

# Mathematical Typesetting with L<sup>A</sup>T<sub>E</sub>X

2024/10/23 — TUG-Version 0.35

Dedicated to my family.

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# Preface

It is often said that  $\text{\TeX}$  was designed for mathematical or technical purposes. This may be true when we remember the reasons why Donald Knuth created  $\text{\TeX}$ . But nowadays there are many examples in which  $\text{\TeX}$  is used for publications with no mathematical or technical background content. However, writing publications with such material is one of the important advantages of  $\text{\TeX}$ . Because it seems impossible to know all existing macros and options of  $\text{\LaTeX}$  and the several additional packages, especially of  $\mathcal{AM}S\text{math}$ . This is the reason why I have attempted to gather all the relevant facts in this paper. An advanced version of this paper is available as a german book Voß 2012a and also as an english translation Voß 2011b. Members of *any*  $\text{\TeX}$  users group may ask DANTE e.V. for a special price of the german edition (<http://www.dante.de>)! Please report typos or any other comments to this documentation to [hvoss@tug.org](mailto:hvoss@tug.org).

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# Chapter 1

## Standard L<sup>A</sup>T<sub>E</sub>X math mode

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## 1.1 Introduction

The following sections describe all the math commands which are available without any additional package. Most of them also work with special packages and some of them are redefined. At first some important facts for typesetting math expressions.

## 1.2 The Inlinemode

As the name says there are always math expressions which are in a standard text line, like this one:  $f(x) = \int_a^b \frac{\sin x}{x} dx$ . There are no limitations for the height of the math expressions, so that the layout may be very lousy if you insert

a big matrix in an inline mode like this:  $\underline{A} = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}$ . In this case it is

better to use the `smallmatrix` environment  $\underline{A} = \begin{smallmatrix} a & b & c \\ d & e & f \\ g & h & i \end{smallmatrix}$  from the *AMSmath* package (see section 2.2.6 on page 57) or the `displaymath` mode (section 1.3 on page 7).

This inline mode is possible with three different commands:

$\sum_{i=1}^n i = \frac{1}{2} n \cdot (n + 1)$	<code>\(\sum_{i=1}^n i=\frac{1}{2} n \cdot (n + 1)\)`</code>	01-02-01
$\sum_{i=1}^n i = \frac{1}{2} n \cdot (n + 1)$	<code>\$\sum_{i=1}^n i=\frac{1}{2} n \cdot (n + 1)\$`</code>	
$\sum_{i=1}^n i = \frac{1}{2} n \cdot (n + 1)$	<code>\begin{math}\sum_{i=1}^n i=\frac{1}{2} n \cdot (n + 1)\end{math}`</code>	

$\sum_{i=1}^n i = \frac{1}{2} n \cdot (n + 1)$

`\(...\)`` 1. `\(` ... `)`, the problem is that `\(`` is not a robust macro (see section 1.2.3 on the facing page).

`$...$` 2. `$ ... $`

`\begin{math}` 3. `\begin{math} ... \end{math}`, also not robust

... In general `$...$` is the best choice, but this does not work in environments

`\end{math}` like `verbatim` or `alltt`. In this case `\(...\)`` works.

### 1.2.1 Limits

In the inline mode the limits are by default only in super or subscript mode and the fractions are always in the `\scriptstyle`<sup>1</sup> font size. For example:

`\limits`  $\int_1^\infty \frac{1}{x^2} dx = 1$ , which is not too big for the textline. You can change this

`\int` with the command `\limits`, which must follow a math operator<sup>2</sup> like an integral

`\lim`

`\prod` (`\int`), a sum (`\sum`), a product (`\prod`) or a limes (`\lim`). But this  $\int_1^\infty \frac{1}{x^2} dx = 1$

`\sum`

`(\$`int`\limits_{`1`}^`infinity` `frac`(`1`, `x`^`2`))` does not look very nice in a text line when it appears between two lines, especially when there are multiline limits.<sup>3</sup>

<sup>1</sup> See section 1.12 on page 30.

<sup>2</sup> To define a new operator see page 66

<sup>3</sup> For more information about limits see section 1.6.1 on page 16 or section 2.11 on page 63.

## 1.2.2 Fraction command

For inlined formulas the fractions are by default in the `\scriptstyle` (see Tabular 1.4 on page 30), which is good for typesetting  $y = \frac{a}{b+1}$ , because the linespacing is nearly the same, but not optimal, when the formula shows some important facts. There are two solutions to get a better reading:

1. choose the display mode instead of the inline mode, which is the better one;
2. set the fontstyle to `\displaystyle`, which makes the fraction  $y = \frac{a}{b+1}$  more readable but the linespacing increases which is always a bad solution and should only be used when the first solution makes no sense.<sup>4</sup>

01-02-02

$$y = \frac{a}{b+1} = \frac{a}{b+1}$$

`$y=\frac{a}{b+1}=\{\displaystyle\frac{a}{b+1}\}$`

## 1.2.3 Math in `\part`, `\chapter`, `\section`, ... titles like

$$f(x) = \prod_{i=1}^n \left( i - \frac{1}{2i} \right)$$

All commands which appear in positions like contents, index, header, ..., must be robust<sup>5</sup> which was in the past the case for `$$` but not for `\(...\)`. The latest L<sup>A</sup>T<sub>E</sub>X version defines:<sup>6</sup>

```
\DeclareRobustCommand\{{\relax\ifmmode\@badmath\else$\fi}%
\DeclareRobustCommand\){\relax\ifmmode\ifinner$\else\@badmath\fi\else\@badmath\fi}%
\DeclareRobustCommand\[\{{\dots}\}%
\DeclareRobustCommand\]{\dots}
```

If you do not have any contents, index, a.s.o. you can write the math-stuff in `\chapter`, `\section`, a.s.o without any restriction. Otherwise use `\protect<macroname>`, The whole math expression appears in the default font shape and not in bold like the other text. Section 1.22.1 on page 40 describes how the math expressions can be printed also in bold.

There are problems with the `hyperref` package when there is no text part in `\texorpdfstring` a title. It is possible with the command `\texorpdfstring` to tell `hyperref` to use different commands, one for the title and another one for the bookmarks:

```
\texorpdfstring{<TeX part>} {<hyperref part>}
```

01-02-03

$$\int f(x) dx$$

`\usepackage{hyperref}`

`\texorpdfstring{$\int f(x)$}{\mathrm{dx}}{Integral function}`

## 1.2.4 Equation numbering

It is obvious that the numbering of inline mathstuff makes no sense!

<sup>4</sup> For an abbreviation see section 2.5 on page 58, there is a special `\dfrac` macro.

<sup>5</sup> robust means that the macro is not expanded before it is moved into for example the table of contents file (\*.toc). No robustness is often a problem, when a macro is part of another macro.

<sup>6</sup> For old versions you have to load package `fixltx2e`

## 1.2.5 Framed math

With the `\fbox` macro everything of inline math can be framed, like the following one:

$$f(x) = \prod_{i=1}^n \left( i - \frac{1}{2i} \right)$$

```
\fbox{$f(x)=\prod_{i=1}^n \left(i-\frac{1}{2i}\right)$}
```

01-02-04

Parameters are the width of `\fboxsep` and `\fboxrule`, the predefined values from the file `latex.ltx` are:

```
\fboxsep = 3pt  
\fboxrule = .4pt
```

The same is possible with the `\colorbox` from the color package.

$$f(x) = \prod_{i=1}^n \left( i - \frac{1}{2i} \right)$$

```
\usepackage{xcolor}  
\colorbox{yellow}{$f(x)=\prod_{i=1}^n \left(i-\frac{1}{2i}\right)$}
```

01-02-05

## 1.2.6 Linebreak

L<sup>A</sup>T<sub>E</sub>X can break an inline formula only when a relation symbol ( $=, <, >, \dots$ ) or a binary operation symbol ( $+, -, \dots$ ) exists and at least one of these symbols appears at the outer level of a formula. Thus  $a+b+c$  can be broken across lines, but  $a+b+c$  not.

- ▷ The default:  $f(x) = a_n x^n + a_{n-1} x^{n-1} + a_{n-2} x^{n-2} + \dots + a_i x^i + a_2 x^2 + a_1 x^1 + a_0$
- ▷ The same inside a group  $\dots$ :  $f(x) = a_n x^n + a_{n-1} x^{n-1} + a_{n-2} x^{n-2} + \dots + a_i x^i$
- ▷ Without any symbol:  $f(x) = a_n (a_{n-1} (a_{n-2} (\dots) \dots) \dots)$

If it is not possible to have any maths symbol, then split the inline formula in two or more pieces ( $\dots \dots$ ). If you do not want a linebreak for the whole document, you can set in the preamble:

```
\relpenalty=9999  
\binoppenalty=9999
```

which is the extreme case of grudgingly allowing breaks in extreme cases, or

```
\relpenalty=10000  
\binoppenalty=10000
```

for absolutely no breaks.

## 1.2.7 Whitespace

L<sup>A</sup>T<sub>E</sub>X defines the length `\mathsurround` with the default value of 0 pt. This length is added before and after an inlined math expression. See Example 01-02-06 for the default value of `\mathsurround` and a modified one.

```
foo \fbox{$ f(x)=\int_1^\infty \frac{1}{x^2}, \mathbf{d}x=1 $} bar      \\  
%  
foo \rule{20pt}{\ht\strutbox}\fbox{$ f(x)=\int_1^\infty \frac{1}{x^2}, \mathbf{d}x=1 $}\rule{20pt}{\ht\strutbox} bar      \\  
%  
\setlength{\mathsurround}{20pt}%  
foo \fbox{$ f(x)=\int_1^\infty \frac{1}{x^2}, \mathbf{d}x=1 $} bar
```

01-02-06

foo 
$$f(x) = \int_1^{\infty} \frac{1}{x^2} dx = 1$$
 bar

foo 
$$f(x) = \int_1^{\infty} \frac{1}{x^2} dx = 1$$
 bar

foo 
$$f(x) = \int_1^{\infty} \frac{1}{x^2} dx = 1$$
 bar

## 1.2.8 $\mathcal{A}\mathcal{M}\mathcal{S}\mathit{math}$ for the inline mode

None of the  $\mathcal{A}\mathcal{M}\mathcal{S}\mathit{math}$ -functions are available in inline mode.

## 1.3 Displaymath mode

This means, that every formula gets its own paragraph (line). There are some differences in the layout to the one from the title of 1.2.3.

### 1.3.1 equation environment

For example:

01-03-01

$$f(x) = \prod_{i=1}^n \left( i - \frac{1}{2i} \right) \quad (1)$$

```
\begin{equation}
f(x)=\prod_{i=1}^n\left(i-\frac{1}{2i}\right)
\end{equation}
```

The delimiters `\begin{equation}` ... `\end{equation}` are the only difference to the inline version. There are some equivalent commands for the displaymath mode:

1. `\begin{displaymath}` ... `\end{displaymath}`, same as `\[ ... \]`
2. `\[ ... \]`. (see above) the short form of a displayed formula, no number

```
\begin{displaymath}
\[ ... \]
\end{displaymath}
```

$$f(x) = \prod_{i=1}^n \left( i - \frac{1}{2i} \right)$$

displayed, no number. Same as 1.

3. `\begin{equation}`...`\end{equation}`

```
\begin{equation}
...
```

$$f(x) = \prod_{i=1}^n \left( i - \frac{1}{2i} \right) \quad (1.1)$$

```
\end{equation}
```

displayed, a sequential equation number, which may be reset when starting a new chapter or section.

- (a) There is only *one* equation number for the whole environment.
- (b) In standard L<sup>A</sup>T<sub>E</sub>X there exists no star-version of the equation environment because `\[ ... \]` is the equivalent. However, with package  $\mathcal{A}\mathcal{M}\mathcal{S}\mathit{math}$  it will be defined. With the tag `\nonumber` it is possible to suppress the equation number, if `amsmath` is used (see Example 01-03-02 on the following page):

$$f(x) = [...]$$

```
\usepackage{amsmath}
\begin{equation}
f(x) = [...] \nonumber
\end{equation}
```

01-03-02

### 1.3.2 eqnarray environment

`\begin{eqnarray}` This is by default an array with three columns and as many rows as you like. It ... is nearly the same as an array with a `rcl` column definition.

`\end{eqnarray}` It is *not possible* to change the internal behaviour of the `eqnarray` environment without rewriting the environment. It is always an implicit array with *three* columns and the horizontal alignment `right-center-left` (`rcl`) and small *symbol* sizes for the middle column. All this can not be changed by the user without rewriting the whole environment in `latex.ltx`.

$\frac{1}{\sqrt{n}} = \frac{\sqrt{n}}{n} = \frac{n}{n\sqrt{n}}$	$\left. \begin{array}{lll} \text{left} & \text{middle} & \text{right} \\ \mathit{left} & \mathit{middle} & \mathit{right} \\ \frac{1}{\sqrt{n}} & \frac{\sqrt{n}}{n} & \frac{n}{n\sqrt{n}} \end{array} \right\}$	<pre>\begin{eqnarray*} \mathit{left} &amp; \mathit{middle} &amp; \mathit{right} \\ \frac{1}{\sqrt{n}} &amp; \frac{\sqrt{n}}{n} &amp; \frac{n}{n\sqrt{n}} \end{eqnarray*}</pre>
---	--	--

01-03-03

The `eqnarray` should not be used as an array. Madsen 2006 As seen in the above example the typesetting is wrong for the middle column and the spacing of the formula is not the best. The numbering of `eqnarray` environments is always for every row, means, that four lines get four different equation numbers (for the labels see section [1.3.4 on page 11](#)):

$y = d \quad (1)$	$y = cx + d \quad (2)$	$y = bx^2 + cx + d \quad (3)$
		$y = ax^3 + bx^2 + cx + d \quad (4)$

```
\begin{eqnarray}
y &= d & \label{eq:2} \\
y &= cx+d & \label{eq:3} \\
y &= bx^2+cx+d & \label{eq:4} \\
y &= ax^3+bx^2+cx+d & \label{eq:5}
\end{eqnarray}
```

01-03-04

Suppressing the numbering for *all* rows is possible with the starred version of `eqnarray`.

$y = d$	$y = cx + d$	$y = bx^2 + cx + d$
		$y = ax^3 + bx^2 + cx + d$

```
\begin{eqnarray*}
y &= d & \label{eq:3} \\
y &= cx+d & \label{eq:4} \\
y &= bx^2+cx+d & \label{eq:5} \\
y &= ax^3+bx^2+cx+d &
\end{eqnarray*}
```

01-03-05

Toggling off/on for *single* rows is possible with the above mentioned `\nonumber` tag at the end of a row (before the newline command). For example:

$y = d$	$y = cx + d$	$y = bx^2 + cx + d$
		$y = ax^3 + bx^2 + cx + d$

```
\begin{eqnarray}
y &= d \nonumber \\
y &= cx+d \nonumber \\
y &= bx^2+cx+d \nonumber \\
y &= ax^3+bx^2+cx+d
\end{eqnarray}
```

01-03-06

## Short commands

It is possible to define short commands for the `eqnarray`

```
\makeatletter
\newcommand\be{\begingroup
% \setlength{\arraycolsep}{2pt}
  \eqnarray@ifstar{\nonumber}{}}
\newcommand\ee{\endeqnarray\endgroup}
\makeatother
```

### 1.3.3 Equation numbering

For all equations which can have one or more equation numbers (for every `\nonumber` line/row) the numbering for the whole equation can be disabled with switching from the unstarred to the star version. This is still for the whole formula and doesn't work for single rows. In this case use the `\nonumber` tag.

- ▷ This doc is written with the article-class, which counts the equations continuously over all parts/sections. You can change this behaviour in different ways (see the following subsections).
- ▷ In standard L<sup>A</sup>T<sub>E</sub>X it is a problem with too long equations and the equation number, which may be printed with the equation one upon the other. In this case use the *AMsmath* package, where the number is set above or below of a too long equation (see equation [01-08-04 on page 20](#)).
- ▷ For counting subequations see section [2.9.1 on page 61](#).

## Changing the style

With the beginning of Section [2.1.2 on page 47](#) the counting changes from `\theequation` “02-01-02” into the new style “02-01-05”. The command sequence is

```
\renewcommand\theequation{\thepart-\arabic{equation}}
```

See section [2.9 on page 61](#) for the *AMsmath* command.

## Resetting a counter style

Removing a given reset is possible with the `remreset`.<sup>7</sup> Write into the preamble `\@removefromreset`

```
\makeatletter
\@removefromreset{equation}{section}
\makeatother
```

or anywhere in the text.

Now the equation counter is no longer reset when a new section starts. You can see this after section [2.2.4 on page 54](#).

## Equation numbers on the left side

Choose package `leqno`<sup>8</sup> or have a look at your document class, if such an option exists.

<sup>7</sup> CTAN://macros/latex/contrib/supported/carlisle/remreset.sty

<sup>8</sup> CTAN://macros/latex/unpacked/leqno.sty

## Changing the equation number style

The number style can be changed with a redefinition of

```
\def\@eqnnum{{\normalfont \normalcolor (\theequation)}}
```

For example: if you want the numbers not in parentheses write

```
\makeatletter
\def\@eqnnum{{\normalfont \normalcolor \theequation}}
\makeatother
```

For *AMSmath* there is another macro, see section 2.9 on page 61.

## More than one equation counter

You can have more than the default equation counter. With the following code you can easily toggle between roman and arabic equation counting. The following examples show how it works:

```
\usepackage{amsmath}
\makeatletter
%Roman counter
\newcounter{roem} \renewcommand\theroem{\roman{roem}}
% save the original counter
\newcommand\c@org@eq{} \let\c@org@eq\c@equation
\newcommand\org@theeq{} \let\org@theeq\theequation
%setroem sets roman counting
\newcommand\setroem{\let\c@equation\c@roem \let\theequation\theroem}
%setarab the arabic counting
\newcommand\setarab{\let\c@equation\c@org@eq \let\theequation\org@theeq}
\makeatother

\begin{align}
f(x) &= \int \sin x, \mathit{d}x \label{eq:arab1} \\
g(x) &= \int \frac{1}{x}, \mathit{d}x \label{eq:arab2}
\end{align}
%
\setroem
\begin{align}
F(x) &= -\cos x \\
G(x) &= \ln x \label{eq:rom1}
\end{align}
%
\setarab
\begin{align}
f'(\prime)(x) &= \sin x \\
g'(\prime)(x) &= \frac{1}{x} \label{eq:rom2}
\end{align}
```

There can be references to these equations in the usual way, like `eq.\ref{eq:arab1}`, `\ref{eq:arab2}` and for the roman one `eq.\ref{eq:rom1}`.

$$f(x) = \int \sin x \, dx \quad (1)$$

$$g(x) = \int \frac{1}{x} \, dx \quad (2)$$

$$F(x) = -\cos x \quad (i)$$

$$G(x) = \ln x \quad (ii)$$

$$f'(x) = \sin x \quad (3)$$

$$g'(x) = \frac{1}{x} \quad (4)$$

There can be references to these equations in the usual way, like eq.1, 4 and for the roman one eq.ii.

### 1.3.4 Labels

Every numbered equation can have a label to which a reference is possible.

- ▷ There is one restriction for the label names, they cannot include one of L<sup>A</sup>T<sub>E</sub>X's command characters.<sup>9</sup>
- ▷ The label names are replaced by the equation number.

If you do not want a reference to the equation number but to a self defined `\tag` name then use the *AMSmath* command `\tag{...}`, which is described in section 2.10 on page 63.

### 1.3.5 Frames

Similiar to the inline mode, displayed equations can also be framed with the `\fbox` command, like equation 01-03-08. The only difference is the fact, that the equation must be packed into a `parbox` or `minipage`. It is nearly the same for a colored box, where the `\fbox{...}` has to be replaced with `\colorbox{yellow}{...}`. The package `color.sty` must be loaded and -important - the `calc` package or using the macro `\dimexpr` to get a correct boxwidth.

01-03-08

$$f(x) = \int_1^{\infty} \frac{1}{x^2} \, dx = 1 \quad (1)$$

```
\usepackage{amsmath}
\fbox{\parbox{\dimexpr\linewidth-2\fboxsep-2\fboxrule}{%
\begin{equation}
f(x)=\int_1^{\infty}\frac{1}{x^2},\mathbf{\mathit{d}}x=1
\end{equation}}}
```

If the equation number should not be part of the frame, then it is a bit complicated. There is one tricky solution, which puts an unnumbered equation just beside an empty numbered equation. The `\hfill` is only useful for placing the equation number right aligned, which is not the default. The following four equations in Example 01-03-09 on the following page are the same, only the second one written with the `\myMathBox` macro which has the border and

<sup>9</sup> \$ \_ ^ \& % { }

background color as optional arguments with the defaults white for background and black for the frame. If there is only one optional argument, then it is still the one for the frame color (Example 01-03-09).

```

usepackage{xcolor}
\makeatletter
\def\myMathBox{@ifnextchar[{|\my@MBoxi}{|\my@MBoxi[black]}}
\def\my@MBoxi[#1]{|\@ifnextchar[{|\my@MBoxii[#1]}{\my@MBoxii[#1][white]}}
\def\my@MBoxii[#1][#2]{\par\noindent
  \fcolorbox{#1}{#2}{%
  \parbox{\dimexpr\linewidth-\labelwidth-2\fboxrule-2\fboxsep}{#3}}%
}%
  \parbox{\labelwidth}{\begin{eqnarray}\label{#4}\end{eqnarray}}\par
}
\makeatother

\begin{equation}\label{eq:frame2} f(x)=x^2 + x \end{equation}
\myMathBox[red]{\{f(x)=x^2 +x\}}{eq:frame3}
\myMathBox[red][yellow]{\{f(x)=x^2 +x\}}{eq:frame4}
\myMathBox[\{f(x)=x^2 +x\}]{eq:frame5}
A reference to eq.\ref{eq:frame2}, eq.\ref{eq:frame3}, eq.\ref{eq:frame4}, and eq.\ref{eq:frame5}.

```

$$f(x) = x^2 + x \quad (1)$$

01-03-09

$$f(x) = x^2 + x \quad (2)$$

$$f(x) = x^2 + x \quad (3)$$

$$f(x) = x^2 + x \quad (4)$$

A reference to eq. 1, eq. 2, eq. 3, and eq. 4

If you are using the *AMSmath* package, then try the solutions from section 2.15 on page 70.

