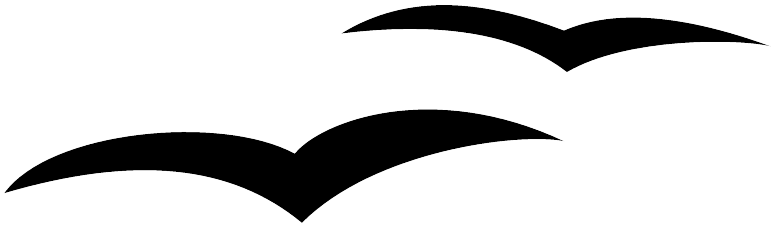
OpenOffice.org
The Open Source Office Suite

Math Objects:

The Equation Editor



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Contents

Overview

OpenOffice.org has a component (OOo Math) for mathematical equations. OOo Math provides mathematical objects which can be embedded in other OOo documents, or saved on their own.

Copyright and trademark information

Feedback

Please direct any comments or suggestions about this document to:
authors@user-faq.openoffice.org

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Modifications and updates

Version	Date	Description of Change
1.0	21 November 2004	First published edition

Introduction

OpenOffice.org (OOo) has a component for mathematical equations. It is most commonly used as an equation editor for text documents, but it can also be used with other types of documents or stand-alone. When used inside Writer, the equation is treated as an object inside the text document.

Important note: *The equation editor is for writing equations in symbolic form (as in equation 1). If you want to evaluate a numeric value, this is not the chapter you want. See the Calc guide.*

$$\frac{df(x)}{dx} = \ln(x) + \tan^{-1}(x^2) \tag{1}$$

Getting started

To insert an equation, go to **Insert > Object > Formula**.

The equation editor opens at the bottom of the screen, and the floating *Selection* toolbox appears. You will also see a small box (with a gray border) in your document, where the formula will be displayed.

