx}$`	$\frac{dy}{dx}$
`$\dfrac{dy}{dx}$`	$\dfrac{dy}{dx}$
`$\frac{d^2y}{dx^2}$`	$\frac{d^2y}{dx^2}$
`$\dfrac{d^2y}{dx^2}$`	$\dfrac{d^2y}{dx^2}$
`$\frac{\partial y}{\partial x}$`	$\frac{\partial y}{\partial x}$
`$\dfrac{\partial y}{\partial x}$`	$\dfrac{\partial y}{\partial x}$
`$\dfrac{\partial^2 y}{\partial x^2}$`	$\dfrac{\partial^2 y}{\partial x^2}$

Problem 5. *Typeset* $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

```
\documentclass{article}
\begin{document}
$x= \frac{-b \pm \sqrt{b^2-4ac}}{2a}$
\end{document}
```

Problem 6. *Typeset* $\sum_{n=1}^{\infty} \left(1+\frac{1}{n}\right)^n$

```
\documentclass{article}
\begin{document}
$\sum_{n=1}^\infty \left( 1+\frac{1}{n}\right)^n$
\end{document}
```

Problem 7. *Typeset* $\left(\sqrt{x^2+y^2}\right)^2 = x^2+y^2$

```
\documentclass{article}
\begin{document}
$\left( \sqrt{x^2+y^2}\right)^2 = x^2+y^2 $
\end{document}
```

Example 6.1.

1	`$\left(` `\begin{array}{c}` `\left\|` `\begin{array}{cc}` `a&b\\` `c&d` `\end{array}` `\right\|\\` `y\\` `z` `\end{array}` `\right)$`	$\left(\begin{array}{c} \left\| \begin{array}{cc} a & b \\ c & d \end{array} \right\| \\ y \\ z \end{array} \right)$
2	`\begin{eqnarray}` `y&=& mx+c\\` `z&>& a+b+c+e+f+g+\nonumber\\` `& & i+j+k+l+m+n+o+p` `\end{eqnarray}`	$\begin{aligned} y &= mx+c && (3)\\ z &> a+b+c+e+f+g+ \\ &\quad i+j+k+l+m+n && (4) \end{aligned}$
3	`\begin{eqnarray*}` `x&\leq & y_1+\cdots+y_n\\` `& <  & z` `\end{eqnarray*}`	$\begin{aligned} x &\leq y_1+\cdots+y_n \\ &< z \end{aligned}$
4	`\begin{eqnarray*}` `y&=& a+b+c+d+e+f+g+h\\` `& & +k+l+m+n+o+p` `\end{eqnarray*}`	$\begin{aligned} y &= a+b+c+d+e+f+g+h \\ &\quad +i+j+k+l+m+n \end{aligned}$

Example 6.2.

No	Input	Output
1	`\underline{The} value is $\underline{3x}$`	$\underline{\text{The}}$ value is $\underline{3x}$
2	`$\overline{x^2+1}$`	$\overline{x^2+1}$
3	`$\overbrace{a+\underbrace{b+c}+d}$`	$\overbrace{a+\underbrace{b+c}+d}$
4	`$\underbrace{n+n+\cdots +n}_{k times}$`	$\underbrace{n+n+\cdots+n}_{k\,times}$
5	`$\widehat{1-x}= \widehat{-y}$`	$\widehat{1-x}=\widehat{-y}$
6	`$ A\stackrel{f}{\rightarrow}B$`	$A \stackrel{f}{\rightarrow} B$

7 Dividing the document

A document is generally organized in to sections,subsections,paragraphs etc. and Latex allows us to do this by inserting commands like section, subsection etc. If the document class is book, you can have chapters also. There is a command to generate the table of contents from the sectioning information.(To generate table of contents, you may have to compile the document two times).

Example 7.1.

Input	Output
\documentclass{article} \begin{document} \section*{Mathematics} Mathematics is the abstract study... \subsection{Algebra} Algebra is one of the main.... \subsubsection{Abstract algebra} It is the subject area of mathematics that studies.. \subsubsection{Linear Algebra} It is the branch of mathematics concerning vector spaces, \subsection{Analysis} Mathematical analysis is a branch of pure mathematics.. \subsubsection{Real Analysis} This deals with real numbers \subsection{Topology} It is a major area of mathematics concerned.. \section{Physics} It is a natural science that involves... \subsection{Nuclear physics} It is the field of physics that studies.. \end{document}	**Mathematics** Mathematics is the abstract study... **Algebra** Algebra is one of the main.... **Abstract algebra** It is the subject area of mathematics that studies.. **Linear Algebra** It is the branch of mathematics concerning vector spaces, **Analysis** Mathematical analysis is a branch of pure mathematics.. **Real Analysis** This deals with real numbers **Topology** It is a major area of mathematics concerned.. **Physics** It is a natural science that involves... **Nuclear physics** It is the field of physics that studies..

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Problem 8. *Write latex Code for* $\mathbb{Z}^+ = \{1, 2, 3, \ldots\}$

```
\documentclass{article}
\begin{document}
$\mathbb{Z}^+= \{ 1,2,3,\ldots \} $
\end{document}
```