## 1.4 array environment

`\begin{array}` This is simply the same as the `eqnarray` only with the possibility of variable rows  
... and columns and the fact, that the whole formula has only *one* equation number  
`\end{array}` and that the array environment can only be part of another math environment,  
like the `equation` or the `displaymath`. With `@{}` before the first and after the last  
column the additional space `\arraycolsep` is not used, which maybe important  
when using left aligned equations.

```

\begin{equation}
\left.
\begin{array}{@{}r@{\quad}c@{\quad}r@{}}
\text{textrm{a}} & y & = & c & \text{textrm{constant}} \\
\text{textrm{b}} & y & = & cx+d & \text{textrm{linear}} \\
\text{textrm{c}} & y & = & bx^2+cx+d & \text{textrm{square}} \\
\text{textrm{d}} & y & = & ax^3+bx^2+cx+d & \text{textrm{cubic}} \\
\end{array}
\right.
\mkern18mu \right\} \quad \text{Polynomes}
\end{equation}

```

01-04-01

$$\left. \begin{array}{lll} \text{a) } y = & c & (\text{constant}) \\ \text{b) } y = & cx + d & (\text{linear}) \\ \text{c) } y = & bx^2 + cx + d & (\text{square}) \\ \text{d) } y = & ax^3 + bx^2 + cx + d & (\text{cubic}) \end{array} \right\} \text{Polynomes} \quad (1)$$

The horizontal alignment of the columns is the same as the one from the tabular environment.

For arrays with delimiters see section [4.1.9 on page 92](#).

### 1.4.1 Cases structure

If you do not want to use the  *$\mathcal{M}$ Smath* package then write your own cases structure with the array environment:

```
\begin{equation}
x=\left\{\begin{array}{cl}
0 & \text{if } A=\ldots \\
1 & \text{if } B=\ldots \\
x & \text{this runs with as much text as you like, but without any}\\
& \quad \text{ragged right text.}\end{array}\right.
\end{equation}
```

01-04-02

$$x = \begin{cases} 0 & \text{if } A = \dots \\ 1 & \text{if } B = \dots \\ x & \text{this runs with as much text as you like, but without an ragged right text.} \end{cases} \quad (1)$$

It is obvious, that we need a \parbox if the text is longer than the possible line width.

```
\usepackage{array}

\begin{equation}
x = \left\{ \begin{array}{l} \text{if } \$A=\ldots\$ \text{\\tabularnewline} \\ \$B=\ldots\$ \text{\\tabularnewline} \\ x & \text{\\parbox{0.5\\columnwidth}{this runs with as much text as you like,} \\ because an automatic linebreak is given with} \\ & \text{a ragged right text. Without this} \\ & \text{\\raggedright command, you'll get a formatted} \\ & \text{text like the following one \\ldots\\ but with a parbox \\ldots\\ it works}} \end{array} \right. \\
\end{equation}
```

01-04-03

$x = \begin{cases} 0 & \text{if } A = \dots \\ 1 & \text{if } B = \dots \\ & \text{this runs with as much text as you} \\ & \text{like, because an automatic linebreak} \\ & \text{is given with a ragged right text.} \\ x & \text{Without this command, you'll get a} \\ & \text{formatted text like the following one} \\ & \dots \text{ but with a parbox ... it works} \end{cases}$  (1)

## 1.4.2 arraycolsep

`\arraycolsep` All the foregoing math environments use the array to typeset the math expression. The predefined separation between two columns is the length `\arraycolsep`, which is set by nearly all document classes to 5 pt, which seems to be too big. The following equation is typeset with the default value and the second one with `\arraycolsep=1.4pt`.

```
\usepackage{array,mathtools}
\fboxsep=0pt
\def\xstrut{\vphantom{\int\frac{x}{x}}}
\[
\begin{array}{rcl}
\boxed{f(x)} \xstrut & \boxed{=} & \boxed{\int \frac{\sin x}{x} dx}
\end{array}
\]
%
\[
\arraycolsep=1.4pt
\begin{array}{rcl}
\boxed{f(x)} \xstrut & \boxed{=} & \boxed{\int \frac{\sin x}{x} dx}
\end{array}
\]
```

01-04-04

If this modification should be valid for all arrays/equations, then write it into the preamble, otherwise put it into a group or define your own environment. The contents of an environment is per definition local to the outside, the reason why the modification of `\arraycolsep` doesn't need an own `\begingroup ... \endgroup` setting.

$$f(x) = \int \frac{\sin x}{x} dx$$

```
\newenvironment{Array}
{[\setlength{\arraycolsep}{1.4pt}
\begin{array}{rcl}
\end{array}]}

\begin{Array}
f(x) & = & \int \frac{\sin x}{x} dx
\end{Array}
```

01-04-05

## 1.5 Matrix

L<sup>A</sup>T<sub>E</sub>X knows three macros for typesetting a matrix `\matrix`, `\pmatrix` and `\bordermatrix`:

`\pmatrix`  
`\bordermatrix`

$$\begin{matrix} A & B & C \\ d & e & f \\ 1 & 2 & 3 \end{matrix}$$

$$\left( \begin{matrix} A & B & C \\ d & e & f \\ 1 & 2 & 3 \end{matrix} \right)$$

```
$\matrix{
A & B & C \cr
d & e & f \cr
1 & 2 & 3 \cr
} \$

$\pmatrix{
A & B & C \cr
d & e & f \cr
1 & 2 & 3 \cr
} \$
```

01-05-01

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01-05-03

	0	1	2
0	$A$	$B$	$C$
1	$d$	$e$	$f$
2	1	2	3

```
$\bordermatrix{%
& 0 & 1 & 2 \cr
0 & A & B & C \cr
1 & d & e & f \cr
2 & 1 & 2 & 3 \cr
}$
```

The first two macros are listed here for some historical reason, because the `array` or especially the  $\mathcal{A}\mathcal{M}\mathcal{S}$ math package offers the same or better macros/environments. Nevertheless it is possible to redefine the `\bordermatrix` macro to get other parentheses and a star version which takes the left top part as matrix. There is now an optional argument for the parenthesis with `()` as the default one. To get such a behaviour, write into the preamble:

```
\makeatletter
\newif\if@borderstar
\def\bordermatrix{\@ifnextchar*{%
  \@borderstarttrue\bordermatrix@i{\@borderstarfalse\bordermatrix@i*}}
{\def\@bordermatrix@i*{\@ifnextchar[{\@bordermatrix@ii}{\@bordermatrix@ii[()]}}}
\def\@bordermatrix@ii[#1]{%
\begin{group}
\m@th\tempdima8.75\p@\setbox\z@\vbox{%
\def\cr{\crcr\noalign{\kern 2\p@\global\let\cr\endline }}%
\ialign{$##$\hfil\kern 2\p@\kern\tempdima & \thinspace
\hfil$##$\hfil \quad\hfil$##$\hfil\crcr\omit\strut
\hfil\crcr\noalign{\kern -\baselineskip}\#2\crcr\omit
\strut\cr}%
\setbox\tw@\vbox{\unvcopy\z@\global\setbox\@ne\lastbox}%
\setbox\tw@\hbox{\unhbox\@ne\unskip\global\setbox\@ne\lastbox}%
\setbox\tw@\hbox{%
\$ \kern\wd\@ne\kern -\tempdima\left@\firstoftwo#1%
\if@borderstar\kern2pt\else\kern -\wd\@ne\fi
\global\setbox\@ne\vbox{\box\@ne\if@borderstar\else\kern 2\p@\fi}%
\vcenter{\if@borderstar\else\kern -\ht\@ne\fi
\unvbox\z@\kern-\if@borderstar2\fi\baselineskip}%
\if@borderstar\kern-2\tempdima\kern2\p@\else\,\fi\right@\secondoftwo#1 $%
}\null;\vbox{\kern\ht\@ne\box\tw@}%
\endgroup}
\makeatother

$\bordermatrix{%
& 1 & 2 \cr
1 & x_1 & x_2 \cr
2 & x_3 & x_4 \cr
3 & x_5 & x_6 }$}

$\bordermatrix[\{}{\}]{ & 1 & 2 \cr
1 & x_1 & x_2 \cr
2 & x_3 & x_4 \cr
3 & x_5 & x_6 }$}

$\bordermatrix*{%
x_1 & x_2 & 1 \cr
x_3 & x_4 & 2 \cr
x_5 & x_6 & 3 \cr
1 & 2 }$}

$\bordermatrix*[\{}{\}]{x_1 & x_2 & 1 \cr
x_3 & x_4 & 2 \cr
x_5 & x_6 & 3 \cr
1 & 2 }$}
```

01-05-04

$$\begin{array}{ccccc}
 & 1 & 2 & & \\
 & \left( \begin{array}{cc} x1 & x2 \\ x3 & x4 \\ x5 & x6 \end{array} \right) & \left( \begin{array}{cc} x1 & x2 \\ x3 & x4 \\ x5 & x6 \end{array} \right) & \left( \begin{array}{cc} x1 & x2 \\ x3 & x4 \\ x5 & x6 \end{array} \right) & \\
 1 & 1 & & 1 & \\
 2 & 2 & & 2 & \\
 3 & 3 & & 3 & \\
 & & & & \\
 & \left( \begin{array}{cc} x1 & x2 \\ x3 & x4 \\ x5 & x6 \end{array} \right) & \left( \begin{array}{cc} x1 & x2 \\ x3 & x4 \\ x5 & x6 \end{array} \right) & \left( \begin{array}{cc} x1 & x2 \\ x3 & x4 \\ x5 & x6 \end{array} \right) & 1 \\
 & 1 & & 1 & \\
 & 2 & & 2 & \\
 & 3 & & 3 & \\
 & & & & \\
 & 1 & 2 & 1 & 2 & 1 & 2 \\
 & & & & & &
 \end{array}$$

The `\matrix` macro cannot be used together with the  $\mathcal{M}$ Smath package, it redefines this environment (see section [2.2.6 on page 57](#)).



## 1.6 Super/Subscript and limits

Writing  $a_{min}$  and  $a_{max}$  gives the same depth for the subscript, but writing them in upright mode with \mbox gives a different depth:  $a_{\min}$  and  $a_{\max}$ . The problem is the different height, which can be modified in several ways

- ▷  $\$a_{\{\mathrm{mbox}\{\mathrm{vphantom}\{i\}max\}\}}\$$ :  $a_{\min}$  and  $a_{\max}$ ;
  - ▷  $\$a_{\{\mathrm{mathrm}\{max\}\}}\$$ :  $a_{\min}$  and  $a_{\max}$ ;
  - ▷  $\$a_{\{\mathrm{max}\}}\$$ :  $a_{\min}$  and  $a_{\max}$ . Both are predefined operators (see section [1.16](#) on page [35](#)).

## 1.6.1 Multiple limits

\atop For general information about limits read section [1.2.1 on page 4](#). With the TeX command \atop multiple limits for a \sum or \prod are possible. The syntax is:

*above*

01-06-01

which is nearly the same as a fraction without a rule. This can be enhanced to  $a \atop b \atop c$  and so on. For Example 01-06-01 do the following steps:

$$\sum_{\substack{1 \leq i \leq p \\ 1 \leq j \leq q \\ 1 \leq k \leq r}} a_{ij} b_{jk} c_{ki} \quad (1)$$

01-06-02

## \shortstack

which is not the best solution because the space between the lines is too big. The  *$\mathcal{A}\mathcal{M}\mathcal{S}$ math* package provides several commands for limits (section 2.11 on page 63) and the `\underset` and `\overset` commands (see Section 2.17 on page 70).

## 1.6.2 Problems

$$\sum_{\substack{1 \leq j \leq p \\ 1 \leq k \leq q \\ 1 \leq l \leq r}} a_{ij} b_{jk} c_{ki} \quad (1)$$

```
\usepackage{mathtools}% for \boxed

\begin{equation}
\fboxsep=0pt\fboxrule=0.1pt
\boxed{\sum_{\substack{1 \leq j \leq p \\ 1 \leq j \leq q \\ 1 \leq k \leq r}} % 
\prod_{i=1}^n a_i b_{jk} c_{ki}}
\end{equation}
```

01.06.03

The Example 01-06-03 on the facing page shows that the horizontal alignment is not optimal, because the math expression on the right follows at the end of the limits which are a unit together with the sum symbol. There is an elegant solution with  $\mathcal{AM}Smath$ , described in subsection 2.11.2 on page 64. If you do not want to use  $\mathcal{AM}Smath$ , then use `\makebox`. But there is a problem when the general fontsize is increased, `\makebox` knows nothing about the actual math font size. The first equation in Example 01-06-04 shows the effect and the second equation the view without the boxes.

```
\usepackage{mathtools}% for \boxed
\begin{subequations}
\begin{minipage}{0.45\textwidth}
\begin{equation}
\fboxsep=0pt\fboxrule=0.1pt
\boxed{\sum_{\substack{1\leq j\leq p \\ 1\leq j\leq q \\ 1\leq k\leq r}} a_{ij}b_{jk}c_{ki}}
\end{equation}
\end{minipage}\hfill
\begin{minipage}{0.45\textwidth}
\begin{equation}\label{eq:disp-limits3}
\sum_{\substack{1\leq j\leq p \\ 1\leq j\leq q \\ 1\leq k\leq r}} a_{ij}b_{jk}c_{ki}
\end{equation}
\end{minipage}
\end{subequations}
```

01-06-04

$$\sum_{\substack{1\leq j\leq p \\ 1\leq j\leq q \\ 1\leq k\leq r}} a_{ij}b_{jk}c_{ki}$$

(1a)

$$\sum_{\substack{1\leq j\leq p \\ 1\leq j\leq q \\ 1\leq k\leq r}} a_{ij}b_{jk}c_{ki}$$

(1b)

## 1.7 Roots

The square root `\sqrt` is the default for L<sup>A</sup>T<sub>E</sub>X and the  $n$ -th root can be inserted with the optional parameter `\sqrt[n]{...}`.

01-07-01

$$\sqrt{x} \sqrt[3]{x} \sqrt[5]{\frac{1}{2} \sqrt{\frac{x}{y}}}$$

```
\sqrt{x}           \sqrt[3]{x}
\sqrt[5]{\frac{1}{2} \sqrt{\frac{x}{y}}}
```

`\sqrt`

There is a different typesetting in roots. Example 01-07-02 has different heights for the roots, whereas Example 01-07-03 has the same one. This is possible with the `\vphantom` command, which reserves the vertical space (without a horizontal one) of the parameter height. In short: It is a box with no width and the normal height.

01-07-02

$$\sqrt{a} \sqrt{T} \sqrt{2\alpha k_{B_1} T^i}$$

(1)

```
\begin{equation}
\sqrt{a}, \%
\sqrt{T}, %
\sqrt{2\alpha k_{B_1} T^i}
\end{equation}
```

01-07-03

$$\sqrt{a} \sqrt{T} \sqrt{2\alpha k_{B_1} T^i}$$

(1)

```
\begin{equation}
\sqrt{a}\vphantom{k_{B_1}T^i}, %
\sqrt{T}\vphantom{k_{B_1}T^i}, %
\sqrt{2\alpha k_{B_1} T^i}
\end{equation}
```

`\vphantom`

The typesetting looks much better, especially when the formula has different roots in a row, like Example 01-07-02 on the previous page. Using *AMSmath* with the `\smash` command<sup>10</sup> gives some more possibilities for the typesetting of roots (see section 2.6 on page 59).

## 1.8 Brackets, braces and parentheses

This is one of the major problems inside the math mode, because there is often a need for different brackets, braces and parentheses in different size. At first we had to admit, that there is a difference between the characters “ $( )/\{\}$ ” | `\left( \right) \left[ \right] \left\{ \right\}` | `\right( \left) \right[ \right] \right\{ \right\}` and their use as an argument of the `\left` and `\right` command, where L<sup>A</sup>T<sub>E</sub>X stretches the size in a way that everything between the pair of left and right parentheses is smaller than the parentheses themselves. In some cases<sup>11</sup> it may be useful to choose a fixed height, which is possible with the `\big`-series. Instead of writing `\leftX` or `\rightX` one of the following commands can be chosen:

<code>\bigX</code>	default	$( )/\{\}$   $[ ]$   $\{ \}$   $\uparrow \uparrow \downarrow \downarrow \uparrow \uparrow \downarrow \downarrow \uparrow \uparrow \downarrow \downarrow$
<code>\BigX</code>	<code>\bigX</code>	$( )/\{\}$   $[ ]$   $\{ \}$   $\uparrow \uparrow \downarrow \downarrow \uparrow \uparrow \downarrow \downarrow \uparrow \uparrow \downarrow \downarrow$
<code>\biggX</code>	<code>\BigX</code>	$( )/\{\}$   $[ ]$   $\{ \}$   $\uparrow \uparrow \downarrow \downarrow \uparrow \uparrow \downarrow \downarrow \uparrow \uparrow \downarrow \downarrow$
<code>\BiggX</code>	<code>\biggX</code>	$( )/\{\}$   $[ ]$   $\{ \}$   $\uparrow \uparrow \downarrow \downarrow \uparrow \uparrow \downarrow \downarrow \uparrow \uparrow \downarrow \downarrow$
	<code>\BiggX</code>	$( )/\{\}$   $[ ]$   $\{ \}$   $\uparrow \uparrow \downarrow \downarrow \uparrow \uparrow \downarrow \downarrow \uparrow \uparrow \downarrow \downarrow$

Only a few commands can be written in a short form like `\big()`. The “X” has to be replaced with one of the following characters or commands from table 1.1 on the facing page, which shows the parentheses character, its code for the use with one of the “big” commands and an example with the code for that.

`\biglX` For all commands there exists a left/right version `\bigl`, `\biggr`, `\Bigl` and `\Biggr` so on, which only makes sense when writing things like:

$$\left( \frac{a}{b} \right) \times \left( \frac{a}{b} \right)$$

`\biggl( \frac{a}{b} \biggr)`
`\biggl( \frac{a}{b} \biggr) \times \biggl( \frac{a}{b} \biggr)`

01-08-01

L<sup>A</sup>T<sub>E</sub>X takes the `\biggl(` as a mathopen symbol, which has by default another horizontal spacing.

In addition to the above commands there exist some more: `\bigm`, `\Bigm`, `\biggm` and `\Biggm`, which work as the standard ones (without the additional “m”) but add some more horizontal space between the delimiter and the formula

`\bigmX` before and after. The difference between the default `\bigg` and the `\biggm` command:

<sup>10</sup> The `\smash` command exists also in L<sup>A</sup>T<sub>E</sub>X but without an optional argument, which makes the use for roots possible.

<sup>11</sup> See section 1.8.2 on page 20 for example.

01-08-02

$$\left( \begin{array}{c|c} 1 & 3 \\ \hline 3 & 4 \end{array} \right)$$

$$\$\\bigg(\\displaystyle\\frac{1}{3}\\bigg|\\frac{3}{4}\\bigg)\\$$$

$$\$\\bigg(\\displaystyle\\frac{1}{3}\\biggm|\\frac{3}{4}\\bigg)\\$$$

Table 1.1: Use of the different parentheses for the “big” commands.

Char	Code	Example	Code
( )	()	$3(a^2 + b^{c^2})$	$3\\Big( a^2+b^{c^2}\\Big)$
[ ]	[]	$3[a^2 + b^{c^2}]$	$3\\Big[ a^2+b^{c^2}\\Big]$
/ \	/\backslash	$3/a^2 + b^{c^2}\backslash$	$3\\Big/ a^2+b^{c^2}\\Big\\backslash$
{ }	\{\}	$3\{a^2 + b^{c^2}\}$	$3\\Big\\{ a^2+b^{c^2}\\Big\\}$
	\Vert	$3 a^2 + b^{c^2} $	$3\\Big a^2+b^{c^2}\\Big\\Vert$
[ ]	\lfloor \rfloor	$3\lfloor a^2 + b^{c^2} \rfloor$	$3\\Big\\lfloor a^2+b^{c^2}\\Big\\rfloor$
[ ]	\lceil \rceil	$3\lceil a^2 + b^{c^2} \rceil$	$3\\Big\\lceil a^2+b^{c^2}\\Big\\rceil$
$\langle \rangle$	\langle \rangle	$3\langle a^2 + b^{c^2} \rangle$	$3\\Big\\langle a^2+b^{c^2}\\Big\\rangle$
$\uparrow \uparrow$	\uparrow\uparrow	$3\uparrow a^2 + b^{c^2}\uparrow$	$3\\Big\\uparrow a^2+b^{c^2}\\Big\\uparrow$
$\downarrow \downarrow$	\downarrow\downarrow	$3\downarrow a^2 + b^{c^2}\downarrow$	$3\\Big\\downarrow a^2+b^{c^2}\\Big\\downarrow$
$\updownarrow \updownarrow$	\updownarrow\updownarrow	$3\updownarrow a^2 + b^{c^2}\updownarrow$	$3\\Big\\updownarrow a^2+b^{c^2}\\Big\\updownarrow$

### 1.8.1 \big versus \bigg

Using »l« immediately following `\Bigg`, `\bigg`, `\Big`, and `\Big` informs TeX that the subsequent »fence symbol« - (, [, {, etc - is to be given math-class »Math Open« rather than »Math Ordinary«. The consequences of this difference in the math class status of the fence symbol (»Open« vs »Ordinary«) are particularly striking if the first math atom that follows the fence symbol is an arithmetic operator such as + (plus), - (minus), or `\times`:

If the fence was assigned class »Math Open«, i.e., if `\Biggl`, `\biggl`, etc was used, TeX will – correctly – not insert a bit of extra space between the fence symbol and the `-`/`+`/`\times` symbols, resulting in the symbol be typeset as a unary operator. Absent the l ("ell") qualifier, the fence is assigned class »Math

Ordinary«, and TeX will incorrectly interpret the  $-/+/\times$  symbols as binary operators (class »MathBin«) and thus also insert a bit more whitespace between these symbols and the next math atom.