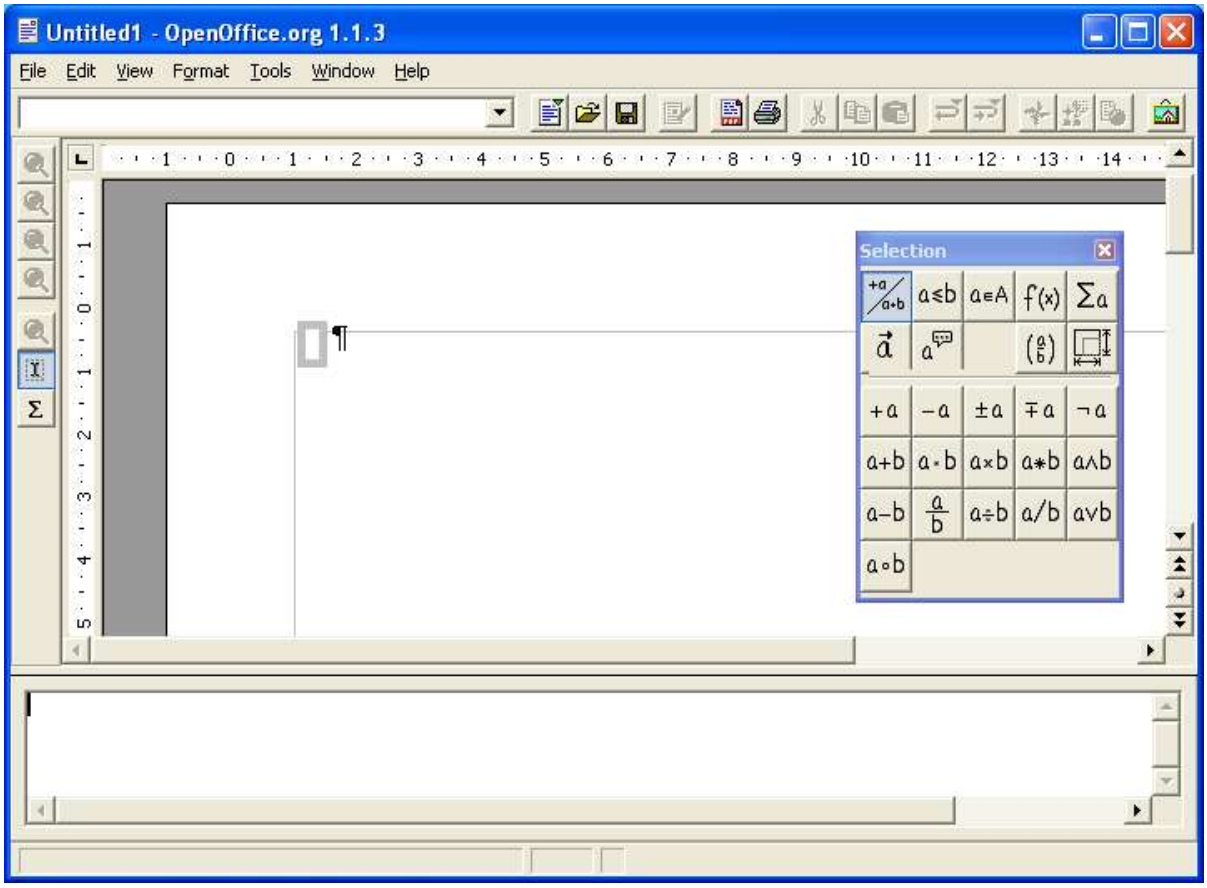

Figure 1. Writer document showing Equation Editor , Selection toolbar, and location of resulting equation.

The equation editor uses a markup language to represent formulas. For example, "%beta" creates the Greek character beta (β). This markup is designed to read similar to English whenever possible. For example, "a over b" produces a fraction:

$$\frac{a}{b}$$

Entering a Formula

There are three main ways of entering a formula:

- Type markup in the equation editor.
- Right-click on the equation editor and select the symbol from the context menu.
- Select a symbol from the *Selection* toolbox.

The context menu and the *Selection* toolbox insert the markup corresponding to a symbol. Incidentally, this provides a convenient way to learn the OOoMath markup. When you select a symbol from the Selection toolbox, it will show up like this in this equation editor:

<?> times <?>

And it will display on screen in Writer like this:

❑×❑

When you are editing in the equation editor, you need to remove the <?> and replace it with the terms of the equation. For example, "5 times 4" produces 5×4 . Below is a short list of common equations and their corresponding markup.

Display	Command	Display	Command
$a = b$	a = b	$\gamma \Gamma$	%gamma %GAMMA
a^2	a^2	a_n	a_n
$\int f(x)\,dx$	int f(x) dx	$\sum a_n$	sum a_n
$a \leq b$	a <= b	∞	infinity
$\frac{a}{b}$	a over b	$\begin{matrix} a \\ b \end{matrix}$	stack { a # b }
$\sqrt{a}$	sqrt {a}	$\vec{u}$	vec u
$x \times y$	x times y	$x \cdot y$	x cdot y

Complex Formulas

Of course, most people can figure out how to do something simple like $\sqrt{a}$. The problems appear when you try to write more complex equations. This section explores some general situations and suggests solutions.

Brackets are your friends

You may have heard your professor say this. It is true for science, and it is true for OOo. The equation editor knows nothing of order of operation. To make moderately complex formulas, you must use brackets. For example:

Display	Command
$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$	x = { -b +- sqrt { b^2 - 4ac } } over { 2a }

Tip: *Squiggly brackets can be used to collect terms without the bracket appearing in the equation.*

Sums and integration

The "sum" and "int" commands can optionally take in "from" and "to" parameters. These are used in a way that is meant to resemble how the equation is read in English. These parameters can be used singly or together. For example:

Display	Command
$\sum_{n=1}^{\infty} a_n + \frac{1}{n^2}$	sum from { n = 1 } to infinity { a_n + 1 over n^2}
$\sum_{a \in A} a^3$	sum from { i in A } { a^3 }
$\int_a^b x^2 + \frac{1}{x} dx$	int from a to b { x^2 + 1 over x dx }
$\int_{\alpha} r(\theta) e^{i\theta} d\theta$	int from %alpha { r(%theta)e^{i%theta} d %theta }

Tip: *Though they look the same, the "sum" command is more flexible than "%SIGMA".*

Tip: *Use "infinity" to produce the* ∞ *symbol.*

Matrices

Matrices are done through the matrix command. The basic syntax is:

Display	Command
$\begin{matrix} a & b \\ c & d \end{matrix}$	matrix { a # b ## c # d }

A single "#" symbol is used to separate entries within a given row. Two "#" symbols are used to separate different rows.

