

Unit : V
 Additional elements : The equation

$$I(x) = \sin\left(\frac{\pi}{2} x^2\right) \sum_{n=0}^{\infty} \frac{(-1)^n \pi^{2n}}{1 \cdot 3 \cdots (4n+1)} x^{4n+1}$$

is generated with

`\begin{equation}`

$$I(x) = \sin\left(\frac{\pi}{2} x^2\right) \sum_{n=0}^{\infty} \frac{(-1)^n \pi^{2n}}{1 \cdot 3 \cdots (4n+1)} x^{4n+1}$$

Automatic sizing of bracket symbols

The bracketing symbols, usually in pairs that enclose part of the formula. When printed, these bracket symbols should be the same size as the included partial formula.

LATEX provides a pair of commands

`\left` `\lbrack` sub.form `\right` `\rbrack`

to accomplish this.

The command `\left` is placed immediately before the opening (left hand) bracket symbol `\lbrack` while `\right` comes just before the closing symbol `\rbrack`.

$$\left[\int_{x=0}^x + \int_{x=1}^x \right] \quad \left[\left[\left[\int_{x=0}^x + \int_{x=1}^x \right] \right] \right]$$

The `[ ]` is adjusted to the size of the enclosed formula, as are the raised exponent and lowered index as well.

The commands `\left` and `\right` must appear as a pair.

$$\underline{\text{En}} : \bar{x} + \bar{y} + \bar{z} = \begin{pmatrix} a \\ b \end{pmatrix}$$

This set of brackets is admittedly unusual but permissible.

$$\left[\text{vec}\{x\} + \text{vec}\{y\} + \text{vec}\{z\} = \text{left}(\dots \text{right}[1] \right]$$

Sometimes a formula contains only a single opening or closed bracket without a corresponding counterpart.

for example $y = \begin{cases} -1 & : x < 0 \\ 0 & : x = 0 \\ +1 & : x > 0 \end{cases}$

$$\left[y = \text{left} \left\{ \begin{array}{l} \\ x @ \{ \text{quad} : \text{quad} \} \end{array} \right\} \right. \\ -1 \& x < 0 - \backslash 0 \& x = 0 \backslash +1 \& x > 0 \\ \left. \text{end} \{array\} \text{right.} \right]$$

The `\left...` `\right` commands may be applied to a total of 22 different symbols. These are

<code>(</code>	<code>)</code>	<code>[</code>	<code>\lfloor</code>	<code>\rfloor</code>
<code>[</code>	<code>]</code>	<code>\lceil</code>	<code>\rceil</code>	
<code>\{</code>	<code>\}</code>	<code>\langle</code>	<code>\rangle</code>	
<code> </code>	<code> </code>	<code>\uparrow</code>	<code>\Uparrow</code>	
<code>/</code>	<code>\backslash</code>	<code>\downarrow</code>	<code>\Downarrow</code>	
		<code>\updownarrow</code>	<code>\Updownarrow</code>	

For example, `\left|...` `\right|` produces two vertical bars adjusted in height to contain the enclosed formula text.

ordinary text within a formula

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It is necessary to include some normal text within a formula, for example single words such as and, or, if and so on. In that case `\mbox{normal text}` given inside the formula together with `\quad`.
For example

$$X_n = X_k \text{ if and only if } Y_n = Y_k \text{ and } Z_n = Z_k$$

$$\{ [X_n = X_k \quad \text{if and only if}] \quad$$

$$Y_n = Y_k \quad \text{and} \quad Z_n = Z_k \quad]$$

Matrices and arrays.

$$\begin{matrix} a_{11} & a_{12} & \dots & a_{1n} \\ \vdots & & & \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{matrix}$$

Structures, like the one at the left are the basis for matrices, determinants, system of equations and so on. They will be referred as arrays.

For example

$$a_{11}x_1 + a_{12}x_2 + \dots + a_{1n}x_n = b_1$$

$$a_{21}x_1 + a_{22}x_2 + \dots + a_{2n}x_n = b_2$$

$$\vdots$$
$$a_{n1}x_1 + a_{n2}x_2 + \dots + a_{nn}x_n = b_n$$

$$\begin{array}{l} \begin{array}{l} \text{\texttt{\textbackslash begin\{array\} *{3} @{\scriptsize +} c@{\scriptsize =} c} \\ a_{\scriptsize 11} x_1 \& a_{\scriptsize 12} x_2 \& \cdots \& a_{\scriptsize 1n} x_n \& b_1 \\ a_{\scriptsize 21} x_1 \& a_{\scriptsize 22} x_2 \& \cdots \& a_{\scriptsize 2n} x_n \& b_2 \\ \vdots \\ a_{\scriptsize n1} x_1 \& a_{\scriptsize n2} x_2 \& \cdots \& a_{\scriptsize nn} x_n \& b_n \end{array} \\ \text{\texttt{\textbackslash multicolumn\{5\} *{1} \text{\texttt{\textbackslash dotfill}}}} \\ a_{\scriptsize n1} x_1 \& a_{\scriptsize n2} x_2 \& \cdots \& a_{\scriptsize nn} x_n \& b_n \\ \text{\texttt{\textbackslash end\{array\}}} \end{array}$$

where

* $\{3\} \{c @ \{1: + 1: \}\}$ - is an abbreviation for three repetitions of the column definition $@ \{1: + 1: \}$.