The following examples illustrate the resulting differences in spacing, both between the opening fence and the arithmetic operators and between the arithmetic operators and what follows.

```
\usepackage{amsmath}

\begin{align*}
\Biggl[-2x - 4y\Biggr] & \quad \text{\textbullet tight spacing after opening fence;} \\ 
\begin{array}{l} \\
\text{\textbullet first ``$-$'' symbol treated as unary operator} \\
\end{array} \\
\Biggl[ -2x - 4y\Biggl] & \quad \text{\textbullet loose spacing after opening fence;} \\ 
\begin{array}{l} \\
\text{\textbullet first ``$-$'' symbol treated as binary operator} \\
\end{array} \\
\biggl(+3u + 7v\biggr) & \\
\biggl( + 3u + 7v \biggr) & \\
\biggl| \div 2x \times 4y \biggr| & \\
\biggl| \div 2x \times 4y \biggr| & \\
\biggl\{ \times 3u \div 7v \biggr\} & \\
\biggl\{ \times 3u \div 7v \biggr\} &
\end{align*}
```

01-08-03  

$$\left[ -2x - 4y \right] \quad \text{with ``l'':} \quad \begin{array}{l} \text{\textbullet tight spacing after opening fence;} \\ \text{\textbullet first ``$-$'' symbol treated as unary operator} \end{array}$$

$$\left[ - 2x - 4y \right] \quad \text{without ``l'':} \quad \begin{array}{l} \text{\textbullet loose spacing after opening fence;} \\ \text{\textbullet first ``$-$'' symbol treated as binary operator} \end{array}$$

$$\left( +3u + 7v \right)$$

$$\left( + 3u + 7v \right)$$

$$\left| \div 2x \times 4y \right|$$

$$\left| \div 2x \times 4y \right|$$

$$\left\{ \times 3u \div 7v \right\}$$

$$\left\{ \times 3u \div 7v \right\}$$

See also <https://tex.stackexchange.com/questions/19480/why-use-the-control-sequences-bigl-biggl-bigr-or-biggr-as-i-can-always-us/144439#144439>

## 1.8.2 Examples

### Braces over several lines

The following equation in the single line mode looks like

```
\begin{equation}
\frac{\partial}{\partial f_{ij}} f^{ij} = \left( \sum_{i,j} \chi_{ij} (\sigma_i - \sigma_j)^2 + f^{ij} \nabla_i \nabla_j (\Delta f) \right)

```

```
\nabla_{k}f_{ij}\nabla^{k}f^{ij}+f^{ij}f^{k}[2\nabla_{i}R_{jk}\\
-\nabla_{k}R_{ij}]\right)\\
\end{equation}
```

01-08-04

$$\frac{1}{2}\Delta(f_{ij}f^{ij}) = 2 \left( \sum_{i < j} \chi_{ij}(\sigma_i - \sigma_j)^2 + f^{ij}\nabla_j\nabla_i(\Delta f) + \nabla_k f_{ij}\nabla^k f^{ij} + f^{ij}f^k[2\nabla_i R_{jk} - \nabla_k R_{ij}] \right) \quad (1)$$

and is too long for the text width and the equation number has to be placed under the equation.<sup>12</sup> With the array environment the formula can be split in two smaller pieces:

```
\arraycolsep=1.4pt
\begin{equation}
\begin{array}{lcl}
& \frac{1}{2}\Delta(f_{ij}f^{ij}) & = & 2\left(\sum_{i < j}\chi_{ij}(\sigma_i - \sigma_j)^2 + f^{ij}\nabla_j\nabla_i(\Delta f)\right. \\
& & & \left. + \nabla_k f_{ij}\nabla^k f^{ij} + f^{ij}f^k[2\nabla_i R_{jk} - \nabla_k R_{ij}]\right) \\
& \end{array}
\end{equation}
```

01-08-05

$$\frac{1}{2}\Delta(f_{ij}f^{ij}) = 2 \left( \sum_{i < j} \chi_{ij}(\sigma_i - \sigma_j)^2 + f^{ij}\nabla_j\nabla_i(\Delta f) + \nabla_k f_{ij}\nabla^k f^{ij} + f^{ij}f^k[2\nabla_i R_{jk} - \nabla_k R_{ij}] \right) \quad (1)$$

It is obvious that there is a problem with the right closing parentheses. Because of the two pairs “\left( ... \right.” and “\left. ... \right)” they have a different size because every pair does it in its own way. Using the \Bigg command changes this into a better typesetting:

```
\arraycolsep=1.4pt
\begin{equation}
\begin{array}{lcl}
& \frac{1}{2}\Delta(f_{ij}f^{ij}) & = & 2\Bigg(\sum_{i < j}\chi_{ij}(\sigma_i - \sigma_j)^2 + f^{ij}\nabla_j\nabla_i(\Delta f) \\
& & & + \nabla_k f_{ij}\nabla^k f^{ij} + f^{ij}f^k[2\nabla_i R_{jk} - \nabla_k R_{ij}]\Bigg) \\
& \end{array}
\end{equation}
```

01-08-06

$$\frac{1}{2}\Delta(f_{ij}f^{ij}) = 2 \left( \sum_{i < j} \chi_{ij}(\sigma_i - \sigma_j)^2 + f^{ij}\nabla_j\nabla_i(\Delta f) + \nabla_k f_{ij}\nabla^k f^{ij} + f^{ij}f^k[2\nabla_i R_{jk} - \nabla_k R_{ij}] \right) \quad (1)$$

Section 22 on page 52 shows another solution for getting the right size for parentheses when breaking the equation in smaller pieces.

```
\usepackage{amsmath}
\begin{aligned}
B(r,\phi,\lambda) &= & \frac{\mu}{r}
\end{aligned}
```

<sup>12</sup> In standard L<sup>A</sup>T<sub>E</sub>X the equation and the number are printed one over the other for too long formulas. Only A<sub>M</sub>Smath puts it one line over (left numbers) or under (right numbers) the formula.

```
\Bigg[\sum_{n=2}^{\infty} \Bigg( \left(\frac{R_e}{r}\right)^n J_n P_n(s\phi) \\
& + \sum_{m=1}^{\infty} \left( C_{nm} \cos m\lambda + S_{nm} \sin m\lambda \right) P_{nm}(s\phi) \Bigg)
```

01-08-07

$$B(r, \phi, \lambda) = \frac{\mu}{r} \left[ \sum_{n=2}^{\infty} \left( \left(\frac{R_e}{r}\right)^n J_n P_n(s\phi) \right. \right. \\ \left. \left. + \sum_{m=1}^n \left( \frac{R_e}{r} \right)^n (C_{nm} \cos m\lambda + S_{nm} \sin m\lambda) P_{nm}(s\phi) \right) \right]$$

## Middle bar

See section 4.1.6 on page 90 for examples and the use of package `braket`.

### 1.8.3 New delimiters

The default delimiters are defined in the file `fontmath.ltx` which is stored in general in `[TEXMF]/tex/latex/base/fontmath.ltx`. If we need for example a thicker vertical symbol than the existing `\vert` symbol we can define in the preamble and the character number  $3E_{16}$  (decimal 62) from the `cmmi10` font is the small thick vertical rule. Now the new delimiter `\Norm` can be used in the usual way:

```
\usepackage{amsmath}% for \dfrac
\DeclareMathDelimiter{\Norm}{\mathord}{largesymbols}{3E}{largesymbols}{3E}
$\left.\Norm *BLA*\right.\Norm$ \quad $\left.\Norm \dfrac{*BLA*}{*BLUB*}\right.\Norm$
```

01-08-08

### 1.8.4 Problems with parentheses

It is obvious that the following equation has not the right size of the parenthesis

`\delimitershortfall` in the second integral, the inner one should be a bit smaller than the outer one.

`\delimiterfactor`

$$\int_Y F'(z) dz = \int_\alpha^\beta F'(\gamma(t)) \cdot \gamma'(t) dt \quad \begin{aligned} &\left[ \int_\alpha^\beta \right. \\ &\quad \left. \int_\alpha^\beta \right. \end{aligned}$$

01-08-09

The problem is that TeX controls the height of the parenthesis with `\delimitershortfall` and `\delimiterfactor`, with the default values

```
\delimitershortfall=5pt
\delimiterfactor=901
```

`\delimiterfactor/1000` is the relative size of the parenthesis for a given formula environment. They could be of `\delimitershortfall` too short. These values are valid at the end of the formula, the best way is to set them straight before the math environment or globally for all in the preamble.

$$\int_Y F'(z) dz = \int_\alpha^\beta F'(\gamma(t)) \cdot \gamma'(t) dt \quad \begin{aligned} &\left[ \int_\alpha^\beta \right. \\ &\quad \left. \int_\alpha^\beta \right. \end{aligned}$$

01-08-10

## 1.9 Text in math mode

Standard text in math mode should be written in upright shape and not in the italic one. This shape is reserved for the variable names:  $I$  am text inside math. (see also Table 1.3 on page 26). There are different ways to write text inside math.

- ▷ `\mathrm`. It is like math mode (no spaces), but in upright mode
- ▷ `\textrm`. Upright mode with printed spaces (real textmode)
- ▷ `\mbox`. The font size is still the one from `\textstyle` (see section 1.12 on page 30), so that you have to place additional commands when you use `\mbox` in a super- or subscript for limits.

`\textstyle`  
`\mbox`

Inserting long text is possible with a `\parbox`, which can be aligned as usual to the top, bottom or center, e.g.

```
01-09-01
\begin{array}{rcl}
a+b+c+d+ef & = & g+h+i+j+k \\
& & \parbox[t]{.25\linewidth}{this is a very long description of a formula}
\end{array}
```

$$a + b + c + d + ef = g + h + i + j + k \quad \text{this is a very long description of a formula}$$

Additional commands for text inside math are provided by  $\mathcal{A}\mathcal{M}\mathcal{S}$ math (see section 2.13 on page 66).

## 1.10 Font commands

### 1.10.1 Old-style font commands

Should never be used, but are still present and supported by L<sup>A</sup>T<sub>E</sub>X. The default syntax for the old commands is

```
{\XX test}
```

Example 01-10-01 shows what has to be replaced for the XX. The major difference to the new style is that these `\XX` are toggling the actual math mode into the "XX" one, whereas the new commands start which, at its end, switches back to the previous mode.

```
01-10-01
\def\cs#1{{\ttfamily\textbackslash#1}}
\cs{bf} \$\{\bf test\}$ | \cs{cal} \$\{\cal TEST\}$ | \cs{it} \$\{it test\}$
\cs{rm} \$\{rm test\}$ | \cs{tt} \$\{tt test\}$
\bf test | \cal TEST | \it test \rm test | \tt test
```

### 1.10.2 New-style font commands

The default syntax is

```
\mathXX{test}
```

`\mathrm`  
`\mathfrak`  
`\mathcal`  
`\mathsf`  
`\mathbb`  
`\mathit`  
`\mathbf`

Example 01-10-02 shows what has to be replaced for the XX. See section 4.1.13 on page 94 for additional packages. `\mathcal` and `\mathbb` are for standard L<sup>A</sup>T<sub>E</sub>X not available for lower letters. For `\mathcal` exists a non free font for lower letters (<http://www.pctex.com>). Macro `\mathds` needs package `dsfont` and macro `\mathfrak` needs package `amsfonts`.

```
\usepackage{tabularx,ragged2e}
\usepackage{amsfonts,dsfont}% for \mathds
\def\cs{\#1{\ttfamily\textrightslash\#1}}

\begin{tabularx}{\linewidth}{@{} l >{\RaggedRight}X @{}}
default & ABCDEFGHIJKLMNOPQRSTUVWXYZ\$ abcdefghijklmnopqrstuvwxyz\$ \\
\cs{\mathfrak} & \$\mathfrak{ABCDEF}GHIJKLMNOPQRSTUVWXYZ\$ \$\mathfrak{abcde}fghijklmnopqrstuvwxyz\$ \\
\cs{\mathcal} & \$\mathcal{ABCDEF}GHIJKLMNOPQRSTUVWXYZ\$ \$\mathcal{abcde}fghijklmnopqrstuvwxyz\$ \\
\cs{\mathsf} & \$\mathsf{ABCDEF}GHIJKLMNOPQRSTUVWXYZ\$ \$\mathsf{abcde}fghijklmnopqrstuvwxyz\$ \\
\cs{\mathbb} & \$\mathbb{ABCDEF}GHIJKLMNOPQRSTUVWXYZ\$ \\
\cs{\mathbf} & \$\mathbf{ABCDEF}GHIJKLMNOPQRSTUVWXYZ\$ \\
\cs{\mathit} & \$\mathit{ABCDEF}GHIJKLMNOPQRSTUVWXYZ\$ \$\mathit{abcde}fghijklmnopqrstuvwxyz\$ \\
\cs{\mathrm} & \$\mathrm{ABCDEF}GHIJKLMNOPQRSTUVWXYZ\$ \$\mathrm{abcde}fghijklmnopqrstuvwxyz\$ \\
\cs{\mathbf} & \$\mathbf{ABCDEF}GHIJKLMNOPQRSTUVWXYZ\$ \\
\cs{\mathds} & \$\mathds{ABCDEF}GHIJKLMNOPQRSTUVWXYZ\$ \\
\end{tabularx}
```

default <code>\mathfrak</code> <code>\mathcal</code> <code>\mathsf</code> <code>\mathbb</code> <code>\mathbf</code> <code>\mathit</code> <code>\mathrm</code> <code>\mathbf</code> <code>\mathds</code>	<i>ABCDE</i> FGHIJKLMNOPQRSTUVWXYZ <i>abcde</i> fghijklmnopqrstuvwxyz $\mathfrak{ABCDEF}GHIJKLMNOPQRSTUVWXYZ$ $\mathfrak{abcde}fghijklmnopqrstuvwxyz$ <i>ABCDEF</i> GHIJKLMNOPQRSTUVWXYZ <i>abcde</i> fghijklmnopqrstuvwxyz <i>ABCDEF</i> GHIJKLMNOPQRSTUVWXYZ <i>abcde</i> fghijklmnopqrstuvwxyz $\mathcal{ABCDEF}GHIJKLMNOPQRSTUVWXYZ$ $\mathcal{abcde}fghijklmnopqrstuvwxyz$ <i>ABCDEF</i> GHIJKLMNOPQRSTUVWXYZ <i>abcde</i> fghijklmnopqrstuvwxyz <i>ABCDEF</i> GHIJKLMNOPQRSTUVWXYZ <i>abcde</i> fghijklmnopqrstuvwxyz $\mathbf{ABCDEF}GHIJKLMNOPQRSTUVWXYZ$ $\mathbf{abcde}fghijklmnopqrstuvwxyz$ <i>ABCDEF</i> GHIJKLMNOPQRSTUVWXYZ <i>abcde</i> fghijklmnopqrstuvwxyz $\mathit{ABCDEF}GHIJKLMNOPQRSTUVWXYZ$ $\mathit{abcde}fghijklmnopqrstuvwxyz$ <i>ABCDEF</i> GHIJKLMNOPQRSTUVWXYZ <i>abcde</i> fghijklmnopqrstuvwxyz $\mathbf{ABCDEF}GHIJKLMNOPQRSTUVWXYZ$ $\mathbf{abcde}fghijklmnopqrstuvwxyz$ <i>ABCDEF</i> GHIJKLMNOPQRSTUVWXYZ
--	--

01-10-02

## 1.11 Space

### 1.11.1 Math typesetting

`\thinmuskip` L<sup>A</sup>T<sub>E</sub>X defines the three math lengths<sup>13</sup> with the following values<sup>14</sup>:

<code>\medmuskip</code>	
<code>\thickmuskip</code>	

```
\thinmuskip \thinmuskip=3mu
\medmuskip \medmuskip=4mu plus 2mu minus 4mu
\thickmuskip \thickmuskip=5mu plus 5mu
```

<sup>13</sup> For more information see: <http://www.tug.org/utilities/plain/cseq.html>

<sup>14</sup> see file `fontmath.ltx`

where `\mu` is the abbreviation for math unit.

$$1\mu = \frac{1}{18}\text{em}$$

default	$f(x) = x^2 + 3x_0 \cdot \sin x$
<code>\thinmuskip=0mu</code>	$f(x) = x^2 + 3x_0 \cdot \sin x$
<code>\medmuskip=0mu</code>	$f(x) = x^2 + 3x_0 \cdot \sin x$
<code>\thickmuskip=0mu</code>	$f(x) = x^2 + 3x_0 \cdot \sin x$
all set to zero	$f(x) = x^2 + 3x_0 \cdot \sin x$

Table 1.2: The meaning of the math spaces.

These lengths can have all glue and are used for the horizontal spacing in math expressions where TeX puts spaces between symbols and operators. The meaning of these different horizontal skips is shown in table 1.2. For a better typesetting L<sup>A</sup>T<sub>E</sub>X inserts different spaces between the symbols.

`\thinmuskip` space between ordinary and operator atoms

`\medmuskip` space between ordinary and binary atoms in display and text styles

`\thickmuskip` space between ordinary and relation atoms in display and text styles

## 1.11.2 Additional horizontal spacing

L<sup>A</sup>T<sub>E</sub>X defines the following short commands:

```
\def\>{\mskip\medmuskip}
\def\;{\mskip\thickmuskip}
\def\!{\mskip-\thinmuskip}
```

<code>\thinspace</code>
<code>\medspace</code>
<code>\thickspace</code>
<code>\negthinspace</code>
<code>\negmedspace</code>
<code>\negthickspace</code>

In math mode there is often a need for additional tiny spaces between variables, e.g.  $L \frac{di}{dt}$  written with a tiny space between  $L$  and  $\frac{di}{dt}$  looks nicer:  $L \frac{di}{dt}$ . Table 1.3 shows a list of all commands for horizontal space which can be used in math mode. The “space” is seen “between” the boxed a and b. For all examples a is `\boxed{a}` and b is `\boxed{b}`. The short forms for some spaces may cause problems with other packages. In this case use the long form of the commands. `\phantom` `\kern`

## 1.11.3 Problems

Using `\phantom` in mathmode depends to on object. `\phantom` reserves only the space of the exact width without any additional space. In the following example the second line is wrong: & `\phantom{\rightarrow} b\|`. It does not reserve any additional space.

Table 1.3: Spaces in math mode

Positive space		Negative space
\$ab\$		
\$a b\$		
\$a\! b\$		
\$a\mbox{\textvisiblespace}b\$		
\$a\!,b\$ (\$a\thinspace b\$)		\$a\! b\$ 
\$a\colon b\$ (\$a\medspace b\$)		\$a\negmedspace b\$ 
\$a\!; b\$ (\$a\thickspace b\$)		\$a\negthickspace b\$ 
\$a\quad b\$		
\$a\qquad b\$		
\$a\hspace{0.5cm}b\$		\$a\hspace{-0.5cm}b\$ 
\$a\kern0.5cm b\$		\$a\kern-0.5cm b\$ 
\$a\phantom{xx}b\$		
\$axxb\$		

 $a \rightarrow b$ 

\usepackage{amsmath}

 $b$ 

\begin{aligned}

 $b$ 

&amp; \rightarrowarrow b \\

 $b$ 

&amp; \&amp; \phantom{\rightarrowarrow} b \\

 $b$ 

&amp; \mkern\thickmuskip\phantom{\rightarrowarrow}\mkern\thickmuskip b \\

&amp; \mathrel{\phantom{\rightarrowarrow}} b

\end{aligned}

\end{aligned\*}

01-11-01

This only works when the math symbol is of type *mathrel*, otherwise you have to change the horizontal space to *\medmuskip* or *\thinmuskip* or to use an empty group after the *\phantom* command. For more informations about the math objects look into the L<sup>A</sup>T<sub>E</sub>X base math file *fontmath.ltx* or package *amssymb* or use the *\show* macro, which prints out the type of the mathsymbol, e.g. *\show\rightarrowarrow* with the output in the *log file*:

```
> \rightarrowarrow=\mathchar"3221.
1.20 \show\rightarrowarrow
```

The first digit represents the type:

0 : ordinary

1 : large operator

2 : binary operation

3 : relation

4 : opening

5 : closing

6 : punctuation

7 : variable family

Grouping a math symbol can change the behaviour in horizontal spacing. Compare  $50 \times 10^{12}$  and  $50\times10^{12}$ , the first one is typeset with  $\$50\text{\times}10^{\{12\}}\$$  and the second one with  $\$50\{\times\}10^{\{12\}}\$$ . Another possibility is to use the `numprint` package.<sup>15</sup>

### 1.11.4 Dot versus comma

In difference to a decimal point and a comma as a marker of thousands a lot of countries prefer it vice versa. To get the same behaviour the meaning of dot and comma has to be changed:

01-11-02	1,234,567.89 default 1.234.567,89 vice versa, wrong spacing 1.234.567,89 correct spacing	(1) (2) (3)	<pre>\usepackage{amsmath}% for align \begin{align} 1,234,567.89 &amp; \text{ default}\\ 1.234.567,89 &amp; \text{ vice versa, wrong spacing}\\ 1.\mathord{\{.}\}234\mathord{\{.}\}567\{,\}89 &amp; \text{ correct spacing} \end{align}</pre>
----------	--	-------------------	--

The original definitions from file `fontmath.ltx`<sup>16</sup> are

```
\DeclareMathSymbol{,}{\mathord}{letters}{3B}
\DeclareMathSymbol{.}{\mathord}{letters}{3A}
```

`\mathord` and `\mathord` can be changed for a documentwide other behaviour. In the above equation of Example 01-11-02 the comma is only set in a pair of braces {}, which is the same as writing `\mathord{,}` because L<sup>A</sup>T<sub>E</sub>X handles everything inside of parentheses as a formula, which gets the same spacing.

It is also possible to use the package `icomma`<sup>17</sup> for a documentwide correct spacing.

### 1.11.5 Vertical whitespace

#### Before/after math expressions

There are four predefined lengths, which control the vertical whitespace of displayed formulas:

```
\abovedisplayskip=12pt plus 3pt minus 9pt
\abovedisplayshortskip=0pt plus 3pt
\belowdisplayskip=12pt plus 3pt minus 9pt
\belowdisplayshortskip=7pt plus 3pt minus 4pt
```

The short skips are used if the formula starts behind the end of the foregoing last line. Only for demonstration the short skips are set to 0 pt in the following examples and the normal skips to 20 pt without any glue:

```
\usepackage{amsmath}% for align
```

<sup>15</sup> CTAN://macros/latex/contrib/numprint/

<sup>16</sup> Located in `texmf/tex/latex/base/`

<sup>17</sup> CTAN://macros/latex/contrib/was/

```
\noindent\fbox{\begin{minipage}{\dimexpr\linewidth-2\fboxsep-2\fboxrule}
\abovedisplayshortskip=0pt \belowdisplayshortskip=0pt
\abovedisplayskip=20pt \belowdisplayskip=20pt
\noindent The line ends before.
\begin{equation}
f(x) = \int\frac{\sin x}{x}, \mathrm{d}x
\end{equation}
\noindent The line doesn't end before the formula.
\begin{equation}
f(x) = \int\frac{\sin x}{x}, \mathrm{d}x
\end{equation}
\noindent And the next line starts as usual with some text ...
\end{minipage}}
```

The line ends before.

$$f(x) = \int \frac{\sin x}{x} dx \quad (1)$$

The line doesn't end before the formula.

$$f(x) = \int \frac{\sin x}{x} dx \quad (2)$$

And the next line starts as usual with some text ...