One of the first problems people have with matrices is working with brackets. Regular brackets have a fixed size, which doesn't fit well with matrices (see the table below). OOoMath provides "scalable brackets". These brackets adjust in size ("scale") to fit the size of their contents. To obtain scalable brackets, use the `left(` and `right)` commands.

Display	Command	Type
$det\left(\begin{matrix} a & b \\ c & d \end{matrix}\right)$	det (matrix { a # b ## c # d })	normal
$det\left(\begin{matrix} a & b \\ c & d \end{matrix}\right)$	det left(matrix { a # b ## c # d } right)	scalable

Tip: *Use left[and right] to obtain square brackets.*

Derivatives

To write a derivative, or a partial derivative, use the "over" command. That is, treat it as if it were a fraction. For higher-order derivatives, use the ^ symbol, like an exponent.

Display	Command
$\frac{df(t)}{dt} = \frac{\partial f}{\partial x}\frac{dx}{dt} + \frac{\partial f}{\partial y}\frac{dy}{dt}$	{df(t)} over {dt} = {partial f} over {partial x} {dx } over {dt} + {partial f} over {partial y} {dy } over {dt}

Complex layout

Often, the problem is not in writing the equation as such, but obtaining the desired layout. There are some features that can help:

- Adjust alignment with “alignl” (left alignment), “alignr” (right alignment) and “alignc” (centered).
- Use matrices for columned layout.
- Use white space and several lines to make your equation understandable.
- Use ~ or ‘ to produce white space on the equation.

Tip: *You can insert white space and additional lines in the markup without affecting the output of the equation.*

The following example illustrates most of the above.

Display	Command

$S_n = 1+r+r^2+\cdots+r^n$
$rS_n = r+\cdots+r^n+r^{n+1}$
$(1-r)S_n = 1-r^{n+1}$
$S_n = \frac{1-r^{n+1}}{1-r}$
	matrix {
	S_n #{}={}# alignl 1 + r + r^2 + dotsaxis + r^n ##
	rS_n #{}={}# alignl r + dotsaxis + r^n + r^{n+1} ##
	(1-r)S_n #{}={}# alignl 1 - r^{n+1} ##
	S_n #{}={}# alignl {1 - r^{n+1} } over {1-r}
	}

In addition to matrices, you can also used the *newline* command to move to a new line. Notice (below) that the *newline* command does not have to be on a line of its own.

Display	Command
$x+y=3$ $x-y=1$	x + y = 3 newline x – y = 1

Tips and tricks

Customizing the interface

There are a few ways to customize the equation editor's interface to make you more productive. Here are some suggestions:

- Show/hide the *Selection* toolbox with **View > Selection**.
- Turn off AutoUpdate with **View >AutoUpdate display** to improve speed. You can still update the formula manually by pressing *F9* or through **View > Update**.
- Turn the editor into a floating window:
  1) Hover the mouse above the *border* of the equation editor.
  2) Hold down the *Control* key.
  3) Drag the editor away from the main window.

Numbering equations

Equation numbering is possible and simple. Sadly, this feature is deeply hidden. To insert a formula with a number, follow these steps:

1) Start a new line.
2) Type `fn` and then press *F3*.

You will see a numbered formula appear:

$$E = mc^2 \tag{2}$$

Then double-click on the formula to edit it. For example, here is the Riemann Zeta function:

$$\zeta(z) = \sum_{n=1}^{\infty} \frac{1}{n^z} \tag{3}$$

The number in the equation is stored in the form of a field. To refer to an equation by its number (for example, “as shown in Equation (2)”):

1) **Insert > Cross-reference**..
2) Click on the *References* tab. (See Figure 2.)
3) Under *Type*, select *Text*.
4) Under *Selection*, pick the equation number.
5) Under *Format*, choose *Reference*.
6) Click **Insert**.