* c defines the column to be one of centered text

* $\{multicolumn\{5\}\{c\}$ says that the next five columns are to be merged and replaced by one with centered text.

* $\{dotfill\}$ fills the column with dots.

Lines above and below formulas

the command

$\overline{\text{sub-form}}$ and $\underline{\text{sub-form}}$ can be used to draw lines over or under a formula or sub-formula.

For example

$$\overline{\overline{a^2} + \underline{xy} + \overline{yz}}$$

$$\left[\overline{\overline{\overline{a^2} + \underline{xy}} + \overline{\overline{yz}}} \right]$$

The command $\underline{\text{sub-form}}$ may also be employed in normal text mode to underline text, whereas

$\overline{\text{sub-form}}$ is allowed only in math mode.

the commands,

$\overbrace{\text{sub-form}}$ and $\underbrace{\text{sub-form}}$

which put horizontal curly braces above or below the sub-formula

$$\underbrace{a+b+c+d} \quad \overbrace{a + \underbrace{b+c} + d}$$

Stacked Symbols the command

`\stackrel{upper-sym}{\lower-sym}`

places the symbol `upper-sym` centered on top of `lower-sym`, whereby the symbol on top is set in a small typeface.

$$A \overset{\alpha'}{\rightarrow} B \overset{\beta'}{\leftarrow} C \quad \$ A \backslash stackrel{\{\alpha'\}}{\{\longrightarrow\}} B \dots$$

Additional T_EX commands

`\choose` command, enclosed within round bracket (binomial coefficients)

$$\binom{n+1}{k} = \binom{n}{k} + \binom{n}{k-1}$$

$$\left[\{n+1 \backslash choose k\} = \{n \backslash choose k\} + \{n \backslash choose k-1\} \right]$$

Multiline equations: the commands

`\begin{eqnarray} line_1 \backslash \dots \backslash line_n \end{eqnarray}`

`\begin{eqnarray*} line_1 \backslash \dots \backslash line_n \end{eqnarray*}`

are used to set several lines of formulas or equations in math mode. The individual lines of the equation or formula are separated from one another by `\backslash`.

Ex. $(x+y)^2 = x^2 + 2xy + y^2$

$$\begin{eqnarray} (x+y)^2 & = & x^2 + 2xy + y^2 \end{eqnarray}$$

`\end{eqnarray}`

Framed or side-by-side formulas

$$\alpha = f(x) \quad (5-8), \quad \beta = f(x^2) \quad (5-9), \quad x = \alpha^2 - \beta^2$$

The left-hand set of equations is set in a parbox of width 4cm, the right hand set in one of width 2.5cm, while this text is inside a minipage of width 4.5cm.

`\parbox{4cm}{\begin{equation}}`

`\alpha &= f(x) \dots \end{equation}}`

`\hfill \parbox{2.5cm}{\begin{equation}^*`

`\alpha^2 - \beta^2 \end{equation}^*}}`

`\hfill \begin{minipage}{4.5cm} the left-hand`
`\dots \end{minipage}`

Chemical formulas and bold face formulas

In mathematics it is sometimes necessary to set individual characters or parts of the formula in bold face.

1) $\mathbf{S^T S} = \text{dg}(\omega_1, \dots, \omega_n)$

produces

$$= (\Lambda) \mathbf{S}$$

$$\mathbf{S}^{-1} \mathbf{T} \mathbf{S} = \text{dg}(\omega_1, \dots, \omega_n) = \Lambda$$

2) $\mathbf{2\sqrt{x/y} = y}$ produces

$$2\sqrt{x/y} = y$$

3) $\mathbf{(P = \boxed{unbold math sm})unboldmath}$

yields $\mathbf{P = mb}$

International typesetting standards

(4)

The major points are

1. Simple variables are represented by italic letters as a b c x y z .
2. Vectors are written in boldface italic
3. Tensors of 2nd order and matrices may appear in a sans serif font as M D I
4. the special numbers e , i , π , d are to be written in an upright font.
5. A measurement consisting of a number plus a dimension is an indivisible unit with a smaller than normal space between them, as 5.3 km and 52 kg . The dimension is in an upright font.