01-11-03

### fleqn class option

When using the `fleqn` class option for left aligned equations the math environments `equation` and `\[ ... \]` are typeset as a list. This is the reason why the vertical space is defined by the length registers for a list, especially `\topsep`, instead of `\abovedisplayskip` and `\belowdisplayskip`. This doesn't effect the environment `eqnarray`.

## Inside math expressions

`\[\<length>\]` This works inside the math mode in the same way as in the text mode.

`\jot` **\jot** The vertical space between the lines for all math expressions which allow multiple lines can be changed with the length `\jot`, which is predefined as

```
\newdimen\jot \jot=3pt
```

The following three formulas show this for the default value, `\setlength{\jot}{0pt}` and for a modified one `\setlength{\jot}{10pt}`. The horizontal is only for some demonstartion and makes it easier to see the differences.

```
\usepackage{amsmath}% for align

\begin{minipage}[t]{0.3\linewidth}
\begin{align*}
y &= d \\
y &= c\frac{1}{x}+d \\
y &= b\frac{1}{x^2}%
&\rlap{\hspace{-1cm}\rule{10cm}{0.4pt}}+cx+d\% \rlap{only demo}
\end{align*}
\end{minipage}
\end{minipage}
\begin{minipage}[t]{0.3\linewidth}
\setlength{\jot}{0pt}
\begin{align*}
y &= d \\
y &= c\frac{1}{x}+d \\
y &= b\frac{1}{x^2}%
&\rlap{\hspace{-1cm}\rule{10cm}{0.4pt}}+cx+d\% \rlap{only demo}
\end{align*}
\end{minipage}
```

```

y &= d\\ y &= c\frac{1}{x}+d\\ y &= b\frac{1}{x^2}+cx+d\\
\end{aligned*}
\end{minipage}\hfill
\begin{minipage}[t]{0.3\linewidth}
\setlength{\jot}{10pt}
\begin{aligned*}
y &= d\\ y &= c\frac{1}{x}+d\\ y &= b\frac{1}{x^2}+cx+d\\
\end{aligned*}
\end{minipage}

```

01-11-04

$$\begin{array}{c}
 y = d \\
 y = c\frac{1}{x} + d \\
 y = b\frac{1}{x^2} + cx + d
 \end{array}
 \quad
 \begin{array}{c}
 y = d \\
 y = c\frac{1}{x} + d \\
 y = b\frac{1}{x^2} + cx + d
 \end{array}
 \quad
 \begin{array}{c}
 y = d \\
 y = c\frac{1}{x} + d \\
 y = b\frac{1}{x^2} + cx + d
 \end{array}
 \quad
 \hline
 y = b\frac{1}{x^2} + cx + d$$

Defining a new environment with a parameter makes things easier, because changes to the length are locally.

```

\newenvironment{mathspace}[1]
{\setlength{\jot}{#1}%
 \ignorespaces%
 \ignorespacesafterend}

```

**\arraystretch** The vertical space between the lines for all math expressions which contain an array environment can be changed with the command **\arraystretch**, which is predefined as

```
\renewcommand{\arraystretch}{1}
```

Renewing this definition is global to all following math expressions, so it should be used in the same way as **\jot**.

**\vskip** Another spacing for single lines is possible with the **\vskip** macro, but only together with the **\noalign** command. It does work only with the environment **pmatrix** from *AMSmath* and not the standard **\pmatrix** macro from *LATeX* base.

```

\usepackage{amsmath}

\begin{minipage}[t]{0.45\linewidth}
\[
\begin{pmatrix}
0 & 1 & 1 & 0 & 0 & 1 \\
1 & 0 & 0 & 1 & 1 & 0
\end{pmatrix}
\relax\rrelap{\rule{10cm}{0.2pt}}% only for demonstration
0 & 1 & 1 & 0 & \dfrac{1}{\sqrt{2}} & 1 \\
1 & 0 & 1 & 0 & 1 & 0 \\
0 & 1 & 0 & 1 & 0 & 1
\end{pmatrix}
\]
\end{minipage}
\begin{minipage}[t]{0.45\linewidth}
\[
\begin{pmatrix}
0 & 1 & 1 & 0 & 0 & 1 \\
1 & 0 & 0 & 1 & 1 & 0
\end{pmatrix}
\noalign{\vskip3pt}
0 & 1 & 1 & 0 & \dfrac{1}{\sqrt{2}} & 1 \\
\noalign{\vskip3pt}
1 & 0 & 1 & 0 & 1 & 0 \\
0 & 1 & 0 & 1 & 0 & 1
\end{pmatrix}
\]
\end{minipage}

```

```
\end{pmatrix} \]
\end{minipage}
```

$\begin{pmatrix} 0 & 1 & 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 1 & 0 & \frac{1}{\sqrt{2}} & 1 \\ 1 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 & 0 & 1 \end{pmatrix}$	$\begin{pmatrix} 0 & 1 & 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 1 & 0 & \frac{1}{\sqrt{2}} & 1 \\ 1 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 & 0 & 1 \end{pmatrix}$
--	--

01-11-05

**Package setspace** To have all formulas with another vertical spacing, one can choose the package `setspace` and redefining some of the math macros, e. g.

```
a = b           \usepackage{setspace}
a = b           \newcommand*\Array[2][1]{\setstretch{\#1}\array{\#2}}
a = b           \let\endArray\endarray
a = b           \begin{array}[ \begin{array}{cc}
a = b           a =& b\\
text a = b text a =& b\\
a = b           a =& b\\
\end{array} \end{array}
% text
\begin{array}{cc}
\$ \begin{array}{cc}
a = & b\\
a =& b\\
a = & b\\
\end{array} \$ text
\end{array}
```

01-11-06

## 1.12 Styles

Table 1.4: Math styles

Mode	Inline	Displayed
default	$f(t) = \frac{T}{2\pi} \int \frac{1}{\sin \frac{\omega}{t}} dt$	$f(t) = \frac{T}{2\pi} \int \frac{1}{\sin \frac{\omega}{t}} dt$
\displaystyle	$f(t) = \frac{T}{2\pi} \int \frac{1}{\sin \frac{\omega}{t}} dt$	$f(t) = \frac{T}{2\pi} \int \frac{1}{\sin \frac{\omega}{t}} dt$
\scriptstyle	$f(t) = \frac{T}{2\pi} \int \frac{1}{\sin \frac{\omega}{t}} dt$	$f(t) = \frac{T}{2\pi} \int \frac{1}{\sin \frac{\omega}{t}} dt$
\scriptscriptstyle	$f(t) = \frac{T}{2\pi} \int \frac{1}{\sin \frac{\omega}{t}} dt$	$f(t) = \frac{T}{2\pi} \int \frac{1}{\sin \frac{\omega}{t}} dt$
\textstyle	$f(t) = \frac{T}{2\pi} \int \frac{1}{\sin \frac{\omega}{t}} dt$	$f(t) = \frac{T}{2\pi} \int \frac{1}{\sin \frac{\omega}{t}} dt$

This depends on the environment in which they are used. An inline formula has a default math fontsize called `\textstyle`, which is smaller than the one for a display formula (see section 1.3), which is called `\displaystyle`. Beside this predefinition there are two other special fontstyles for math, `\scriptstyle` and `\scriptscriptstyle`. They are called “style” in difference to “size”, because they have a dynamic character, their real fontsize belongs to the environment in which they are used. A fraction for example is by default in `scriptstyle` when it is in an inline formula like this  $\frac{a}{b}$ , which can be changed to  $\frac{a}{b}$ . This may be in some cases useful but it looks in general ugly because the line spacing is too big. These four styles are predefined and together in a logical relationship.

It is no problem to use the other size macros like `\large`, `\Large`, ... outside the math environment. For example a fraction written with `\Huge`:  $\frac{a}{b}$  (`\Huge\frac{a}{b}`). This may cause some problems when you want to write a displayed formula in another fontsize, because it also affects the interline spacing of the preceding part of the paragraph. If you end the paragraph, you get problems with spacing and page breaking above the equations. So it is better to declare the font size and then restore the baselines:

```
\makeatletter
\newenvironment{smallequation}[1]
  {\skip@=\baselineskip\#1\baselineskip=\skip@\relax}
  {\endequation \ignorespacesafterend}
\makeatother

Normal size
\begin{smallequation}{\tiny} \int_1^2 \frac{1}{x^2} dx = 0.5 \end{smallequation}
```

Normal size

$$\int_1^2 \frac{1}{x^2} dx = 0.5 \quad (1)$$

If you use this the other way round for huge fontsize, don't forget to load package `exscale` (see section 4.1.14 on page 94). Also see this section for different symbol sizes.

## 1.13 Dots

In addition to the above decorations there are some more different dots which are single commands and not by default over/under a letter. It is not easy to see the differences between some of them. Dots from lower left to upper right are possible with `\reflectbox{\ddots}`.

Table 1.5: Dots in math mode

<code>\cdots</code>	<code>\ddots</code>	<code>\ddots</code>	<code>\dotsb</code>	<code>\dotsc</code>	<code>\dotsi</code>	<code>\dotsm</code>	<code>\dotso</code>	<code>\dotsb</code>	<code>\dotsc</code>	<code>\dotsi</code>	<code>\dotsm</code>	<code>\dotso</code>
<code>\dotsm</code>	<code>\dotso</code>	<code>\dotsb</code>	<code>\dotsc</code>	<code>\dotsi</code>	<code>\dotsm</code>	<code>\dotso</code>	<code>\dotsb</code>	<code>\dotsc</code>	<code>\dotsi</code>	<code>\dotsm</code>	<code>\dotso</code>	<code>\dotsb</code>

## 1.14 Accents

The letter “a” is only for demonstration. The table 1.6 shows all in standard L<sup>A</sup>T<sub>E</sub>X available accents and also the ones placed under a character. With package `amssymb` it is easy to define new accents. For more information see section 2.7 on page 60 or other possibilities at section 4.1.1 on page 88.

Table 1.6: Accents in math mode

\acute{a}	\bar{a}	\breve{a}	\breve{a}
\bar{a}	\breve{a}	\ddot{a}	\ddot{a}
\check{a}	\ddot{a}	\grave{a}	\hat{a}
\dot{a}	\grave{a}	\widehat{a}	\widehat{a}
\mathring{a}	\overbrace{a}	\overline{a}	\overleftarrow{a}
\overleftarrow{a}	\overline{a}	\tilde{a}	\overparen{a}
\overrightarrow{a}	\tilde{a}	\underbrace{a}	\underbar{a}
\underbrace{a}	\underbrace{a}	\underleftarrow{a}	\underleftarrow{a}
\underline{a}	\underline{a}	\underbrace{a}	\underrightarrow{a}
\vec{a}	\widehat{a}	\widetilde{a}	\widetilde{a}

The letters *J* and *j* can be substituted with the macros `\imath` and `\jmath` when an accents is placed over these letters and the dot should disappear:  $\vec{\imath} \vec{\jmath}$  ( $\vec{\imath}$   $\vec{\jmath}$ )

Accents can be used in different ways, e.g. strike a single character with a horizontal line like  $\mathop{\mathit{\mathbf{A}}}\limits^-$ :  $\mathit{\mathbf{A}}$  or  $\mathop{\mathit{\mathbf{A}}}\limits^{\mathit{\mathbf{A}}}$ :  $\mathit{\mathbf{A}}$ . In section 4.1.7 on page 91 is a better solution for more than one character.

### 1.14.1 Over- and underbrackets

There are no `\underbrace` and `\overbrace` commands in the list of accents. They can be defined in the preamble with the following code.<sup>18</sup>

```
\makeatletter
\def\underbrace{%
  \@ifnextchar[{ \@underbrace}{\@underbrace [\@bracketheight]}}
\def\@underbrace[#1]{%
  \@ifnextchar[{ \@underbrace[#1]{\@underbrace[#1][0.4em]}}{%
  \def\@underbrace[#1][#2]{\%message {Underbrace: #1,#2,#3}
    \mathop{\vtop{\m@th \ialign {\##\cr\cr $\hfil \displaystyle {#3}\hfil $%
      \cr\cr \noalign {\kern 3\p@\nointerlineskip }\upbracefill {#1}{#2}%
      \cr\cr \noalign {\kern 3\p@ }}}}\limits}
  \def\upbracefill#1#2{$\m@th \setbox \z@ \hbox {\$#1#2\$}%
    \edef\@bracketheight{\the\ht\z@}\bracketend{\#1}{#2}%
    \leaders \vrule \@height #1 \@depth \z@ \hfill%
    \leaders \vrule \@height #1 \@depth \z@ \hfill \bracketend{\#1}{#2}%
  \def\bracketend#1#2{\vrule height #2 width #1\relax}%
\makeatother

\begin{enumerate}
\item \verb|\underbrace{...}| is an often used command:
\item \verb|\begin{array}{rcl}|
```

<sup>18</sup> The package `mathtools` has this code included.

```

\underbrace{\{x^2+2x+1\}} &= & f(x) \\
\left(x+\right)^2\backslash,\backslash,\nonumber
\end{array} \]
\item Sometimes an underbrace is needed, which can be used in  

more ways than \verb|\underbrace{...}|. An example for \verb|\underbrace{...}|:  

\begin{array}{rcl}
\text{Hate Science} & \underbrace{[0.5pt]{1\rightarrow2\rightarrow3\rightarrow4}}_{[0.75pt][0.75em]{5\rightarrow6\rightarrow7}} \\
& \underbrace{[1pt][1em]{8\rightarrow9\rightarrow10}}_{[low]\hspace{1.5cm}[medium]\hspace{1.5cm}[high]} & \text{Love Science} \\
\end{array}

```

1. \underbrace{\dots} is an often used command:

$$\frac{x^2 + 2x + 1}{(x+1)^2} = f \cdot x /$$

2. Sometimes an `underbrace` is needed, which can be used in more ways than `\underbrace{...}`. An example for `\underbrace{...}`:

Hate Science [0.5pt] 1 ε 2 ε 3 ε 4 [0.75pt] [0.75em] ε 5 ε 6 ε 7 [1pt] [1em] ε 8 ε 9 ε 10 Love Science  
 low medium high

### **Use of \underbrace{...}**

The `\underbrace{...}` command has two optional parameters:

- ▷ the line thickness in any valid latex unit, e.g. 1pt
  - ▷ the height of the edge brackets, e.g. 1em

using without any parameters gives the same values for thickness and height as predefined for the \underbrace command.

1. <i>foo bar</i>	% has the underbrace stuff in hidden part
2. [2pt] <i>foo bar</i>	\begin{tabular}{cl}
3. [2pt][1em] <i>foo bar</i>	1.& \\$\underbrace{foo-bar}\\$ \\ 2.& \\$\underbrace[2pt]{foo-bar}\\$ \\ 3.& \\$\underbrace[2pt][1em]{foo-bar}\\$ \end{tabular}

## Overbracket

In addition to the underbrace an overbrace is also useful, which can be used in more ways than `\overbrace{...}`.<sup>19</sup> For example:

```

\makeatletter
\def@bracketheight{2pt}
\def@bracketend{\#1\#2{\vrule height #2 width #1\relax}
\def@overbrace{\{@inextchar[{\{@overbracket}{\{@overbracket[@bracketheight]}}
\def@overbracket{\#1[{\@ifnextchar[{\@overbracket[#1]}{\@overbracket[#1][0.3em]}}]
\def@overbracket{\#1[{\ifnextchar[{\@overbracket[#1]}{\@overbracket[#1][0.3em]}}]
\def@overbracket{\#1[#2]#3%\message {Overbracket: #1,#2,#3}
\mathop {\vbox{\m@th \ialign {\##\cr\cr\noalign {\kern 3}\p@
\nointerlineskip }\downbracketfill {\#1}{\#2}
\crr\noalign {\kern 3}\p@ }
\crr \$\fil \displaystyle {\#3}\hfil \$%
\crr }}\limits}
\def\downbracketfill{\#1\#2{\mathop {\setbox \z@ \hbox {\hbrace{\$}}\limits}

```

---

<sup>19</sup> The package `mathtools` has this code included.

```

\edef@\bracketheight{\the\ht z@\downbracketend{#1}{#2}}
\Leaders \vrule @height #1 \@depth z@ \hfill
\leaders \vrule @height #1 \@depth z@ \hfill
\downbracketend{#1}{#2}%
\def\downbracketend#1#2{\vrule depth #2 width #1\relax}
\makeatother

$begin{array}{rcl}
\text{Hate Science } & \& \overbrace[0.5pt]{1\rightarrow 2\rightarrow 3\rightarrow 4} \\
\overbrace[0.75pt][0.75em]{\rightarrow 5\rightarrow 6\rightarrow 7} \\
\overbrace[1pt][1em]{\rightarrow 8\rightarrow 9\rightarrow 10} & \& \text{Love Science}\\
& \& \text{low} \hspace{1.5cm} \text{medium} \hspace{1.5cm} \text{high} \\
\end{array}$

```

The `\overbrace{...}` command has two optional parameters:

- ▷ the line thickness in any valid latex unit, e.g. 1pt
  - ▷ the height of the edge brackets, e.g. 1em

using without any parameters gives the same values for thickness and height as predefined for the \overbrace command.

1. *foo bar*
  2. [2pt]*foo bar*
  3. [2pt][1em]*foo ba*

```
% has the underbrace stuff in hidden part

\begin{tabular}{cl}
1.& \$\overbrace{foo\ bar} \$ \\
2.& \$\overbrace[2pt]{foo\ bar} \$ \\
3.& \$\overbrace[2pt][1em]{foo\ bar} \$ \\
\end{tabular}
```

## 1.14.2 Vectors

Especially for vectors there is the package `esvect`<sup>20</sup> package, which looks better than the `\overrightarrow`, e.g.

Table 1.7: Vectors with package esvect (in the right column the default one from L<sup>A</sup>T<sub>E</sub>X)

$\backslash vv \dots$	$\backslash overrightarrow{...}$
$\vec{a}$	$\vec{a}$
$\overrightarrow{abc}$	$\overrightarrow{abc}$
$\vec{i}$	$\vec{i}$
$\vec{A}_x$	$\vec{A}_x$

Look into the documentation for more details about the package `esvect`.

## 1.15 Exponents and indices

The two active characters `_` and `^` can only be used in math mode. The *following* character will be printed as an index (`$y=a_1x+a_0$`:  $y = a_1x + a_0$ ) or as an exponent (`$x^2+y^2=r^2$`:  $x^2 + y^2 = r^2$ ). For more than the next character put it inside of {}, like `$a_{i-1}+a_{i+1}< a_i$`:  $a_{i-1} + a_{i+1} < a_i$ .

Especially for multiple exponents there are several possibilities. For example:

<sup>20</sup> CTAN:macros/latex/contrib/esvect/

01-15-01

$$\dots x^2/{}^3/{}^4 = \dots x^2/{}^3/{}^4 = \left( \left( x^2 \right)^3 \right)^4 \quad (1)$$

```
\begin{equation}
((x^2)^3)^4 = (((x^2)^3))^4 =
{\left( {\left( {x^2} \right)^3} \right)^4}
\end{equation}
```

For variables with both exponent and indice index the order is not important,  $\$a\_1^2\$$  is exactly the same than  $\$a^2\_1\$$ :  $a_1^2 = a_1^2$ . By default all exponents and indices are set as italic characters. It is possible to change this behaviour to get upright characters. The following example shows this for the indices.

01-15-02

$$\begin{array}{l} A_{abc123def} \\ A_{abc_{xyz}123def} \\ A_{abc123def} \\ A_{abc_{xyz}123def} \end{array}$$

```
$A_{\{abc\_xyz\}123def}^{abc123def}aa$  

\makeatletter  

\catcode`\_\active  

\def_#1{\sb{\operator@font#1}}  

\makeatother  

$A_{\{abc\_xyz\}123def}^{abc123def}aa$
```

## 1.16 Operators

They are written in upright font shape and are placed with some additional space before and after for a better typesetting. With the  $\mathcal{AM}$ Smath package it is possible to define one's own operators (see section [2.12 on page 66](#)). Table [1.8](#) and [1.9 on the following page](#) show a list of the predefined ones for standard  $\text{\LaTeX}$ .

\coprod	$\coprod$	\bigvee	$\bigvee$	\bigwedge	$\bigwedge$
\biguplus	$\biguplus$	\bigcap	$\bigcap$	\bigcup	$\bigcup$
\intop	$\intop$	\int	$\int$	\prod	$\prod$
\sum	$\sum$	\bigotimes	$\bigotimes$	\bigoplus	$\bigoplus$
\bigdot	$\bigdot$	\ointop	$\ointop$	\oint	$\oint$
\bigsqcup	$\bigsqcup$	\smallint	$\smallint$		

Table 1.8: The predefined operators of `fontmath.ltx`.

The difference between  $\intop$  and  $\int$  is that the first one has by default over/under limits and the second subscript/superscript limits. Both can be changed with the `\limits` or `\nolimits` command. The same behaviour happens to the  $\ointop$  and  $\oint$  Symbols.