Done! If you later add more equations to the paper before the referenced equation, all the equations will automatically renumber and the cross-references will update.

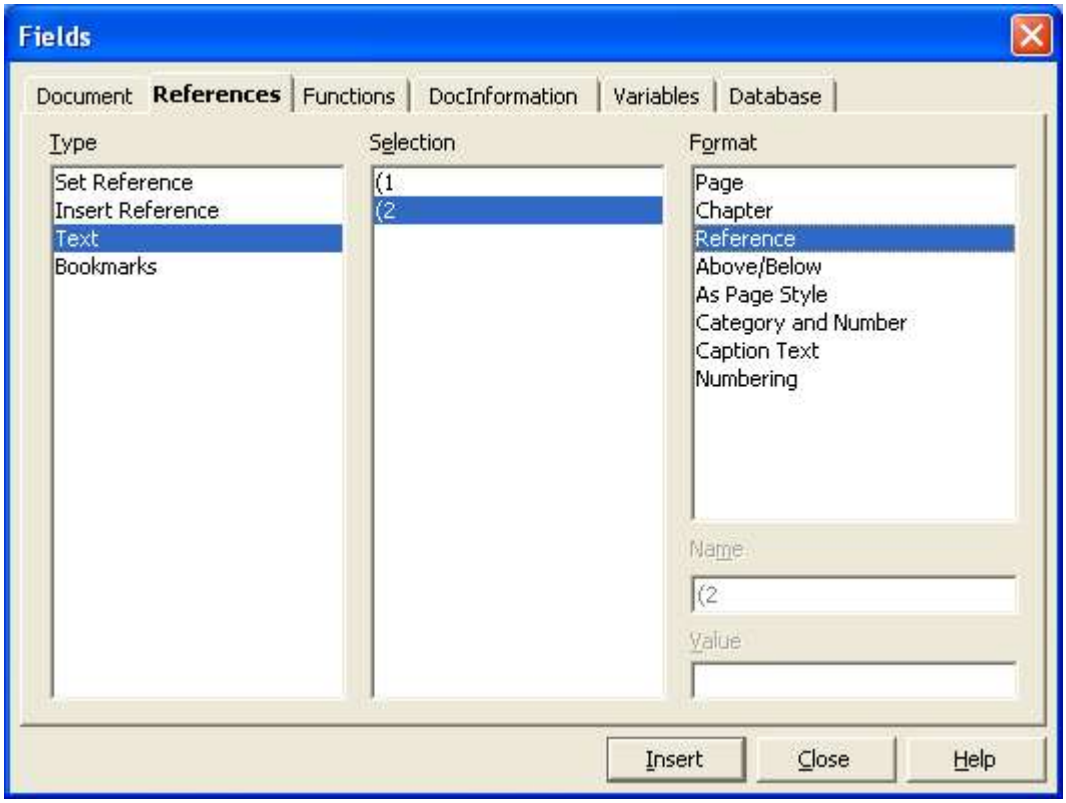

Figure 2. Inserting a cross-reference to an equation number.

Math commands - Reference

Unary / binary operators

Table 1. Commands, unary & binary

Operation	Command	Display
+sign	+1	$+1$
-sign	-1	-1
+/- sign	+-1	± 1
-/+ sign	neg 1	∓ 1
Boolean not	neg a	$\neg a$
Addition +	a + b	$a+b$
Multiplication dot	a cdot b	$a \cdot b$
Multiplication (X)	a times b	$a \times b$
Multiplication (*)	a * b	$a * b$
Boolean and	a and b	$a \wedge b$
Subtraction (-)	a - b	$a-b$
Division (fraction)	a over b	$\frac{a}{b}$
Division (operand)	a div b	$a \div b$
Division (slash)	a / b	a/b
Boolean or	a or b	$a \vee b$
Concatenate	a circ b	$a \circ b$