5.5 Fine-tuning Mathematics

Horizontal spacing

Small amounts of horizontal spacing can be added in math mode with the commands

!, small space = $3/18$ of a quad

!:, medium space = $4/18$ of a quad

!;, large space = $5/18$ of a quad

!! negative space = $-3/18$ of a quad

and the horizontal spacing commands are

$\$ \sqrt[2]{x} \$$

$\sqrt[2]{x}$

$\$ \left(\frac{1}{\sqrt{n}} \right) \$$

$O(1/\sqrt{n})$

$\$ [1, 0, 1] \$$

$[0, 1]$

$\$ x^1_2 \text{ } 1/2 \$$

x^2_2

$\$ \Gamma_{12} + \Delta^{12} \$$

$\Gamma_2 + \Delta^2$

$$\$ R_{-i} \{ \} ^{ \{ \} } _{ \{ \} } \{ \backslash ! k 7 \} \$$$

$$R_i^j k l$$

$$\$ \int \limits_{- \infty}^{\infty} x \backslash ! \int \limits_{- \infty}^{\infty} y \mathrm{d} F(u, v) \$ \quad \int \limits_{0}^x \int \limits_{0}^y dF(u, v)$$

Selecting font size in formulas

In math mode there are four font sizes that may be chosen, their actual sizes being relative to the basic font size of the document class:

<code>\displaystyle</code>	D	Normal size for displayed formulas
<code>\textstyle</code>	T	Normal size for text formulas
<code>\scriptstyle</code>	S	Normal size for first sub-, superscript
<code>\scriptscriptstyle</code>	SS	Normal size for later sub-, superscript

Starting from these base sizes, various math elements will be set in other sizes. Once another size has been chosen for an element, it remains the active size within that element.

The table below shows the selection rules

Active size	Fractions		Super subscripts
	upper	lower	
D	T	T	S
T	S	S	S
S	SS	SS	SS
SS	SS	SS	SS

If the active size is D, size T is selected for both parts of the fraction. That is, for both numerator and denominator T becomes the active size. If they in turn contain further fractions, these will be set in S. If the active size is D or T, superscripts and subscripts

appear in S ; within them S is the active size and any fractions or shiftings inside them will be set in SS .

Ex:

$$\frac{a_0 + \frac{1}{a_1 + \frac{1}{a_2 + \frac{1}{a_3 + \frac{1}{a_4}}}}}{1}$$

must appear as shown at the right. Such a math structure, called a continued fraction, is normally printed as

$$a_0 + \frac{1}{a_1 + \frac{1}{a_2 + \frac{1}{a_3 + \frac{1}{a_4}}}}$$

For each of the four math font sizes D, T, S, SS there is a modified version D', T', S', SS' . The difference is that with D, T, S, SS the superscripts are somewhat higher than they are with D', T', S', SS' .

Active size	Fraction upper	Fraction lower	Superscripts	Subscripts
D	T	T'	S	S
D'	T'	T'	S'	S'
T	S	S'	S	S'
T'	S'	S'	S'	S'
S, SS	SS	SS'	SS	SS'
S', SS'	SS'	SS'	SS'	SS'

When the font size is explicitly started within a numerator or superscript, the unprinted version is selected; and in the denominators and subscripts, the printed fonts.

Manual Sizing of bracket symbols

The `\left`...`\right` commands preceding one of the 22 bracket symbols. However, it is possible to select a size explicitly by placing one of the $\text{T}_\text{E}\text{X}$ commands `\big`, `\Big`, `\bigg`, or `\Bigg` before the bracket symbol.

none $() [] \{\} \llcorner \lrcorner \langle \rangle \uparrow \uparrow \downarrow \downarrow \downarrow$

`\big` $() [] \{\} \llcorner \lrcorner \langle \rangle \uparrow \uparrow \downarrow \downarrow \downarrow$

`\Big` $() [] \{\} \llcorner \lrcorner \langle \rangle \uparrow \uparrow \downarrow \downarrow \downarrow$

`\bigg` $() [] \{\} \llcorner \lrcorner \langle \rangle \uparrow \uparrow \downarrow \downarrow \downarrow$

`\Bigg` $() [] \{\} \llcorner \lrcorner \langle \rangle \uparrow \uparrow \downarrow \downarrow \downarrow$

In contrast to the `\left`...`\right` pairs, the explicit bracket size commands do not have to be contained within one line of a multiline formula.

Math style parameters: The mathematical style parameters listed below are set to standard values by $\text{L}_\text{A}_\text{T}_\text{E}_\text{X}$. `\setlength` command is used as usual manner.

`\arraycolsep` — Half the width of the intercolumn spacing for the array environment.

`\jot` — Extra vertical spacing that appears between the rows of multiple equations in the `\eqnarray` and `\eqnarray` environment.

$\backslash$ mathindent - The amount of indentation for math formulas when the document class option $\backslash$ leqno has been selected

$\backslash$ abovedisplayskip - The vertical spacing above displayed formulas when the left side of the formula is closer to the left margin than the end of the preceding line of text. Such a formula is designated long.

$\backslash$ belowdisplayskip - The vertical spacing inserted below a long displayed formula.

$\backslash$ abovedisplayshortskip - Vertical spacing added above a short displayed formula. This is one in which the left edge to the right of the end of the preceding line of text.

$\backslash$ belowdisplayshortskip - Vertical spacing inserted after a short displayed formula.

$\backslash$ topsep - Inserted above and below displayed formulas.