For more predefined operator names see table [4.1.3 on page 89](#). It is easy to define a new operator with the macro `\mathop`. Then you can use any macro (e.g. `\foo`) in the usual way:

01-16-01

$$\text{foo}_1^2 = x^2$$

```
\makeatletter  

\newcommand\foo{\mathop{\operator@font foo}\nolimits}  

\makeatother
```

```
\[ \text{foo}_1^2 = x^2 \]
```

In this example `\foo` is defined with `\nolimits`, means that limits are placed in superscript/subscript mode and not over under. This is still possible with `\limits` in the definition or the equation:

01-16-02

$$\text{foo}_1^2 = x^2$$

```
\makeatletter  

\newcommand\foo{\mathop{\operator@font foo}\nolimits}  

\makeatother
```

```
\[ \text{foo}\limits_1^2 = x^2 \]
```

Table 1.9: The predefined operators of `latex.ltx`

<code>\log</code>	<code>log</code>	<code>\lg</code>	<code>lg</code>	<code>\ln</code>	<code>ln</code>
<code>\lim</code>	<code>lim</code>	<code>\limsup</code>	<code>lim sup</code>	<code>\liminf</code>	<code>lim inf</code>
<code>\sin</code>	<code>sin</code>	<code>\arcsin</code>	<code>arcsin</code>	<code>\sinh</code>	<code>sinh</code>
<code>\cos</code>	<code>cos</code>	<code>\arccos</code>	<code>arccos</code>	<code>\cosh</code>	<code>cosh</code>
<code>\tan</code>	<code>tan</code>	<code>\arctan</code>	<code>arctan</code>	<code>\tanh</code>	<code>tanh</code>
<code>\cot</code>	<code>cot</code>	<code>\coth</code>	<code>coth</code>	<code>\sec</code>	<code>sec</code>
<code>\csc</code>	<code>csc</code>	<code>\max</code>	<code>max</code>	<code>\min</code>	<code>min</code>
<code>\sup</code>	<code>sup</code>	<code>\inf</code>	<code>inf</code>	<code>\arg</code>	<code>arg</code>
<code>\ker</code>	<code>ker</code>	<code>\dim</code>	<code>dim</code>	<code>\hom</code>	<code>hom</code>
<code>\det</code>	<code>det</code>	<code>\exp</code>	<code>exp</code>	<code>\Pr</code>	<code>Pr</code>
<code>\gcd</code>	<code>gcd</code>	<code>\deg</code>	<code>deg</code>	<code>\bmod</code>	<code>mod</code>
<code>\pmod{a}</code>	(mod $a$ )				

$\mathcal{AM}$ Smath has an own macro for a definition, have a look at section [2.12 on page 66](#).

## 1.17 Greek letters

The  $\mathcal{AM}$ Smath package simulates a bold font for the greek letters, it writes a greek character twice with a small kerning. The `\mathbf{<character>}` doesn't work with lower greek character. See Section [2.16 on page 70](#) for the `\pmb` macro, which makes it possible to print bold lower greek letters. Not all upper case letters have own macro names. If there is no difference to the roman font, then the default letter is used, e. g. A for the upper case of  $\alpha$ . Table [01-17-03](#) shows only those upper case letters which have own macro names. Some of the lower case letters have an additional var option for an alternative.

Bold greek letters are possible with the package `bm` (see section [4.1.5 on page 90](#)) and if they should also be upright with the package `upgreek`:

$\alpha, \beta \dots$	<code>\usepackage{bm, upgreek}</code>
	<code>\$ \bm{\upalpha}, \bm{\upbeta} \dots \$</code>

01-17-01

With a useful definition we can type `\bfgreek{mu}` to obtain an upright boldface for the greek letter  $\mu \Rightarrow \pmb{\mu}$

$\beta \mu \delta \theta \sigma$	<code>\usepackage{bm, upgreek}</code>
	<code>\makeatletter</code>
	<code>\newcommand\bfgreek[1]{\bm{\@nameuse{up#1}}}</code>
	<code>\makeatother</code>
	<code>\$\bfgreek{\beta}\bfgreek{\mu}\bfgreek{\delta}\bfgreek{\theta}\bfgreek{\sigma}\$</code>

01-17-02

Table 1: The greek letters of Latin Modern

<i>lower</i>	<i>default</i>	<i>upper</i>	<i>default</i>	$\mathbf{\backslash mathbf{}}$	$\mathit{\backslash mathit{}$
<code>\alpha</code>	$\alpha$				
<code>\beta</code>	$\beta$				
<code>\gamma</code>	$\gamma$	<code>\Gamma</code>	$\Gamma$	$\Gamma$	$\Gamma$
<code>\delta</code>	$\delta$	<code>\Delta</code>	$\Delta$	$\Delta$	$\Delta$
<code>\epsilon</code>	$\epsilon$				
<code>\varepsilon</code>	$\varepsilon$				
<code>\zeta</code>	$\zeta$				
<code>\eta</code>	$\eta$				
<code>\theta</code>	$\theta$	<code>\Theta</code>	$\Theta$	$\Theta$	$\Theta$
<code>\vartheta</code>	$\vartheta$				
<code>\iota</code>	$\iota$				
<code>\kappa</code>	$\kappa$				
<code>\lambda</code>	$\lambda$	<code>\Lambda</code>	$\Lambda$	$\Lambda$	$\Lambda$
<code>\mu</code>	$\mu$				
<code>\nu</code>	$\nu$				
<code>\xi</code>	$\xi$	<code>\Xi</code>	$\Xi$	$\Xi$	$\Xi$
<code>\pi</code>	$\pi$	<code>\Pi</code>	$\Pi$	$\Pi$	$\Pi$
<code>\varpi</code>	$\varpi$				
<code>\rho</code>	$\rho$				
<code>\varrho</code>	$\varrho$				
<code>\sigma</code>	$\sigma$	<code>\Sigma</code>	$\Sigma$	$\Sigma$	$\Sigma$
<code>\varsigma</code>	$\varsigma$				
<code>\tau</code>	$\tau$				
<code>\upsilon</code>	$\upsilon$	<code>\Upsilon</code>	$\Upsilon$	$\Upsilon$	$\Upsilon$
<code>\phi</code>	$\phi$	<code>\Phi</code>	$\Phi$	$\Phi$	$\Phi$
<code>\varphi</code>	$\varphi$				
<code>\chi</code>	$\chi$				
<code>\psi</code>	$\psi$	<code>\Psi</code>	$\Psi$	$\Psi$	$\Psi$
<code>\omega</code>	$\omega$	<code>\Omega</code>	$\Omega$	$\Omega$	$\Omega$

With an OpenType font we can use macros for every type of greek letter. [Unicode](#) The only prerequisites are a proper OpenType font, like XITS Math, and one of the newer TeX-engines XeTeX or LuaTeX.

01-17-04

```
\usepackage{unicode-math}
\setmathfont{XITS Math}

$ \theta \Theta \vartheta \Theta \Theta \Theta
```

## 1.18 Pagebreaks

By default a displayed formula cannot have a pagebreak. This makes some sense, but sometimes it gives a better typesetting when a pagebreak is possible.

`\allowdisplaybreaks``\allowdisplaybreaks`

`\allowdisplaybreaks` enables TeX to insert pagebreaks into displayed formulas whenever a newline command appears. With the command `\displaybreak` it

is also possible to insert a pagebreak at any place. But this is for standard L<sup>A</sup>T<sub>E</sub>X not a real option; the only possible environment is `eqnarray` which shouldn't be used. It makes only sense with the environments from *AMSmath* (see Chapter 2 on page 43).

## 1.19 \stackrel

`\stackrel` puts a character on top of another one which may be important if a used symbol is not predefined. For example “ $\stackrel{\wedge}{=}$ ” (`\stackrel{\wedge}{=}`). The syntax is

```
\stackrel{<top>}{<base>}
```

Such symbols may be often needed so that a macro definition in the preamble makes some sense:

```
\newcommand\eqdef{%
\ensuremath{\mathrel{\stackrel{\mathrel{\mathrm{def}}}{=}}}}
```

With the `\ensuremath` command we can use the new `\eqdef` command in text and in math mode, L<sup>A</sup>T<sub>E</sub>X switches automatically in math mode, which saves some keystrokes like the following command, which is written without the delimiters (\$...\$) for the math mode  $\square$ , only `\eqdef` with a space at the end. In math mode together with another material it may look like  $\vec{x} \stackrel{\mathrm{def}}{=} (x_1, \dots, x_n)$  and as command sequence

```
$\vec{x}\eqdef\left(x_1,\ldots,x_n\right)$
```

The fontsize of the top is one size smaller than the one from the base, but it is no problem to get both the same size, just increase the top or decrease the base.

## 1.20 \choose

`\choose` `\choose` is like `\atop` with delimiters or like `\frac` without the fraction line and also with delimiters. It is often used for binomial coefficients and has the following syntax:

```
{above \choose below}
```

The two braces are not really important but it is safe to use them.

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

```
\begin{equation}
{m+1 \choose n} = {m \choose n} + {m \choose k-1}
\end{equation}
```

01-20-01

See section 2.5.2 on page 59 for the *AMSmath* equivalents and enhancements.

## 1.21 Color in math expressions

There is no difference in using colored text and colored math expressions. With `\textcolor{blue}{f(x)}` `\usepackage{xcolor}`

in the preamble the macro `\textcolor{<color>}{<text or math>}` exists.

01-21-01      
$$f(x) = \int_1^{\infty} \frac{1}{x^2} dx = 1 \quad (1)$$

```
\usepackage{xcolor}
\begin{equation}
\textcolor{blue}{f(x)} = \int \limits_1^{\infty} \textcolor{red}{\frac{1}{x^2}} \, dx = 1
\end{equation}
```

If all math expressions should be printed in the same color, then it is better to use the `\everydisplay` macro (Section 1.24 on page 41).

## 1.22 Boldmath

Writing a whole formula in bold is possible with the command sequence `\mathversion{boldmath} ... \mathversion{unboldmath}`, which itself must be written in textmode (outside the formula) or with the command `\mathversion{bold}`.

01-22-01

```
\begin{minipage}[t]{0.45\linewidth}
\[
\sum_{\substack{1 \leq i \leq p \\ 1 \leq j \leq q \\ 1 \leq k \leq r}} \text{scriptscriptstyle } a_{ij} b_{jk} c_{ki}
\]
\end{minipage}\hfill
\begin{minipage}[t]{0.45\linewidth}
\boldmath
\[
\sum_{\substack{1 \leq i \leq p \\ 1 \leq j \leq q \\ 1 \leq k \leq r}} a_{ij} b_{jk} c_{ki}
\]
\end{minipage}
```

`$ y=f(x) $ \unboldmath $ y=f(x) $`

$$\sum_{\substack{1 \leq i \leq p \\ 1 \leq j \leq q \\ 1 \leq k \leq r}} a_{ij} b_{jk} c_{ki}$$

$$\sum_{\substack{1 \leq i \leq p \\ 1 \leq j \leq q \\ 1 \leq k \leq r}} a_{ij} b_{jk} c_{ki}$$

$$y = f(x) \quad y = f(x)$$

The `\mathversion` macro defines a math style which is valid for all following math expressions. If you want to have all math in bold then use this macro instead of `\boldmath`. But it is no problem to put `\mathversion` inside a group to hold the changes locally.

01-22-02

```
y(x) = ax^3 + bx^2 + cx + d \quad (1) \mathversion{bold} \begin{equation} y(x) = ax^3+bx^2+cx+d \end{equation} \mathversion{normal} y = f(x) \quad y = f(x)
```

```
\begin{equation}
y(x) = ax^3+bx^2+cx+d
\end{equation}
```

Single characters inside a formula can be written in bold with `\mathbf{b}`, but only in upright mode, which is in general not useful as shown in Example 01-22-03. It is better to use package `bm` (see section 4.1.5 on page 90).

$$\sum_{\substack{1 \leq i \leq p \\ 1 \leq j \leq q \\ 1 \leq k \leq r}} a_{ij} b_{jk} c_{ki} \quad (1)$$

```
\begin{equation}
\sum_{\substack{1 \leq i \leq p \\ 1 \leq j \leq q \\ 1 \leq k \leq r}} a_{ij} b_{jk} c_{ki}
\end{equation}
```

01-22-03

### 1.22.1 Bold math expressions as part of titles and items

By default the titles in sections, subsections, a.s.o. are printed in bold. Same for the `description` environment. The problem is that a math expression in one of these environments is printed in default font shape, like the following example for a `\section` and `description`:

#### 1 The math function $f(x) = x^2$

**This is**  $y = f(x)$  Only a demonstration.

**And**  $z = f(x, y)$  Another demonstration.

With a redefinition of the `\section` and `\item` macros it is possible to get everything in bold font.

#### 1 The math function $f(x) = x^2$

**This is**  $y = f(x)$  Only a demonstration.

**And**  $z = f(x, y)$  Another demonstration.

```
\section{The math function $f(x)=x^2$}
\begin{description}
\item[This is $y=f(x)$] Only a demonstration.
\item[And $z=f(x,y)$] Another demonstration.
\end{description}
```

01-22-04

```
\makeatletter
\let\itemOld\item
\renewcommand{\item}[1][]{
  \def\@tempa{\#1}
  \ifx\@tempa\empty\itemOld
  \else\boldmath\itemOld[\#1]\unboldmath
  \fi}
\makeatother
\let\sectionOld\section
\renewcommand{\section}[2][\empty]{%
  \boldmath\sectionOld[\#1]\#2\unboldmath}

\section{The math function $f(x)=x^2$}
\begin{description}
\item[This is $y=f(x)$] Only a demonstration.
\item[And $z=f(x,y)$] Another demonstration.
\end{description}
```

01-22-05

## 1.23 Multiplying numbers

When the dot is used as the decimal marker as in the United States, the preferred sign for the multiplication of numbers or values of quantities is a cross (`\times`), not a half-high and centered dot (`\cdot`).

When the comma is used as the decimal marker as in Europe, the preferred sign for the multiplication of numbers is the half-high dot. The multiplication of quantity symbols (or numbers in parentheses or values of quantities in parentheses) may be indicated in one of the following ways:  $ab$ ,  $a \cdot b$ ,  $a \times b$ .

For more information see “Nist Guide to SI Units -More on Printing and Using Symbols and Numbers in Scientific and Technical Documents”<sup>21</sup> or the German DIN 1304, Teil 1.

<sup>21</sup> <http://physics.nist.gov/Pubs/SP811/sec10.html>

## 1.24 Other macros

There are some other macros which are not mentioned in the foregoing text. `\everymath`  
`\everydisplay`

Here comes a not really complete list of these macros.

`\everymath` puts the argument before any inlined math expression, e.g. `\everymath{\displaysize}`.

Using this macro doesn't really make sense, when one is using footnotes because the footnote number is printed as superscript in inline mathmode and an `\everymath` will be valid, too.

`\everydisplay` puts the argument before any displayed math expression, e.g. `\everydisplay{\color{blue}}`.

`\underline` underlines a math expression and has to be used inside the math mode.

$$\underline{F(x) = \int f(x) dx}$$



# Chapter 2

## *AMSmash package*

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In general the *AMS* packages are at least a collection of three different ones:

1. amsmath
2. amssymb
3. amsfonts

amsmath itself loads by default:

```
\RequirePackage{amstext}[1995/01/25]
\RequirePackage{amsbsy}[1995/01/20]
\RequirePackage{amsopn}[1995/01/20]
```

The package amssymb loads:

---

\RequirePackage{amsfonts}[1995/01/01]

For a simple L<sup>A</sup>T<sub>E</sub>X source which has only \usepackage{amsmath} you'll get:

amsmath.sty	2016/06/28 v2.15d AMS math features
amstext.sty	2000/06/29 v2.01 AMS text
amsenviron.sty	1999/11/30 v2.0 generic functions
amsbsy.sty	1999/11/29 v1.2d Bold Symbols
amsopn.sty	2016/03/08 v2.02 operator names

All macros from these packages are available by default if only amsmath is loaded.  
In the following only the the package amsmath is described in detail.

The *AM***Smath** has the following options:

centertags	(default) For a split equation, place equation numbers vertically centered on the total height of the equation.
tbtags	'Top-or-bottom tags' For a split equation, place equation numbers level with the last (resp. first) line, if numbers are on the right (resp. left).
sumlimits	(default) Place the subscripts and superscripts of summation symbols above and below, in displayed equations. This option also affects other symbols of the same type - $\prod$ , $\coprod$ , $\otimes$ , $\oplus$ , and so forth - but excluding integrals (see below).
nosumlimits	Always place the subscripts and superscripts of summation-type symbols to the side, even in displayed equations.
intlimits	Like sumlimits, but for integral symbols.
nointlimits	(default) Opposite of intlimits.
namelimits	(default) Like sumlimits, but for certain 'operator names' such as <code>det</code> , <code>inf</code> , <code>lim</code> , <code>max</code> , <code>min</code> , that traditionally have subscripts placed underneath when they occur in a displayed equation.
nonamelimits	Opposite of namelimits.

To use one of these package options, put the option name in the optional argument, e.g. \usepackage[intlimits]{amsmath}. The *AM***Smath** also recognises the following options which are normally selected (implicitly or explicitly) through the documentclass command, and thus need not be repeated in the option list of the \usepackage{amsmath} statement.

leqno	Place equation numbers on the left.
reqno	(default) Place equation numbers on the right.
fleqn	Position equations at a fixed indent from the left margin rather than centered in the text column. <i>AM</i> <b>Smath</b> defines the length \mathindent and uses it when the equations have only one tabbing character (&).

All math environments are displayed ones, so there is no special inline math.

## 2.1 align environments

There are four different align environments, described in the following subsections. Their behaviour is shown in Table 2.1. The symbolic code for all align environments is:

```
\begin{<name>}  
  <name> &= x & x &= x\\  
  <name> &= x & x &= x  
\end{<name>}
```

Table 2.1: Comparison between the different align environments with the same code, where the first three can have an equation number

<b>align</b>	x	x	x
<b>align</b>	x	x	x

<b>alignat</b>	x	x	x
<b>alignat</b>	x	x	x

<b>flalign</b>	x	x	x
<b>flalign</b>	x	x	x

<b>xalignat</b>	x	x	x
<b>xalignat</b>	x	x	x

<b>xxalignat</b>	x	x	x
<b>xxalignat</b>	x	x	x

In difference to the environment `eqnarray` from standard L<sup>A</sup>T<sub>E</sub>X (section 1.3.2), the “three” parts of one equation `expr.-symbol-expr.` are divided by only one ampersand in two parts. In general the ampersand should be placed *before* the symbol to get the right spacing, e.g. `y &= x`. Compare the following three equations, the second one has a wrong spacing.

$$\begin{array}{l} y = x \\ y = x \\ y = x \end{array} \quad \begin{array}{l} (1) \\ (2) \\ (3) \end{array}$$

```
\usepackage{amsmath}
\begin{align}
y &= x\makebox(0,0){\rule[-2.2cm]{0.2pt}{1.5cm}}
\begin{align}
y &\makebox(0,0){\rule[-1.5cm]{0.2pt}{1.5cm}}= x
\end{align}
y &= x
\end{align}
```

02-01-01

## 2.1.1 The default align environment

The eqnarray environment has a not so good spacing between the cells. Writing the equations from Example 01-03-04 on page 8 with the align environment gives Example 02-01-02:

$$\begin{array}{lll} y = d & (1) & \usepackage{amsmath} \\ y = cx + d & (2) & \begin{aligned} &\begin{aligned} y &= d\label{eq:align}\\ y &= cx+d\\ y_{12} &= bx^2+cx+d\\ y(x) &= ax^3+bx^2+cx+d \end{aligned} \\ y_{12} &= bx^2+cx+d & (3) \\ y(x) &= ax^3+bx^2+cx+d & (4) \end{aligned}$$

02-01-02

See eq. 1 ...

See eq.~\ref{eq:align} \ldots

▷ The align environment has an implicit {\rlap{r}l{\rlap{l}r}} horizontal alignment with a vertical column-alignment, e.g.

$$\begin{array}{ccc} 12 & 3 & \usepackage{amsmath} \\ & & \begin{aligned} &\begin{aligned} &\begin{aligned} 1 && 2 && 3 \end{aligned} \\ &\end{aligned} \end{aligned}$$

02-01-03

▷ nonumber-version \begin{align\*} ... \end{align\*} exists.

▷ Unnumbered single rows are possible with \nonumber before the end-of-line command \\\.

▷ The align environment takes the whole horizontal space if you have more than two columns:

$$\begin{aligned} &\usepackage{amsmath} \\ &\begin{aligned} &\begin{aligned} y &= d & \& z &= 1 & \\ y &= cx+d & \& z &= x+1 & \\ y_{12} &= bx^2+cx+d & \& z &= x^2+x+1\text{\nonumber} & \\ y(x) &= ax^3+bx^2+cx+d & \& z &= x^3+x^2+x+1 & \end{aligned} \\ &\end{aligned}$$

02-01-04

## 2.1.2 alignat environment

This means “align at several places” and is something like more than two align environments side by side. Parameter is the number of the \align environments, ... which is not important for the user. The above last align example looks like: \end{align}

```
\usepackage{amsmath}
```

```
\begin{alignat}{2}
y &= d & z &= 1 \\
y &= cx+d & z &= x+1 \\
y_{12} &= bx^2+cx+d & z &= x^2+x+1\nonumber \\
y(x) &= ax^3+bx^2+cx+dz = x^3+x^2+x+1
\end{alignat}
```

02-01-05

$$y = d \quad z = 1 \quad (1)$$

$$y = cx + d \quad z = x + 1 \quad (2)$$

$$y_{12} = bx^2 + cx + d \quad z = x^2 + x + 1$$

$$y(x) = ax^3 + bx^2 + cx + dz = x^3 + x^2 + x + 1 \quad (3)$$

The parameter was 2 and it is 3 for the following example:

```
\usepackage{amsmath}
```

```
\begin{alignat}{3}
i_{11} &\approx 0.25 & i_{12} &\approx i_{21} & i_{13} &\approx i_{23} \\
i_{21} &\approx \frac{1}{3}i_{11} & i_{22} &\approx 0.5i_{12} & i_{23} &\approx i_{31} \\
i_{31} &\approx 0.33i_{22} & i_{32} &\approx 0.15i_{32} & i_{33} &\approx i_{11}
\end{alignat}
```

02-01-06

$$i_{11} = 0.25 \quad i_{12} = i_{21} \quad i_{13} = i_{23} \quad (1)$$

$$i_{21} = \frac{1}{3}i_{11} \quad i_{22} = 0.5i_{12} \quad i_{23} = i_{31} \quad (2)$$

$$i_{31} = 0.33i_{22} \quad i_{32} = 0.15i_{32} \quad i_{33} = i_{11} \quad (3)$$

With the alignat environment one can easily align equations vertically at more than one marker:

```
\usepackage{amsmath}
```

```
\begin{alignat}{3}
abc &\approx xxx & &\approxxxxxxxxxxx &\approx aaaaaaaaa \\
ab &\approx yyyyyyyyyyyy & \approx yyyy &\approx ab
\end{alignat}
```

02-01-07

$$abc = xxx = xxxxxxxxxxxx = aaaaaaaaa \quad (1)$$

$$ab = yyyyyyyyyyyy = yyyy = ab \quad (2)$$

▷ The alignat environment has an implicit {rlrl...rlrl} horizontal alignment with a vertical column alignment.

▷ A nonumber-version \begin{alignat\*} ... \end{alignat\*} exists.