Relational operators

Table 2. Commands, relations

Operation	Command	Display
Is equal	a = b	$a = b$
Is not equal	a <> b	$a \neq 2$
Approximately	a approx 2	$a \approx 2$
Divides	a divides b	$a \mid b$
Does not divide	a ndivides b	$a \nmid b$
Less than	a < 2	$a < 2$
Greater than	a > 2	$a > 2$
Similar to or equal	a simeq b	$a \simeq b$
Parallel	a parallel b	$a \parallel b$
Orthogonal to	a ortho b	$a \perp b$
Less than or equal to	a leslant b	$a \leqslant b$
Greater than or equal to	a geslant b	$a \geqslant b$
Similar to	a sim b	$a \sim b$
Congruent	a equiv b	$a \equiv b$
Less than or equal to	a <= b	$a \leq b$
Greater than or equal to	a >= b	$a \geq b$
Proportional	a prop b	$a \propto b$
Toward	a toward b	$a \rightarrow b$
Arrow left	a dlarrow b	$a \Leftarrow b$
Double arrow left and right	a dlrarrow b	$a \Leftrightarrow b$
Arrow right	a drarrow b	$a \Rightarrow b$

Set operations

Table 3. Commands, set operators

Operation	Command	Display
Is in	a in B	$a \in B$
Is not in	a notin B	$a \notin B$
Owens	A owns b	$A \ni b$
Empty set	emptyset	$\emptyset$
Intersection	A intersection B	$A \cap B$
Union	A union B	$A \cup B$
Difference	A setminus B	$A \setminus B$
Quotient	A slash B	A / B
Aleph	aleph	$\aleph$
Subset	A subset B	$A \subset B$
Subset or equal to	A subseteq B	$A \subseteq B$
Superset	A supset B	$A \supset B$
Superset or equal to	A supseteq B	$A \supseteq B$
Not subset	A nsubset B	$A \not\subset B$
Not subset or equal	A nsubseteq B	$A \not\subseteq B$
Not superset	A nsupset B	$A \not\supset B$
Not Superset or equal	A nsupseteq B	$A \not\supseteq B$
Natural Numbers Set	setN	$\mathbb{N}$
Set of Integers	setZ	$\mathbb{Z}$
Set of rational numbers	setQ	$\mathbb{Q}$
Set of real numbers	setR	$\mathbb{R}$
Set of complex numbers	setC	$\mathbb{C}$

Functions

Table 4. Commands, function

Operation	Command	Display
Exponential	func e^{a}	e^{a}
Natural logarithm	ln(a)	$\ln(a)$
Exponential function	exp(a)	$\exp(a)$
Logarithm	log(a)	$\log(a)$
Power	a^{b}	a^{b}
Sine	sin(a)	$\sin(a)$
Cosine	cos(a)	$\cos(a)$
Tangent	tan(a)	$\tan(a)$
Cotangent	cot(a)	$\cot(a)$
Square root	sqrt{a}	$\sqrt{a}$
Arcsine	arcsin(a)	$\arcsin(a)$
Arc cosine	arccos(a)	$\arccos(a)$
Arctangent	arctan(a)	$\arctan(a)$
Arc cotangent	arccot(a)	$\operatorname{arccot}(a)$
n^{th} root	nroot{a}{b}	$\sqrt[a]{b}$
Hyperbolic sine	sinh(a)	$\sinh(a)$
Hyperbolic cosine	cosh(a)	$\cosh(a)$
Hyperbolic tangent	tanh(a)	$\tanh(a)$
Hyperbolic cotangent	coth(a)	$\coth(a)$
Absolute value	abs{a}	$\lvert a \rvert$
Arc hyperbolic sine	arsinh(a)	$\operatorname{arsinh}(a)$
Arc hyperbolic cosine	arccosh(a)	$\operatorname{arcosh}(a)$
Arc hyperbolic tangent	arctanh(a)	$\operatorname{artanh}(a)$
Arc hyperbolic cotangent	arccoth(a)	$\operatorname{arcoth}(a)$
factorial	fact(a)	$a!$

Operators

All operators can be used with the limit functions (“from” and “to”)

Table 5. Commands, operators

Operation	Command	Display
Limit	lim(a)	$\lim a$
Sum	sum(a)	$\sum a$
Product	prod(a)	$\prod a$
Coproduct	coprod(a)	$\coprod a$
Limits from and to (shown with intigral)	int from {r_0} to {r_t} a	$\int_{r_0}^{r_t} a$
Intigral	int{a}	$\int a$
Double intigral	iint{a}	$\iint a$
Tripple Intigral	iiint{a}	$\iiint a$
Lower limit shown with summation symbol	sum from{3}b	$\sum_{3} b$
Curved intigeral	lint a	$\oint a$
Double curved intigeral	llint a	$\oiint a$
Tripple curved intigeral	lllint a	$\oiiint a$
Upper limit shown with product symbol	prod to{3} r	$\prod^{3} r$

Attributes

Table 6. Attributes

Operation	Command	Display
Acute accent	acute a	$\acute{a}$
Grave accent	grave a	$\grave{a}$
Reverse circumflex	check a	$\check{a}$
Breve	breve a	$\breve{a}$
Circle	circle a	$\mathring{a}$
Vector arrow	vec a	$\vec{a}$
Tilde	tilde a	$\tilde{a}$
Circumflex	hat a	$\hat{a}$
Line above	bar a	$\bar{a}$
Dot	dot a	$\dot{a}$
Wide vector arrow	widevec abc	$\overrightarrow{abc}$
Wide tilde	widetilde abc	$\widetilde{abc}$
Wide circumflex	widehat abc	$\widehat{abc}$
Double dot	ddot	$\ddot{a}$
Line over	overline abc	$\overline{abc}$
Line under	underline abc	$\underline{abc}$
Line through	overstrike acb	~~*acb*~~
Ripple dot	dddot a	$\dddot{a}$
Transparent (useful to get a placeholder of a given size)	phantom a	
Bold font	bold a	$\boldsymbol{a}$
Italic font[1]	ital a	a
Resize font	size 16 qv	qv
Following item in sans serif font[2]	font sans qv	qv
Following item in serif font	font serif qv	qv
Following item in fixed font	font fixed qv	$\mathtt{qv}$

1 Unquoted text that isn't a command is considered to be a variable. Variables are, by default, italicized.

2 There are three custom fonts: sans serif (without kicks), serifs (with kicks), and fixed (non proportional). To change the actual fonts used for custom fonts and the fonts used for variables (unquoted text), numbers and functions, use: **Format > Fonts**.

Operation	Command	Display
Make color of following text cyan	color cyan qv	*qv*
Make color of following text yellow	color yellow qv	*qv*
Make color of following text green	color white qv	*qv*
Make color of following text white	color green qv	*qv*
Make color of following text blue	color blue qv	*qv*
Make color of following text red	color red qv	*qv*
Make color green returns to default color black	color green X qv	*X qv*
Brace items to change color of more than one item	color green {X qv}	*X qv*

Others

Table 7. Commands, others

Operation	Command	Display
Infinity	infinity	∞
Partial	partial	∂
Nabla	nabla	∇
There exists	exists	$\exists$
For all	forall	$\forall$
H bar	hbar	$\hbar a$
Lambda bar	lambdabar	λ
Real part	re	$\Re$
Imaginary part	im	$\Im$
Weierstrss p	wp	$\wp$
Left arrow	leftarrow	$\leftarrow$
Right arrow	rightarrow	$\rightarrow$
Up arrow	uparrow	$\uparrow$
Down arrow	downarrow	$\downarrow$
Dots at bottom	dotslow	$\ldots$
Dots at middle	dotsaxis	$\cdots$
Dots vertical	dotsvert	$\vdots$
Dots diagonal upward	dotsup	$\iddots$
Dots diagonal downward	dotsdown	$\ddots$