▷ Unnumbered single rows are possible with \nonumber.

## 2.1.3 flalign environment

This is the new replacement for the xalignat and xxalignat environments. It is \begin{flalign} nearly the same as the xalignat environment, only more “out spaced” and “left ... aligned”. \end{flalign}

$$i_{11} = 0.25$$

$$i_{21} = \frac{1}{3} i_{11} \quad (1)$$

$$i_{31} = 0.33 i_{22} \quad (2)$$

```
\usepackage{amsmath}
```

```
\begin{flalign}
i_{11} &= 0.25\nonumber \\
i_{21} &= \frac{1}{3} i_{11} \\
i_{31} &= 0.33 i_{22}
\end{flalign}
```

02-01-08

As seen, the equations are not really left aligned, when they have only one ampersand. In this case `flalign` has the same behaviour as the `align` environment.

When there are more than one tabbing characters (&), then the equations are really left aligned. This is also an easy way to get an equation with only one ampersand left aligned, see Example 02-01-09 below.

```
\usepackage{amsmath}
```

```
\begin{flalign}
i_{11} &= 0.25 & i_{12} &= i_{21} & i_{13} &= i_{23} \nonumber \\
i_{21} &= \frac{1}{3} i_{11} & i_{22} &= 0.5 i_{12} & i_{23} &= i_{31} \\
i_{31} &= 0.33 i_{22} & i_{32} &= 0.15 i_{32} & i_{33} &= i_{11}
\end{flalign}
```

$$i_{11} = 0.25 \quad i_{12} = i_{21} \quad i_{13} = i_{23}$$

$$i_{21} = \frac{1}{3} i_{11} \quad i_{22} = 0.5 i_{12} \quad i_{23} = i_{31} \quad (1)$$

$$i_{31} = 0.33 i_{22} \quad i_{32} = 0.15 i_{32} \quad i_{33} = i_{11} \quad (2)$$

02-01-09

This environment can be used to mix centered and left aligned equations without using the document wide valid option `fleqn`.

$$f(x) = \int \frac{1}{x^2} dx \quad (1)$$

$$f(x) = \int \frac{1}{x^2} dx \quad (2)$$

Equation 2 is left aligned in fact of the second tabbing character &.

```
\usepackage{amsmath}
```

```
\begin{align}
f(x) &= \int \frac{1}{x^2}, \mathbf{d}x
\end{align}
%
\begin{flalign}\label{eq:leftaligned}
f(x) &= \int \frac{1}{x^2}, \mathbf{d}x &
\end{flalign}
```

Equation~\ref{eq:leftaligned} is left aligned in fact of the second tabbing character \&.

02-01-10

Another case is placing text left aligned, whereas the formulas should be right aligned.

$$12(x - 1) + 20(y - 3) + 14(z - 2) = 0$$

same as

$$6x + 10y + 7z = 0$$

```
\usepackage{amsmath}
```

```
\begin{flalign*}
&& 12(x-1)+20(y-3)+14(z-2) &= 0 \\
\text{same as } && 6x+10y+7z &= 0
\end{flalign*}
```

02-01-11

## 2.1.4 `xalignat` environment

`\begin{xalignat}` This is an obsolete macro but still supported by the `\text{\textit{AmSmath}} package`. Same ... as `alignat` environment, only a little more “out spaced”.

```
\end{xalignat}
```

```
\usepackage{amsmath}
```

```
\begin{xxalignat}{3}
i_{11} &= 0.25 & i_{12} &= i_{21} & i_{13} &= i_{23} \nonumber \\
i_{21} &= \frac{1}{3} i_{11} & i_{22} &= 0.5 i_{12} & i_{23} &= i_{31} \\
i_{31} &= 0.33 i_{22} & i_{32} &= 0.15 i_{32} & i_{33} &= i_{11}
\end{xxalignat}
```

02-01-12

$$i_{11} = 0.25$$

$$i_{12} = i_{21}$$

$$i_{13} = i_{23}$$

$$i_{21} = \frac{1}{3} i_{11}$$

$$i_{22} = 0.5 i_{12}$$

$$i_{23} = i_{31}$$

$$i_{31} = 0.33 i_{22}$$

$$i_{32} = 0.15 i_{32}$$

$$i_{33} = i_{11}$$

(1)

(2)

## 2.1.5 xxalignat environment

Likexalignat an obsolete macro but still supported by the  $\mathcal{AM}$ Smath package. `\begin{xxalignat}`  
Same as align environment, only extremely “out spaced”, therefore no equation ...  
`\end{xxalignat}`

```
\usepackage{amsmath}
```

```
\begin{xxalignat}{3}
i_{11} &= 0.25 & i_{12} &= i_{21} & i_{13} &= i_{23} \\\
i_{21} &= \frac{1}{3} i_{11} & i_{22} &= 0.5 i_{12} & i_{23} &= i_{31} \\
i_{31} &= 0.33 i_{22} & i_{32} &= 0.15 i_{32} & i_{33} &= i_{11}
\end{xxalignat}
```

02-01-13

$$i_{11} = 0.25$$

$$i_{12} = i_{21}$$

$$i_{13} = i_{23}$$

$$i_{21} = \frac{1}{3} i_{11}$$

$$i_{22} = 0.5 i_{12}$$

$$i_{23} = i_{31}$$

$$i_{31} = 0.33 i_{22}$$

$$i_{32} = 0.15 i_{32}$$

$$i_{33} = i_{11}$$

## 2.1.6 aligned environment

In difference to the split environment (Section 2.2.4 on page 54), the aligned environment allows more than one horizontal alignment but has also only one ...  
equation number:  
`\end{aligned}`

02-01-14

$$2x + 3 = 7 \quad 2x + 3 - 3 = 7 - 3$$

$$2x = 4 \quad \frac{2x}{2} = \frac{4}{2}$$

$$x = 2$$

(1)

```
\usepackage{amsmath}
```

```
\begin{equation}
\begin{aligned}
2x+3 &= 7 & 2x+3-3 &= 7-3 \\
2x &= 4 & \frac{2x}{2} &= \frac{4}{2} \\
x &= 2 & &
\end{aligned}
\end{equation}
```

The aligned environment is similar to the array environment, there exists no starred version and it has only one equation number and has to be part of another math environment, which should be equation environment. The advantage of aligned is the much better horizontal and vertical spacing.

## 2.1.7 Problems

When using one of the align environments, there should be no \\ at the end of the last line, otherwise you'll get another equation number for this “empty” line:

$2x + 3 = 7$	(1)	<pre>\usepackage{amsmath}</pre>
	(2)	<pre>\begin{align}  2x+3 &amp;= 7 \\ \end{align}</pre>
$2x + 3 = 7$	(3)	<pre>\begin{aligned}  2x+3 &amp;= 7 \end{aligned}</pre>

02-01-15

## 2.2 Other environments

### 2.2.1 gather environment

`\begin{gather}` This is like a multi line environment with no special horizontal alignment. All ... rows are centered and can have an own equation number:

`\end{gather}`

$i_{11} = 0.25$	(1)	<pre>\usepackage{amsmath}</pre>
$i_{21} = \frac{1}{3}i_{11}$		<pre>\begin{gather}  i_{11}=0.25 \\  i_{21}=\frac{1}{3}i_{11} \\  i_{31}=0.33i_{22} \end{gather}</pre>
$i_{31} = 0.33i_{22}$	(2)	

02-02-01

- ▷ The `gather` environment has an implicit `{c}` horizontal alignment with no vertical column alignment. It is just like an one column array/table.
- ▷ A nonumber-version `\begin{gather*}... \end{gather*}` exists. Look at section [2.2.4 on page 54](#) for an example.

### 2.2.2 gathered environment

`\begin{gathered}`- The `gathered` environment is like the `aligned` or `alignat` environment. They use `ered}[c]` only so much horizontal space as the widest line needs. In difference to the ... `gather` environment it must be itself inside the math mode.

`\end{gathered}`

$i_{11} = 0.25$		<pre>\usepackage{amsmath}</pre>
$i_{21} = \frac{1}{3}i_{11}$	—	<pre>\begin{aligned} \begin{gathered}  i_{11}=0.25 \\  i_{21}=\frac{1}{3}i_{11} \\  i_{31}=0.33i_{22} \end{gathered} \end{aligned}</pre>
$i_{31} = 0.33i_{22}$	(1)	

02-02-02

The optional argument can be used for setting the vertical alignment which is by default `c` (centered). It can also be `t` for top or `b` for bottom.

02-02-03

$$\begin{array}{ccc} A = a & & \\ A = a & B = b & \\ \hline A = a & B = b & C = c \\ B = b & C = c & \\ C = c & & \end{array} \quad (1)$$

```
\usepackage{amsmath}
\begin{aligned}
\begin{gathered}
\begin{array}{l}
A=a\\
B=b\\
C=c
\end{array}
\end{gathered}
\end{aligned}
```

When using a square bracket as first character inside the environment, then everything is ignored by  $\mathcal{AM}$ S until a following closing bracket, because  $\mathcal{AM}$ Stakes this as an optional argument:

02-02-04

$$\begin{array}{ll} [A] & A = a \\ [B] & B = b \\ [C] & C = c \end{array} \quad (1)$$

```
\usepackage{amsmath}
\begin{aligned}
\begin{gathered}
[A]\quad A=a\\
[B]\quad B=b\\
[C]\quad C=c
\end{gathered}
\end{aligned}
```

The [A] is completely ignored, which can be avoided by using the optional argument [c] or at least an empty one directly after the `\begin{gathered}`. Another possibility is using the package `empheq`, which fixes this behaviour by default.

02-02-05

$$\begin{array}{ll} [A] & A = a \\ [B] & B = b \\ [C] & C = c \end{array} \quad (1)$$

```
\usepackage{amsmath}
\begin{aligned}
\begin{gathered}
[]\\
[A]\quad A=a\\
[B]\quad B=b\\
[C]\quad C=c
\end{gathered}
\end{aligned}
```

### 2.2.3 multiline environment

This is also like a multi line<sup>1</sup> environment with a special vertical alignment. The `\begin{multiline}` first row is *left aligned*, the second and all following ones except the last one are ... *centered* and the *last line is right aligned*. It is often used to write extremely long formulas:

```
\usepackage{amsmath}
\begin{multiline}
A=\lim_{n\rightarrow\infty}\Delta x\left(a^2+\left(a^2+2a\Delta x+\left(\Delta x\right)^2\right)\right)\\
\rightarrow right.\label{eq:reset}\\
+\left(a^2+2\cdot2a\Delta x+2^2\left(\Delta x\right)^2\right)\\
+\left(a^2+2\cdot3a\Delta x+3^2\left(\Delta x\right)^2\right)
\end{multiline}
```

<sup>1</sup> It is no typo, the name of the environment is `multiline`, no missing i here!

```
+ \ldots \\
\left. + \left( a^2 + 2a\Delta x + (\Delta x)^2 \right) \cdot \left( \Delta x \right)^2 \right) \\
= \frac{1}{3} (b^3 - a^3)
```

$$\begin{aligned}
A &= \lim_{n \rightarrow \infty} \Delta x \left( a^2 + (a^2 + 2a\Delta x + (\Delta x)^2) \right. \\
&\quad + (a^2 + 2 \cdot 2a\Delta x + 2^2 (\Delta x)^2) \\
&\quad + (a^2 + 2 \cdot 3a\Delta x + 3^2 (\Delta x)^2) \\
&\quad + \dots \\
&\quad \left. + (a^2 + 2 \cdot (n-1)a\Delta x + (n-1)^2 (\Delta x)^2) \right) \\
&= \frac{1}{3} (b^3 - a^3) \quad (1)
\end{aligned}$$

02-02-06

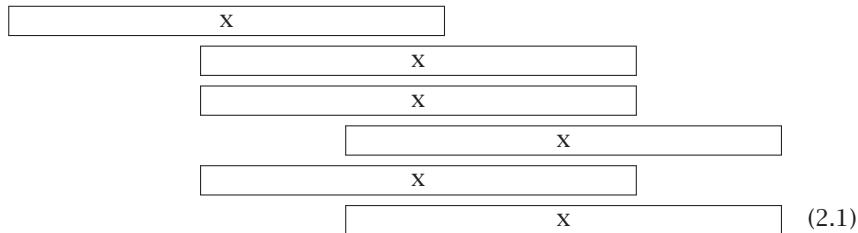


Figure 2.1: `multline` Alignment demo (the fourth row is shifted to the right with `\shoveright`)

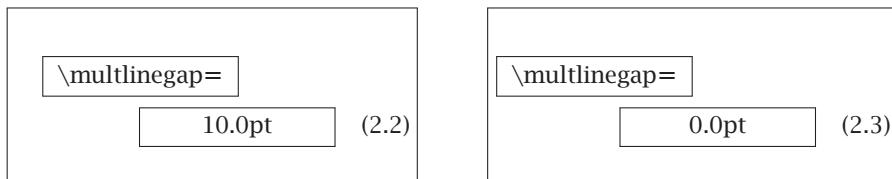


Figure 2.2: Demonstration of `\multlinegap` (default is 0pt)

- ▷ A nonumber-version `\begin{multline*} ... \end{multline*}` exists.
- ▷ By default only the last line (for right equation numbers) or the first line (for left equation numbers) gets a number, the others can't.
- ▷ The alignment of a single line can be changed with the command `\shoveright` (figure 2.1)
- ▷ The first line and the last line have a small gap to the text border.<sup>2</sup> See figure 2.2, where the length of `\multlinegap` is set to 0pt for the right one.

## Examples for `multline`

With the `multline` environment the equation 01-08-04 on page 20 looks like:

<sup>2</sup> When the first (numbers left) or last line (numbers right) has an equation number then `\multlinegap` is not used for these ones, only for the line without a number.

```
\usepackage{amsmath}
\begin{multiline}
\frac{1}{2}\Delta(f_{ij}f^{ij})=2\left(\sum_{i<j}\chi_{ij}(\sigma_i-\sigma_j)^2+f^{ij}\nabla_i(\Delta f)+\right.\\
\left.+f^i\nabla_kf_{ij}\nabla_i(\Delta f)+\right.\\
\left.\left.\nabla_kf_{ij}\nabla_kf_{ij}+\nabla_kf_{ij}\nabla_kf_{ij}\right)\right) \quad (1)
\end{multiline}
```

02-02-07

$$\frac{1}{2}\Delta(f_{ij}f^{ij}) = 2 \left( \sum_{i < j} \chi_{ij}(\sigma_i - \sigma_j)^2 + f^{ij} \nabla_i(\Delta f) + \right. \\ \left. + \nabla_k f_{ij} \nabla^k f^{ij} + f^{ij} f^k [2 \nabla_i R_{jk} - \nabla_k R_{ij}] \right) \quad (1)$$

which is again a bad typesetting because of the two unequal parentheses. Each one has a size which is correct for the line but not for the whole formula. L<sup>A</sup>T<sub>E</sub>X accepts only pairs of parentheses for one line and has an “empty” parentheses, the dot “\left.” or “\right.” to get only one of the “pair”. There are different solutions to get the right size of the parentheses. One of them is to use the \vphantom command, which reserves the vertical space without any horizontal one, like a vertical rule without any thickness. The sum symbol from the first line is the biggest one and responsible for the height, so this one is the argument of \vphantom which has to be placed anywhere.

```
\usepackage{amsmath}
\begin{multiline}
\frac{1}{2}\Delta(f_{ij}f^{ij})=2\left(\sum_{i<j}\chi_{ij}(\sigma_i-\sigma_j)^2+f^{ij}\nabla_i(\Delta f)+\right.\\
\left.2\left(\sum_{i<j}\chi_{ij}(\sigma_i-\sigma_j)^2+f^{ij}\nabla_i(\Delta f)+\right.\right.\\
\left.\left.\left.\nabla_kf_{ij}\nabla_kf_{ij}\right)\right.\right.\\
\left.\left.\left.\nabla_kf_{ij}\nabla_kf_{ij}\right)\right.\right.\vphantom{\sum_{i<j}}\right) \quad (1)
\end{multiline}
```

02-02-08

$$\frac{1}{2}\Delta(f_{ij}f^{ij}) = 2 \left( \sum_{i < j} \chi_{ij}(\sigma_i - \sigma_j)^2 + f^{ij} \nabla_i(\Delta f) + \right. \\ \left. + \nabla_k f_{ij} \nabla^k f^{ij} + f^{ij} f^k [2 \nabla_i R_{jk} - \nabla_k R_{ij}] \right) \quad (1)$$

Instead of using the \vphantom command it is also possible to use fixed-width parentheses, which is described in section [1.8 on page 18](#).

A math expression with a very long fraction like the following one, which runs out of the margin could be written as a multiplication to avoid the fraction line.

```
\usepackage{amsmath}
\begin{equation}
\frac{\mathrm{d}G_\infty}{\mathrm{d}n} = \frac{[1 - e^{-pn}] [Q(n) - pR(n) + R'(n)] e^{-pn} - \left[ -\frac{Q(n)e^{-pn}}{p} + \frac{Q(0)}{p} + R(n)e^{-pn} - A \right] pe^{-pn}}{(1 - e^{-pn})^2} = 0
\end{equation}
```

02-02-09

$$\frac{\mathrm{d}G_\infty}{\mathrm{d}n} = \frac{[1 - e^{-pn}] [Q(n) - pR(n) + R'(n)] e^{-pn} - \left[ -\frac{Q(n)e^{-pn}}{p} + \frac{Q(0)}{p} + R(n)e^{-pn} - A \right] pe^{-pn}}{(1 - e^{-pn})^2} = 0 \quad (1)$$

With the `multline` environment it can then be split into two or more parts:

```
\usepackage{amsmath}

\begin{multiline}
\frac{\mathit{d}G_{\infty}}{\mathit{d}n} = \frac{1}{(1-e^{-pn})^2} \cdot \left\{ [1 - e^{-pn}] [Q(n) - pR(n) + R'(n)] e^{-pn} \right. \\ \left. - \left[ -\frac{Q(n) e^{-pn}}{p} + \frac{Q(0)}{p} + R(n) e^{-pn} - A \right] p e^{-pn} \right\} = 0
\end{multiline}
```

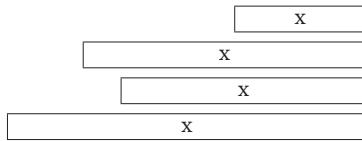
$$\frac{dG_\infty}{dn} = \frac{1}{(1-e^{-pn})^2} \cdot \left\{ [1 - e^{-pn}] [Q(n) - pR(n) + R'(n)] e^{-pn} \right. \\ \left. - \left[ -\frac{Q(n) e^{-pn}}{p} + \frac{Q(0)}{p} + R(n) e^{-pn} - A \right] p e^{-pn} \right\} = 0 \quad (1)$$

02-02-10

## 2.2.4 split environment

`\begin{split}` The `split` environment is like the `multiline` or `array` environment for equations longer than the column width. Just like the `array` environment and in contrast to `multline`, `split` can only be used as *part of another environment*. `split` itself has no own numbering, this is given by the other environment. Without an ampersand all lines in the `split` environment are right-aligned and can be aligned at a special point by using an ampersand. In difference to the `aligned` environment (section 2.1.6 on page 49), the `split` environment don't permit more than one horizontal alignment.

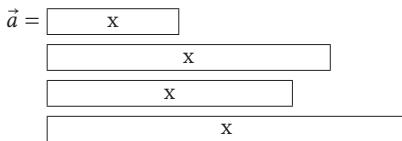
It is important that the `split` environment has another behaviour when used inside one of the “old” L<sup>A</sup>T<sub>E</sub>X environments `\[ ... \]` or `\begin{equation} ... \end{equation}`, in this case more than one horizontal alignment tabs are possible.



```
\usepackage{amsmath}
```

02-02-11

```
\[ \begin{split} & \text{\framebox[0.35\columnwidth]{x}} \\ & \text{\framebox[0.75\columnwidth]{x}} \\ & \text{\framebox[0.65\columnwidth]{x}} \\ & \text{\framebox[0.95\columnwidth]{x}} \end{split} \]
```



```
\usepackage{amsmath}
```

02-02-12

```
\[ \begin{split} \vec{a} = & \text{\{} \& \text{\framebox[0.35\columnwidth]{x}} \\ & \text{\framebox[0.75\columnwidth]{x}} \\ & \text{\framebox[0.65\columnwidth]{x}} \\ & \text{\framebox[0.95\columnwidth]{x}} \text{\}} \end{split} \]
```

The following example shows the `split` environment as part of the `equation` environment:

```
\usepackage{amsmath}

\begin{equation}
\begin{aligned}
A_1 &= \left| \int_0^1 (f(x) - g(x)) dx \right| + \left| \int_1^2 (g(x) - h(x)) dx \right| \\
&= \left| \int_0^1 (x^2 - 3x) dx \right| + \left| \int_1^2 (x^2 - 5x + 6) dx \right| \\
&= \left| \frac{x^3}{3} - \frac{3}{2}x^2 \right|_0^1 + \left| \frac{x^3}{3} - \frac{5}{2}x^2 + 6x \right|_1^2 \\
&= \left| \frac{1}{3} - \frac{3}{2} \right| + \left| \frac{8}{3} - \frac{20}{2} + 12 - \left( \frac{1}{3} - \frac{5}{2} + 6 \right) \right| \\
&= \left| -\frac{7}{6} \right| + \left| \frac{14}{3} - \frac{23}{6} \right| = \frac{7}{6} + \frac{5}{6} = 2 \text{ FE}
\end{aligned}
\end{equation}

```

02-02-13

$$\begin{aligned}
A_1 &= \left| \int_0^1 (f(x) - g(x)) dx \right| + \left| \int_1^2 (g(x) - h(x)) dx \right| \\
&= \left| \int_0^1 (x^2 - 3x) dx \right| + \left| \int_1^2 (x^2 - 5x + 6) dx \right| \\
&= \left| \frac{x^3}{3} - \frac{3}{2}x^2 \right|_0^1 + \left| \frac{x^3}{3} - \frac{5}{2}x^2 + 6x \right|_1^2 \\
&= \left| \frac{1}{3} - \frac{3}{2} \right| + \left| \frac{8}{3} - \frac{20}{2} + 12 - \left( \frac{1}{3} - \frac{5}{2} + 6 \right) \right| \\
&= \left| -\frac{7}{6} \right| + \left| \frac{14}{3} - \frac{23}{6} \right| = \frac{7}{6} + \frac{5}{6} = 2 \text{ FE}
\end{aligned} \tag{1}$$

The same using the array environment with `{rl}`-alignment instead of `split` gives same horizontal alignment, but another vertical spacing<sup>3</sup> and the symbols are only in `\scriptstyle` and not `\textstyle`:<sup>4</sup>

```
\usepackage{amsmath}
```

```
\begin{equation}
\begin{array}{rl}
A_1 &= \left| \int_0^1 (f(x) - g(x)) dx \right| + \left| \int_1^2 (g(x) - h(x)) dx \right| \\
&= \left| \int_0^1 (x^2 - 3x) dx \right| + \left| \int_1^2 (x^2 - 5x + 6) dx \right| \\
&= \left| \frac{x^3}{3} - \frac{3}{2}x^2 \right|_0^1 + \left| \frac{x^3}{3} - \frac{5}{2}x^2 + 6x \right|_1^2 \\
&= \left| \frac{1}{3} - \frac{3}{2} \right| + \left| \frac{8}{3} - \frac{20}{2} + 12 - \left( \frac{1}{3} - \frac{5}{2} + 6 \right) \right| \\
&= \left| -\frac{7}{6} \right| + \left| \frac{14}{3} - \frac{23}{6} \right| = \frac{7}{6} + \frac{5}{6} = 2 \text{ FE}
\end{array}
\end{equation}

```

<sup>3</sup> Can be changed with `\renewcommand{\arraystretch}{1.5}`

<sup>4</sup> See section 1.12 on page 30

$$\begin{aligned}
 A_1 &= \left| \int_0^1 (f(x) - g(x)) dx \right| + \left| \int_1^2 (g(x) - h(x)) dx \right| \\
 &= \left| \int_0^1 (x^2 - 3x) dx \right| + \left| \int_1^2 (x^2 - 5x + 6) dx \right| \\
 &= \left| \frac{x^3}{3} - \frac{3}{2}x^2 \Big|_0^1 \right| + \left| \frac{x^3}{3} - \frac{5}{2}x^2 + 6x \Big|_1^2 \\
 &= \left| \frac{1}{3} - \frac{3}{2} \right| + \left| \frac{8}{3} - \frac{20}{2} + 12 - \left( \frac{1}{3} - \frac{5}{2} + 6 \right) \right| \\
 &= \left| -\frac{7}{6} \right| + \left| \frac{14}{3} - \frac{23}{6} \right| = \frac{7}{6} + \frac{5}{6} = 2 \text{ FE}
 \end{aligned} \tag{1}$$

02-02-14

Compare the following two examples for typesetting the minus sign. In the first case it is typeset similar to the plus character, and in the second example it is typeset without the additional space for a binary math atom.

```
\usepackage{amsmath}
```

$$\begin{aligned} \begin{aligned} a &= \{& -b + c \\ && -d + e \end{aligned} \end{aligned} \quad (1)$$

02-02-15

$$\begin{array}{l} a = -b + c \\ \quad -d + e \end{array} \quad (2)$$

- ▷ There exists no starred version (`\begin{split*}`) of the `split` environment.