Brackets

Table 8. Commands, braces

Operation	Command	Display
Round Brackets	(a)	(a)
Square Brackets	[b]	$[b]$
Double Square Brackets	ldbracket c rdbracket	$[\![c]\!]$
Single line	lline a rline	$\lvert a \rvert$
Double line	ldline a rdline	$\lVert a \rVert$
Braces	lbrace w rbrace	$\{w\}$
Angle Brackets	langle d rangle	$\langle d \rangle$
Operator Brackets	langle a mline b rangle	$\langle a \mid b \rangle$
Group brackets (used for program control)	{a}	a
Scalable round brackets (add the word “left before a left bracket and “right” before a right bracket).	left (stack{a # b # z} right)	$\left(\begin{matrix} a \\ b \\ z \end{matrix} \right)$
Square brackets scalable (as above).	left [stack{ x # y} right]	$\left[\begin{matrix} x \\ y \end{matrix} \right]$
Double square brackets scalable	left ldbracket c right rdbracket	$\left[\!\left[c \right]\!\right]$
Line scalable	left lline a right rline	$\left\lvert a \right\rvert$
Double line scalable	left ldline d right rdline	$\left\lVert d \right\rVert$
Brace scalable	left lbrace e right rbrace	$\left\{ e \right\}$
Angle bracket scalable	left langle f right rangle	$\left\langle f \right\rangle$
Operator brackets scalable	left langle g mline h right rangle	$\left\langle g \middle\vert h \right\rangle$
Over brace scalable	{The brace is above} overbrace a	$\overbrace{\text{The brace is above}}^{a}$
Under brace scaleable	{the brace is below}underbrace {f}	$\underbrace{\text{the brace is below}}_{f}$

Formats

Table 9. Commands, formats

Operation	Command	Display
Left Superscript	a lsup{b}	${}^{b}a$
Center Superscript	sum(a)a csup{b}	$\sum_{a}^{b}$
Right Superscript	a^{b}	a^{b}
Left subscript	a lsub{b}	${}_{b}a$
Center subscript	a csub{b}	a_{b}
Right subscript	a_{b}	a_{b}
Align character to left	stack { Hello world # alignl (a) }	$\begin{matrix}Hello\,world\\(a)\end{matrix}$
Align character to center	stack{Hello world # alignc(a)}	$\begin{matrix}Hello\,world\\(a)\end{matrix}$
Align character to right	stack { Hello world # alignr(a)}	$\begin{matrix}Hello\,world\\(a)\end{matrix}$
Vertical stack of 2	binom{a}{b}	$\begin{matrix}a\\b\end{matrix}$
Vertical stack, more than 2	stack{a # b # z}	$\begin{matrix}a\\b\\z\end{matrix}$
Matrix stack	matrix{a # b ## c # d}	$\begin{matrix}a & b\\c & d\end{matrix}$
Common mathematical arrangement	matrix{a # "="b ## {} # "="c}	$\begin{matrix}a & =b\\ & =c\end{matrix}$
New Line	asldkfjo newline sadkfj	$\begin{matrix}asldkfjo\\sadkfj\end{matrix}$
Small gap (apostrophe)	stuff`stuff	$stuff\ stuff$
Large gap (tilde)	stuff~stuff	$stuff\ \ stuff$

Characters – Greek

Table 10. Characters, Greek

%ALPHA	A	%BETA	B	%CHI	X	%DELTA	Δ	%EPSILON	E
%ETA	H	%GAMMA	Γ	%IOTA	I	%KAPPA	K	%LAMBDA	Λ
%MU	M	%NU	N	%OMEGA	Ω	%OMICRON	O	%PHI	Φ
%PI	Π	%PSI	Ψ	%RHO	P	%SIGMA	Σ	%THETA	Θ
%UPSILON	Υ	%XI	Ξ	%ZETA	Z				
%alpha	α	%beta	β	%chi	χ	%delta	δ	%epsilon	ϵ
%eta	η	%gamma	γ	%iota	ι	%kappa	κ	%lambda	λ
%mu	μ	%nu	ν	%omega	ω	%omicron	o	%phi	ϕ
%pi	π	%rho	ρ	%sigma	σ	%tau	τ	%theta	θ
%upsilon	υ	%varepsilon	ε	%varphi	φ	%varpi	ϖ	%varrho	ϱ
%varsigma	ς	%vartheta	ϑ	%xi	ξ	%zeta	ζ		

Characters - Special

Table 11. Characters, special

%and $\wedge$	%angle $\sphericalangle$	%element $\in$	%identical $\equiv$
%infinite ∞	%noelement $\notin$	%notequal $\neq$	%or $\vee$
%perthousand ‰	%strictlygreaterthan $\gg$	%strictlylessthan $\ll$	%tendto $\rightarrow$