## 2.2.5 cases environment

This gives support for an often used mathematical construct. You can also choose the more than once described way to convert some text into math, like

```
$x=\begin{cases} 0 & \text{if } A=... \\ 1 & \text{if } B=... \\ x & \text{extrm{this runs with as much text as you like, but without an automatic linebreak, it runs out of the page~\ldots}} \end{cases}$
```

which gives equation 02-02-16. It is obvious what the problem is.

```
\usepackage{amsmath}
```

```
\[
x=\begin{cases}
    0 & \text{if } A=... \\
    1 & \text{if } B=... \\
    x & \text{otherwise}
\end{cases}
\end{cases}
```

$$x = \begin{cases} 0 & \text{if A=...} \\ 1 & \text{if B=...} \\ x & \text{this runs with as much text as you like, but without a linebreak, it runs out of page....} \end{cases}$$

In this case it is better to use a `parbox` for the text part with a `flushleft` command for a better view.

```
\usepackage{amsmath}

\begin{equation}
x=\begin{cases} 0 & \text{if A=...} \\ 1 & \text{if B=...} \\ x & \text{\parbox{7cm}{\flushleft this runs with as much text as you like, but without an automatic linebreak, it runs out of page-\ldots}} \end{cases}
\end{cases}
\end{equation}
```

02-02-17

$$x = \begin{cases} 0 & \text{if A=...} \\ 1 & \text{if B=...} \\ x & \text{this runs with as much text as you like, but without an automatic linebreak, it runs out of page ...} \end{cases} \quad (1)$$

## 2.2.6 Matrix environments

<code>Vmatrix</code>	$\left\  \begin{array}{cc} a & b \\ c & d \end{array} \right\ $	<code>Bmatrix</code>	$\left\{ \begin{array}{cc} a & b \\ c & d \end{array} \right\}$	<code>matrix</code>	$\begin{array}{cc} a & b \\ c & d \end{array}$	Table 2.2:
<code>vmatrix</code>	$\left  \begin{array}{cc} a & b \\ c & d \end{array} \right $	<code>bmatrix</code>	$\left[ \begin{array}{cc} a & b \\ c & d \end{array} \right]$	<code>pmatrix</code>	$\left( \begin{array}{cc} a & b \\ c & d \end{array} \right)$	<code>\begin{matrix} a &amp; b \\ c &amp; d \end{matrix}</code>
				<code>smallmatrix</code>	$\begin{smallmatrix} a & b \\ c & d \end{smallmatrix}$	

All matrix environments can be nested and an element may also contain any other math environment, so that very complex structures are possible. By default all cells have a centered alignment, which is often not the best when having different decimal numbers or plus/minus values. Changing the alignment to right (not for the `smallmatrix` environment) is possible with

```
\makeatletter
\def\env@matrix{\hskip -\arraycolsep
  \let\ifnextchar\new@ifnextchar
  \array{*{*\c@MaxMatrixCols r}}
\makeatother
```

Table 2.2: Matrix environments  
`(\begin{matrix} a & b \\ c & d \end{matrix})`

`Vmatrix`  
`vmatrix`  
`Bmatrix`  
`bmatrix`  
`matrix`  
`pmatrix`  
`smallmatrix`

The special matrix environment `smallmatrix`, which decreases horizontal and vertical space is typeset in `\scriptstyle`. The `smallmatrix` environment makes some sense in the inline mode to decrease the line height. For dots over several columns look for `\hdotsfor` in the following section.

## 2.3 Vertical whitespace

See section 1.11.5 on page 27 for the lengths which control the vertical whitespace. There is no difference to  $\mathcal{AM}$ sath.

## 2.4 Dots

In addition to section 1.13 on page 31 *AMSmath* has two more commands for dots: `\dddot{...}`<sup>5</sup> and `\dddot{...}`

```
$\ddot{\dots} : \ddot{\dots}
```

Another interesting dot command is `\hdotsfor` with the syntax:

```
\hdotsfor[<spacing factor>]{<number of columns>}
```

With the spacing factor the width of the dots can be stretched or shrunked. The number of columns allows a continuing dotted line over more columns. Example 02-04-01 shows the definition of a tridiagonal matrix.

```
\usepackage{amsmath}

\begin{equation}
\begin{array}{ccccccccc}
\underline{A} = & \left[ \begin{array}{ccccccc}
a_{11} & a_{12} & 0 & \cdots & \cdots & \cdots & 0 \\
a_{21} & a_{22} & a_{23} & 0 & \cdots & \cdots & 0 \\
0 & a_{32} & a_{33} & a_{34} & 0 & \cdots & 0 \\
\vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\
\hdotsfor{7} & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\
0 & \cdots & 0 & a_{n-2,n-3} & a_{n-2,n-2} & a_{n-2,n-1} & 0 \\
0 & \cdots & \cdots & 0 & q_{n-1,n-2} & a_{n-1,n-1} & a_{n-1,n} \\
0 & \cdots & \cdots & \cdots & 0 & a_{n,n-1} & a_{nn}
\end{array} \right]
\end{array}
\end{equation}
```

$$A = \left[ \begin{array}{ccccccc}
a_{11} & a_{12} & 0 & \cdots & \cdots & \cdots & 0 \\
a_{21} & a_{22} & a_{23} & 0 & \cdots & \cdots & 0 \\
0 & a_{32} & a_{33} & a_{34} & 0 & \cdots & 0 \\
\vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\
\hdotsfor{7} & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\
0 & \cdots & 0 & a_{n-2,n-3} & a_{n-2,n-2} & a_{n-2,n-1} & 0 \\
0 & \cdots & \cdots & 0 & q_{n-1,n-2} & a_{n-1,n-1} & a_{n-1,n} \\
0 & \cdots & \cdots & \cdots & 0 & a_{n,n-1} & a_{nn}
\end{array} \right] \quad (1)$$

02-04-01

## 2.5 fraction commands

### 2.5.1 Standard

Additional to the font size problem described in subsection 1.2.2 on page 5 *AMSmath* supports some more commands for fractions. The `\frac` command described in Downes 2002, does no more exist in *AMSmath*.

- ▷ The global fraction definition has five parameters

```
\genfrac{<left delim>}{<right delim>}{{<thickness>}{<mathstyle>}}{<nominator>}{<denominator>}
```

where thickness can have any length with a valid unit like

```
genfrac{}{}{1pt}{}{x^2+x+1}{3x-2} \rightarrow \frac{x^2+x+1}{3x-2}
```

<sup>5</sup> already mentioned in section 1.14

- ▷ `\cfrac` (continued fraction) which is by default set in the display mathstyle and useful for fractions like

$$\cfrac{1}{\sqrt{2} + \cfrac{1}{\sqrt{3} + \cfrac{1}{\sqrt{4} + \cfrac{1}{\dots}}}} \quad (2.4)$$

which looks with the default `\frac` command like

$$\frac{1}{\sqrt{2} + \frac{1}{\sqrt{3} + \frac{1}{\sqrt{4} + \frac{1}{\dots}}}} \quad (2.5)$$

where the mathstyle decreases for every new level in the fraction. The `\cfrac` command can be called with an optional parameter which defines the placing of the nominator, which can be [l]eft, [r]ight or [c]enter (the default - see equation 2.4):

$$\begin{array}{c} 1 \\ \hline \sqrt{2} + \frac{1}{\sqrt{3} + \frac{1}{\sqrt{4} + \frac{1}{\dots}}} \end{array} \qquad \begin{array}{c} 1 \\ \hline \sqrt{2} + \frac{1}{\sqrt{3} + \frac{1}{\sqrt{4} + \frac{1}{\dots}}} \end{array}$$

- ▷ `\dfrac` which takes by default the displaystyle, so that fractions in inline mode  $\frac{1}{2}$  have the same size than in display mode.
- ▷ `\tfrac` (vice versa to `\dfrac`) which takes by default the scriptstyle, so that fractions in display mode have the same size than in inline mode.

$$\begin{array}{ll} \frac{2}{3} & \text{\textbackslash tfrac\{2\}\{3\}} \\ \frac{2}{3} & \text{\textbackslash frac\{2\}\{3\}} \end{array}$$

## 2.5.2 Binoms

They are like fractions without a rule and its syntax is different to the `\choose` command from standard L<sup>A</sup>T<sub>E</sub>X (see section 1.2.2 on page 5). *AM*Smath provides `\dbinom` and `\tbinom` three different commands for binoms just like the ones for fractions.

## 2.6 Roots

The typesetting for roots is sometimes not the best. Some solutions for better typesetting are described in section 1.7 on page 17 for standard L<sup>A</sup>T<sub>E</sub>X. *AM*Smath has some more commands for the  $n$ -th root:

Table 2.3: The different binom commands

<i>Command</i>	<i>Inlinemath</i>	<i>Displaymath</i>
<code>\binom{m}{n}</code>	$\binom{m}{n}$	$\binom{m}{n}$
<code>\dbinom{m}{n}</code>	$\dbinom{m}{n}$	$\dbinom{m}{n}$
<code>\tbinom{m}{n}</code>	$\tbinom{m}{n}$	$\tbinom{m}{n}$

\sqrt[\leftroot{<number>} \uproot{<number>} <root>]{< ... >}

`<number>` indicates a value for the points<sup>6</sup> of which the root can be adjusted to the left and/or to the top, e.g.  $\sqrt[k_n]{a}$  (`$\sqrt[k_n]{a}$`) has a too deep exponent, whereas  $\sqrt[k_n]{a}$  (`$\sqrt[k_n]{a}$`) looks nicer.

## 2.6.1 Roots with \smash command

`\smash` The default for a root with  $\lambda_{k_i}$  as root argument looks like  $\sqrt{\lambda_{k_i}}$ , which may be not the best typesetting. It is possible to reduce the lowest point of the root to the baseline with the `\smash` command:  $\sqrt{\lambda_{k_i}} \xrightarrow{\text{with } \text{\smash}} \sqrt{\lambda_{k_i}}$

The syntax of the `\smash` command<sup>7</sup> renewed by the *AMSmath* package is

\smash[<position>]{<argument>}

The optional argument for the position can be:

**t** keeps the bottom and annihilates the top

**b** keeps the top and annihilates the bottom

**tb** annihilates top and bottom (the default)

## 2.7 Accents

With the macro \mathaccnt and the package amssymb it is easy to define new accent types, for example

```
\def\dotcup{\mathrel{\dot{\cup}}}
```

02-07-01

Overwriting of two symbols is also possible. In this case the second symbol has to be shifted to the left for a length of  $5mu$  (mu: math unit).

<sup>6</sup> In PostScript units (bp - Big Points).

<sup>7</sup> In `latex.ltx` `\smash` is defined without an optional argument.

02-07-02



```
\usepackage{amsmath,amssymb}
\def\curvearrowleftright{%
\lensuremath{%
\mathaccent\curvearrowright{%
\mkern-5mu\curvearrowleft}}}

\huge
\$ \curvearrowleft \curvearrowright
\curvearrowleftright$
```

For other possibilities to define new accents see Section [4.1.1 on page 88](#).

## 2.8 \mod command

In standard L<sup>A</sup>T<sub>E</sub>X the modulo command is not an operator, though it is often used in formulas. *AMSmash* provides two (three) different commands for modulo, which are listed in tabular [2.4](#).

- ▷ They all insert some useful space before and behind the mod-operator.

<code>a\mod{n^2}=b</code>	$\rightarrow$	$a \bmod n^2 = b$
<code>a\pmod{n^2}=b</code>	$\rightarrow$	$a \pmod{n^2} = b$
<code>a\pod{n^2}=b</code>	$\rightarrow$	$a \pod{n^2} = b$

Table 2.4: The modulo commands and their meaning

## 2.9 Equation numbering

See section [1.3.3 on page 9](#) for equation numbering. It is mostly the same, only one command is new to *AMSmash*. If you want a numbering like “3.44” for an article class or “1.3.44” for a book class then write either in the preamble or like this example anywhere in your doc:

```
\numberwithin{equation}{section}
\makeatletter
\def\tagform@#1{\maketag@@@{\ignorespaces#1\unskip\@italiccorr}}
\makeatother
```

Now the following four subequation numbers have no parentheses.

### 2.9.1 Subequations

Amssmath supports this with the environment `subequations`.

```
\usepackage{amsmath}
\begin{subequations}
\begin{aligned}
y &= d \\ 
y &= cx+d \\ 
y &= bx^2+cx+d \\ 
y &= ax^3+bx^2+cx+d
\end{aligned}
\end{subequations}
```

$$y = d \quad (1a)$$

$$y = cx + d \quad (1b)$$

$$y = bx^2 + cx + d \quad (1c)$$

$$y = ax^3 + bx^2 + cx + d \quad (1d)$$

02-09-01

If you want to get rid of the parentheses then write in the preamble:

```
\usepackage{amsmath}
\makeatletter
\def\tagform@{\maketag@@{\ignorespaces#1\unskip\@italiccorr}}
\makeatother

\begin{subequations}
\begin{align}
y &= d \\
y &= cx + d \\
y &= bx^2 + cx + d \\
y &= ax^3 + bx^2 + cx + d
\end{align}
\end{subequations}
```

$$y = d \quad 1a$$

$$y = cx + d \quad 1b$$

$$y = bx^2 + cx + d \quad 1c$$

$$y = ax^3 + bx^2 + cx + d \quad 1d$$

02-09-02

Inside of subequations only complete other environments (`\begin{...} ... \end{...}`) are possible. CHanging the numberung can be done with redefining the macro `\theequation`:

```
\usepackage{amsmath}

\begin{subequations}
\renewcommand\theequation{\theparentequation -\arabic{equation}}%
\begin{align}
y &= d \\
y &= cx + d \\
y &= bx^2 + cx + d \\
y &= ax^3 + bx^2 + cx + d
\end{align}
\end{subequations}
```

A reference to eq. $\sim$ \ref{eq:subequation-neu}

$$y = d \quad (1-1)$$

$$y = cx + d \quad (1-2)$$

$$y = bx^2 + cx + d \quad (1-3)$$

$$y = ax^3 + bx^2 + cx + d \quad (1-4)$$

02-09-03

A reference to eq. 1-4

A ref to a subequation is possible like the one in Examle 02-09-03. The environment chooses the same counter “equation” but saves the old value into “parentequation”. It is also possible to place two equations side by side with counting as subfigures: In this case, the *AM***S**math internal subfigure counter cannot be used and an own counter has to be defined:

```
\usepackage{amsmath}
\newcounter{mySubCounter}
\newcommand\twocoleqn[2]{%
  \setcounter{mySubCounter}{0}%
  \let\OldTheEquation\theequation
  \renewcommand{\theequation}{\OldTheEquation\alph{mySubCounter}}%
```

```
\noindent%
\begin{minipage}{.49\textwidth}
\begin{equation}\refstepcounter{mySubCounter} \#1 \end{equation} \end{minipage}\hfill
\addtocounter{equation}{-1}%
\begin{minipage}{.49\textwidth}
\begin{equation}\refstepcounter{mySubCounter} \#2 \end{equation}
\end{minipage}%
\let\theequation\OldTheEquation
\twocoleqn{y=f(x)}{y=f(z)}
```

$$y = f(x) \quad (1a)$$

$$y = f(z) \quad (1b)$$

02-09-04

## 2.10 Labels and tags

For the `\label` command see section [1.3.4 on page 11](#), it is just the same behaviour.  $\mathcal{M}$ Smath allows to define own single “equation numbers” with the `\tag` command.

```
\usepackage{amsmath}
\begin{align}
f(x) &= a \tag{linear} \\
g(x) &= d x^2 + c x + b \tag{quadratic} \\
h(x) &= \sin x \tag{trigonometric}
\end{align}
```

`Eq.\tag{...}` is a linear and `Eq.\tag{...}` is a quadratic function.

02-10-01

$f.x/ = a$	(linear)
$g.x/ = dx^2 + cx + b$	(quadratic)
$h.x/ = \sin x$	trigonometric

`Eq.\tag{...}` is a linear and `Eq.\tag{...}` is a quadratic function.

- ▷ The `\tag` command is also possible for unnumbered equations, L<sup>A</sup>T<sub>E</sub>X changes the behaviour when a tag is detected.
- ▷ There exists a starred version `\tag*{...}`, which suppresses any annotations like parentheses for equation numbers.
- ▷ There exist two package options for tags, `ctagsplit` and `righttag` (look at the beginning of this part on page [43](#)).

## 2.11 Limits

By default the sum/prod has the limits above/below and the integral at the side. To get the same behaviour for all symbols which can have limits load the package  $\mathcal{M}$ Smath in the preamble as

```
\usepackage[sumlimits,intlimits]{amsmath}
```

There exist also options for the vice versa (see page [43](#)). See also Section [2.17](#) for the additional commands `\underset` and `\overset`.

### 2.11.1 Multiple limits

For general information about limits read Section [1.2.1 on page 4](#). Standard L<sup>A</sup>T<sub>E</sub>X provides the `\atop` command for multiple limits (Section [1.6.1 on page 16](#)).

```
\begin{Sb}
...
\end{Sb}
\begin{Sp}
...
\end{Sp}
```

*AM***Smath** has an additional command for that, which can have several lines `\substack` with the following syntax:

```
\substack{...\\...\\...}
```

The environments described in Downes 2002

```
\begin{Sb} ... \end{Sb}
\begin{Sp} ... \end{Sp}
```

are obsolete and no more part of *AM***Smath**.

The example Equation 01-06-01 on page 16 with the `\substack` command looks like:

$$\sum_{\substack{1 \leq i \leq p \\ 1 \leq j \leq q \\ 1 \leq k \leq r}} a_{ij} b_{jk} c_{ki} \quad (1)$$

```
\usepackage{amsmath}
\begin{equation}
\sum_{\substack{1 \leq i \leq p \\ 1 \leq j \leq q \\ 1 \leq k \leq r}}
a_{ij} b_{jk} c_{ki}
\end{equation}
```

02-11-01

## 2.11.2 Problems

There are still some problems with limits and the following math expression. For example:

$$X = \sum_{1 \leq i \leq j \leq n} X_{ij}$$

```
\usepackage{amsmath}
[ X = \sum_{1 \leq i \leq j \leq n} X_{ij} ]

```

02-11-02

does not look nice because of the long limit. Using a `\makebox` also does not really solve the problem, because `\makebox` is in *TeX* horizontal mode and knows nothing about the appropriate math font size, because limits have a smaller font size. It is better to define a `\mathclap` macro, similar to the two macros `\llap` and `\rlap` and uses the also new defined `\mathclap` macro:

```
\def\mathllap{\mathpalette\mathllapinternal}
\def\mathllapinternal#1#2{%
\llap{$\mathsf{#1}\mathsf{#2}$} $}
}
\def\mathrlap{\mathpalette\mathrlapinternal}
\def\mathrlapinternal#1#2{%
\rlap{$\mathsf{#1}\mathsf{#2}$} $}
}
```

Now we can write limits which have a boxwidth of Opt and the right font size and the following math expression appears just behind the symbol:

$$X = \sum_{1 \leq i \leq j \leq n} X_{ij}$$

```
\usepackage{amsmath}
\def\clap#1{\hbox to 0pt{\hss#1\hss}}
\def\mathclap{\mathpalette\mathclapinternal}
\def\mathclapinternal#1#2{%
\clap{$\mathsf{#1}\mathsf{#2}$} $}
}
X = \sum_{\mathclap{1 \leq i \leq j \leq n}} X_{ij}
```

02-11-03

These macros are also part of the package `mathtools` from Morten Høgholm and Lars Madsen. `mathtools` itself loads package `amsmath` by default.

$$X = \sum_{1 \leq i \leq j \leq n} X_{ij}$$

```
\usepackage{mathtools}
\[
X = \sum_{\mathclap{1 \leq i \leq j \leq n}} X_{ij}
\]
```

Another problem occurs when having operators with stacked limits in braces:

$$\left[ \sum_{\substack{i,j \\ i>j}} \dots \right] \quad (2.6)$$

This case is not easy to handle when some other math expressions are around the braces which should be on the same baseline. However, the following may help in some cases to get better looking braces.

$$foo \left[ \sum_{\substack{i,j \\ i>j}} \dots \right] bar \quad (1)$$

```
\usepackage{mathtools}

\begin{align}
\text{foo } \left[ \begin{array}{c} @{} c @{} \\ \displaystyle \sum_{\substack{i,j \\ i > j}} \dots \\ \right] \bar{ }
\end{array} \right]
\end{align}
```

### 2.11.3 \sideset

This is a command for a very special purpose, to combine over/under limits with superscript/subscripts for the sum-symbol. For example: it is not possible to place the prime for the equation 2.7 near to the sum symbol, because it becomes an upper limit when writing without an preceeding {}.

$$\sum_{\substack{n < k \\ n \text{ odd}}} 'nE_n \quad (2.7)$$

The command \sideset has the syntax

\sideset{<before>}{<behind>}

It can place characters on all four corners of the sum-symbol:

$$\begin{matrix} & T \\ \text{UpperLeft} & \sum \\ \text{LowerLeft} & \text{LowerRight} \\ & B \end{matrix}$$

```
\usepackage{amsmath}
\[
 \sideset{\text{LowerLeft}}{\text{UpperLeft}}{_{\text{LowerRight}}^{\text{UpperRight}}}\sum_B{}^T
]\
```

Now it is possible to write the equation 2.7 in a proper way with the command `\sideset{}{}{'}` before the sum symbol:

$$\sum'_{n < k} nE_n \quad (1)$$

```
\usepackage{amsmath}

\begin{equation}
\text{\textbackslash sideset\{}'\textbackslash sum_{n<\kappa\atop n}\textbackslash text{odd}\textbackslash nE_n\text{\textbackslash end\{}equation\text{\textbackslash}}

```

## 2.12 Operator names

`\operatorname{name}` By default variables are written in italic and operator names in upright mode, like  $y = \sin(x)$ .<sup>8</sup> This happens only for the known operator names, but creating a new one is very easy with:

Now `\mysin` is also written in upright mode:  $y = \mysin(x)$

```
\usepackage{amsmath}
\newcommand{\mysin}{\operatorname{mysin}}
```

Now `\verb|\mysin|` is also written in upright mode:  
`$y=\mysin(x)$`

02-12-01

The new operator also has the default additional space before and behind. It is obvious, that only those names can be defined as new operator names which are not commands in another way. Instead of using the new definition as an operator, it is also possible to use the text mode. But it is better to have all operators of the same type, so that changing the style will have an effect for all operators.

The new defined operator names cannot have limits, only superscript/subscript is possible. `amsopn.sty` has an additional command `\operatorname{withlimits}`, which supports over/under limits like the one from `\int` or `\sum`.

`\mathop` It is also possible to use the macro `\mathop` to declare anything as operator, like

```
1B
\usepackage{amsmath}
\newcommand{\mysin}{\operatorname{mysin}}
\[
\operatorname{\sideset{_1}{^2}{\mathop{B}}}
\]
```

02-12-02

With this definition it is possible to use `\sideset` for a forgoing index, which is only possible for an operator. For a real L<sup>A</sup>T<sub>E</sub>X definition have a look at Section 1.16 on page 35.

## 2.13 Text in math mode

If you need complex structures between formulas, look also at section 7.7.

### 2.13.1 `\text` command

`\text` This is the equivalent command to `\mathrm` or `\mbox` from the standard L<sup>A</sup>T<sub>E</sub>X `\mbox` (Section 1.9 on page 23) with the exception, that `\mathrm` always uses the roman `\textnormal` font and `\text` the actual one and that the font size is different when used in `\mathrm` super- and subscript.

```
\usepackage{amsmath}
\boxed{f(x)=x}\quad\text{this is text in math} \\
\par\medskip\sffamily\huge
\$A^{\mbox{\tiny\text{text}}}_{\text{text}}\$ \quad \$A^{\text{text}}_{\text{text}}\$ \quad \$A^{\text{text}}_{\text{text}}\$ \quad \$A^{\text{text}}_{\text{text}}\$
```

---

<sup>8</sup> See section 1.16 on page 35, where all the standard L<sup>A</sup>T<sub>E</sub>X known operator names are listed. Package AMSmath has some more (see documentation).

02-13-01

$$f(x) = x \quad \text{this is text in math}$$

$A_{\text{text}}^{\text{text}}$   $A_{\text{text}}^{\text{text}}$   $A_{\text{text}}^{\text{text}}$   $A_{\text{text}}^{\text{text}}$

The `\text` macro can be used at any place and can be in some cases a better solution as `\intertext` (see section 2.13.2).

```
\usepackage{amsmath}
```

```
\begin{flalign*}
    && 12(x-1) + 20(y-3) + 14(z-2) &= 0 \quad \& \\
    \text{and} \quad && 6x + 10y + 7z &= 0 \quad \& \\
\end{flalign*}
%
\begin{aligned}
    && 12(x-1) + 20(y-3) + 14(z-2) &= 0 \quad \& \\
    \text{and} \quad && 6x + 10y + 7z &= 0 \quad \& \\
\end{aligned}
```

02-13-02

and

$$\begin{aligned} 12(x-1) + 20(y-3) + 14(z-2) &= 0 \\ 6x + 10y + 7z &= 0 \end{aligned}$$

$$12(x-1) + 20(y-3) + 14(z-2) = 0 \quad (1)$$

$$\text{and} \quad 6x + 10y + 7z = 0 \quad (2)$$

## 2.13.2 `\intertext` command

This is useful when you want to place some text between two parts of math stuff without leaving the math mode, like the name `\intertext` says. For example we write the Equation 02-13-03 with an additional command after the second line.

```
\usepackage{amsmath}
```

```
\[
\begin{split}
A_{\{1\}} &= \left( \int_{-3}^1 (f(x) - g(x)) dx \right) \\
&= \left( \int_{-3}^1 (x^2 - 3x) dx \right) \\
&= \left[ \frac{x^3}{3} - \frac{3x^2}{2} \right]_{-3}^1 \\
&\quad \intertext{Now the limits of the integrals are used}
&= \left[ \frac{x^3}{3} - \frac{3x^2}{2} \right]_{-3}^1 \\
&= \left[ \frac{1}{3} - \frac{9}{2} \right] - \left[ \frac{-27}{3} - \frac{27}{2} \right] \\
&= \frac{1}{3} - \frac{9}{2} + \frac{27}{3} + \frac{27}{2} \\
&= \frac{1}{3} - \frac{9}{2} + \frac{27}{3} + \frac{27}{2} \\
&= \frac{1}{3} - \frac{9}{2} + \frac{27}{3} + \frac{27}{2}
\end{split}
\]
```

$$\begin{aligned} A_1 &= \left| \int_0^1 (f(x) - g(x)) dx \right| + \left| \int_1^2 (g(x) - h(x)) dx \right| \\ &= \left| \int_0^1 (x^2 - 3x) dx \right| + \left| \int_1^2 (x^2 - 5x + 6) dx \right| \end{aligned}$$

Now the limits of the integrals are used

$$\begin{aligned} &= \left| \frac{x^3}{3} - \frac{3}{2}x^2 \right|_0^1 + \left| \frac{x^3}{3} - \frac{5}{2}x^2 + 6x \right|_1^2 \\ &= \left| \frac{1}{3} - \frac{3}{2} \right| + \left| \frac{8}{3} - \frac{20}{2} + 12 - \left( \frac{1}{3} - \frac{5}{2} + 6 \right) \right| \\ &= \left| -\frac{7}{6} \right| + \left| \frac{14}{3} - \frac{23}{6} \right| = \frac{7}{6} + \frac{5}{6} = 2 \text{ FE} \end{aligned}$$

Writing very long text is possible by using a `\parbox`, see section [1.9 on page 23](#) for an example with `\texttt{\textnormal{textrm}}`, which behaves in the same way as `\text`.

## 2.14 Extensible arrows

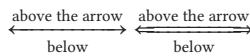
`\xrightarrow` To write something like  $\xrightarrow[\text{below}]{\text{above the arrow}}$  you can use the following macro  
`\xleftarrow`

`\xmapsto{\xrightarrow[\text{below}]{\text{above the arrow}}}`

and the same with `\xleftarrow`. You can define your own extensible arrow macros if you need other than these two predefined ones. To get a doublelined extensible arrow like `\Longleftrightarrow` but with the same behaviour as an extensible one, create the commands derived from the existing:

`\xLongLeftRightArrow[\text{below}]{\text{above the arrow}}`  
`\xlongleftrightarrow[\text{below}]{\text{above the arrow}}`

```
\usepackage{amsmath}
\makeatletter
\newcommand\xLongLeftRightArrow[2][]{\ext@arrow 0055{\LongLeftRightArrowfill@}{#1}{#2}}
\def\LongLeftRightArrowfill@{\arrowfill@\Leftarrow\Relbar\Rightarrow}
\newcommand\xlongleftrightarrow[2][]{\ext@arrow 0055{\longleftrightarrowfill@}{#1}{#2}}
\def\longleftrightarrowfill@{\arrowfill@\leftarrow\relbar\rightarrow}
\makeatother
\$ \xlongleftrightarrow[\text{below}]{\text{above the arrow}} \\
\$ \xLongLeftRightArrow[\text{below}]{\text{above the arrow}}
```



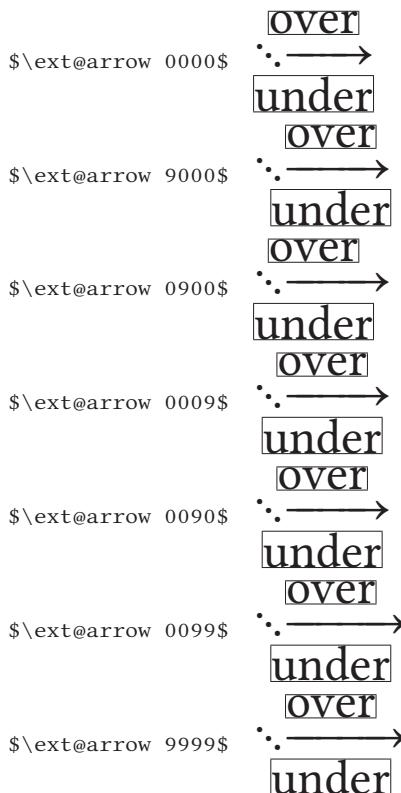
The three parts `\Leftarrow\Relbar\Rightarrow` define left|middle|right of the arrow, where the middle part would be stretched in a way that the arrow is at least as long as the text above and/or below it. This macro has one optional and one standard parameter. The optional one is written below and the standard one above this arrow. The “number” 0055 after `\ext@arrow` defines the position

relative to the extended arrow and is not a number but four parameters for additional space in the math unit  $\mu\text{u}$ .

```
\usepackage{amsmath}
\makeatletter
\def\xmapsto{\mapstochar\relbar\relbar\rightarrow}
\newcommand*\xmapsto[6][]{%
  \ext@arrow #3#4#6\mapsto@fill@{\#1}{\#2}}
\makeatother

\verb+$\ext@arrow 0000$+\quad{\huge $\xmapsto[\!\fbox{under}]{\fbox{over}}\!$}\par
\verb+$\ext@arrow 9000$+\quad{\huge $\xmapsto[\!\fbox{under}]{\fbox{over}}\!$}\par
\verb+$\ext@arrow 0900$+\quad{\huge $\xmapsto[\!\fbox{under}]{\fbox{over}}\!$}\par
\verb+$\ext@arrow 0090$+\quad{\huge $\xmapsto[\!\fbox{under}]{\fbox{over}}\!$}\par
\verb+$\ext@arrow 0009$+\quad{\huge $\xmapsto[\!\fbox{under}]{\fbox{over}}\!$}\par
\verb+$\ext@arrow 0099$+\quad{\huge $\xmapsto[\!\fbox{under}]{\fbox{over}}\!$}\par
\verb+$\ext@arrow 9999$+\quad{\huge $\xmapsto[\!\fbox{under}]{\fbox{over}}\!$}
```

02-14-02



- ▷ 1st digit: space left
- ▷ 2nd digit: space right
- ▷ 3rd digit: space left and right
- ▷ 4th digit: space relativ to the tip of the “arrow”

The two macros  $\xrightarrow$  and  $\xleftarrow$  are defined as:

```
\newcommand\xrightarrow[2][]{\ext@arrow 0359\rightarrowfill@{\#1}{\#2}}
\newcommand\xleftarrow[2][]{\ext@arrow 3095\leftarrowfill@{\#1}{\#2}}
```

## 2.15 Frames

`\boxed` AMSmath knows the macro `\boxed` which can be used for inline  $a \boxed{b + c}$  and displayed math expressions:

$$f(x) = \int_1^{\infty} \frac{1}{x^2} dx = 1$$

(1)

```
\usepackage{amsmath}
\begin{aligned}
\boxed{f(x)=\int_1^{\infty}\frac{1}{x^2}\mathrm{d}x=1}
\end{aligned}
```

02-15-01

For coloured boxes use package `empheq` from Morten Høgholm and Lars Madsen. For an example see section [4.1.11 on page 93](#). Important is the fact that the `\boxed` command cannot include a column specifier &. In such a case you need some tricky code.

## 2.16 Greek letters

`\pmb` The AMSmath package simulates a bold font for the greek letters by writing a greek character twice with a small kerning. This is done with the macro `\pmb{<letter>}`. The `\mathbf{<character>}` doesn't work with lower greek character. However, using the `\boldsymbol` macro from AMSmath is the better way when the font has a bold symbol.

Uppercase greek letters are by default in upright mode. AMSmath supports also such letters in italic mode with a preceding var e.g., `\varGamma`

letter	<code>\pmb{letter}</code>	<code>\boldsymbol{letter}</code>	letter	italic
$\alpha$	<b><math>\alpha</math></b>	$\alpha$	$\Gamma$	$\Gamma$
$\beta$	<b><math>\beta</math></b>	$\beta$	$\Delta$	$\Delta$
$\gamma$	<b><math>\gamma</math></b>	$\gamma$	$\Theta$	
$\delta$	<b><math>\delta</math></b>	$\delta$	$\Lambda$	$\Lambda$
$\epsilon$	<b><math>\epsilon</math></b>	$\epsilon$	$\Xi$	$\Xi$
$\varepsilon$	<b><math>\varepsilon</math></b>	$\varepsilon$	$\Pi$	$\Pi$
$\zeta$	<b><math>\zeta</math></b>	$\zeta$	$\Sigma$	$\Sigma$
$\eta$	<b><math>\eta</math></b>	$\eta$	$\Upsilon$	$\Upsilon$
$\theta$	<b><math>\theta</math></b>	$\theta$	$\Phi$	$\Phi$
$\vartheta$	<b><math>\vartheta</math></b>	$\vartheta$	$\Psi$	$\Psi$
$\iota$	<b><math>\iota</math></b>	$\iota$	$\Omega$	$\Omega$
...	...	...		

## 2.17 Miscellaneous commands

`\overset` There are several commands which can be used in math mode: Some examples `\underset` are shown in Table [2.17 on the next page](#).

`\underset` is a useful macro for having limits under non-operators (see page [89](#)). `\boldsymbol` can be used for a math symbol that remains unaffected by `\mathbf` if the current math font set includes a bold version of that symbol.

$\underset{under}{\text{baseline}}$	$\text{baseline}_{\overset{under}{\overbrace{\phantom{baseline}}}}$
$\overset{over}{\text{baseline}}$	$\text{baseline}$
$\boldsymbol{\Omega}$	$\Omega$

Table 2.5: Different mathcommands

## 2.18 Problems with amsmath

$\mathcal{A}\mathcal{M}\mathcal{S}math$  is an excellent package with some “funny features”. When using an  `environment inside a  environment, it should be centered just like the other lines. This is only true, when there is a number/tag or an additional ampersand:`

```
\usepackage{amsmath}

\begin{gather*}
\begin{aligned*}
m_2 &= m_2' + m_2'' \\
&= \frac{V_2'}{v_2'} + \frac{V_2''}{v_2''}
\end{aligned*} \\
\Rightarrow m_2 v_2' = V - V_2' + V_2'' \frac{v_2'}{v_2''} \\
\end{gather*}
\begin{gather*}
\begin{aligned*}
m_2 &= m_2' + m_2'' \\
&= \frac{V_2'}{v_2'} + \frac{V_2''}{v_2''} & \text{& \%<<=====}
\end{aligned*} \\
\Rightarrow m_2 v_2' = V - V_2' + V_2'' \frac{v_2'}{v_2''}
\end{gather*}
```

02-18-01

$$\begin{aligned} m_2 &= m_2' + m_2'' \\ &= \frac{V_2'}{v_2'} + \frac{V_2''}{v_2''} \\ \Rightarrow m_2 v_2' &= V - V_2' + V_2'' \frac{v_2'}{v_2''} \end{aligned}$$

$$\begin{aligned} m_2 &= m_2' + m_2'' \\ &= \frac{V_2'}{v_2'} + \frac{V_2''}{v_2''} \\ \Rightarrow m_2 v_2' &= V - V_2' + V_2'' \frac{v_2'}{v_2''} \end{aligned}$$

This effect depends to the horizontal width, which is wrong in the first example, in fact of a missing tag or number the right whitespace is cut, but the left one is still there. The additional ampersand prevents  $\mathcal{A}\mathcal{M}\mathcal{S}math$  to change the right margin. Another kind of curiosities is the following example, which depends to the same problem of cutting whitespace only on one side.

```
\usepackage{amsmath}
```

```
\fbox{%
\begin{minipage}{10cm}
\begin{align*}
a=b \& c=d
\end{align*}
\end{minipage}}}

\noindent\fbox{%
\begin{minipage}{10cm}
\noindent\begin{align*}
a=b \& c=d
\end{align*}
\end{minipage}}}
```

$$a = b$$

$$c = d$$

$$a = b$$

$$c = d$$

02-18-02

# Chapter 3

## TeX and math

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There is in general no need to use the TeX macros, because the ones defined with L<sup>A</sup>T<sub>E</sub>X or with *AMSmath* are much more useful. Nevertheless there may be situations, where someone has to use one of the TeX macros or special TeX math length. One can not expect, that all macros work in the usual way, a lot of them are redefined by L<sup>A</sup>T<sub>E</sub>X or *AMSmath*. On the other hand some of these basic macros or length definitions are used in the TeX way, so it might be interesting to have all declared in a short way for some information.

### 3.1 Length registers

#### 3.1.1 \abovedisplayshortskip

A length with glue, see section 1.11.5 for an example.

#### 3.1.2 \abovedisplayskip

A length with glue, see section 1.11.5 for an example.

#### 3.1.3 \belowdisplayshortskip

A length with glue, see section 1.11.5 for an example.

#### 3.1.4 \belowdisplayskip

A length with glue, see section 1.11.5 for an example.

### 3.1.5 \delimiterfactor

The height of a delimiter is often not optimally calculated by TeX. In some cases it is too short. With `\delimiterfactor` one can correct this height. The `\delimiterheight` is  $< \text{calculated height} > \cdot < \#1 > / 1000$  where `#1` is the parameter of `\delimiterfactor`. The default value is 901.

```
\[
y = \left\{ \begin{array}{ll}
x^2+2x & \text{if } x < 0, \\
x^3 & \text{if } 0 \leq x < 1, \\
x^2+x & \text{if } 1 \leq x < 2, \\
x^3-x^2 & \text{if } 2 \leq x. \\
\end{array} \right.
\]
\[
\begin{array}{l}
\text{\delimdef{1500}} \\
y = \left\{ \begin{array}{ll}
x^2+2x & \text{if } x < 0, \\
x^3 & \text{if } 0 \leq x < 1, \\
x^2+x & \text{if } 1 \leq x < 2, \\
x^3-x^2 & \text{if } 2 \leq x. \\
\end{array} \right.
\end{array}
\right.
```

03-01-01

$$y = \begin{cases} x^2 + 2x & \text{if } x < 0, \\ x^3 & \text{if } 0 \leq x < 1, \\ x^2 + x & \text{if } 1 \leq x < 2, \\ x^3 - x^2 & \text{if } 2 \leq x. \end{cases}$$

$$y = \begin{cases} x^2 + 2x & \text{if } x < 0, \\ x^3 & \text{if } 0 \leq x < 1, \\ x^2 + x & \text{if } 1 \leq x < 2, \\ x^3 - x^2 & \text{if } 2 \leq x. \end{cases}$$

03-01-01

### 3.1.6 \delimitershortfall

Additionally to the forgoing `\delimiterfactor` one can modify the height of the delimiter with another value. TeX makes the delimiter larger than the values of  $< \text{calculated height} > \cdot < \text{delimiterfactor} > / 1000$  and  $< \text{calculated height} > - < \text{delimitershortfall} >$ . This makes it possible to always get different heights of a sequence of delimiters.

$x \cdot ((x^2 - y^2) - 3)$	$\$ x \cdot \left( \left( x^2 - y^2 \right) - 3 \right)$	$\$ \cdot \left( \left( x^2 - y^2 \right) - 3 \right)$	$\$ \cdot \left( \left( x^2 - y^2 \right) - 3 \right)$
$((A))$	$\$ \left( \left( A \right) \right)$	$\$ \left( \left( A \right) \right)$	$\$ \left( \left( A \right) \right)$

03-01-02

$\bigskip$	$\$ \bigskip$	$\$ \left( \left( A \right) \right)$	$\$ \left( \left( A \right) \right)$
	$\$ \left( \left( A \right) \right)$	$\$ \left( \left( A \right) \right)$	$\$ \left( \left( A \right) \right)$

### 3.1.7 \displayindent

This is the left shift amount of a line holding displayed equation. By default it is `Opt` but gets the value of an indented paragraph when there is an environment

like the quotation one. The following formula is typeset in the usual way without modifying anything.

$$f(x) = \int \frac{\sin x}{x} dx$$

Now we start a quotation environment which sets `\labelwidth` to new values for a greater left margin.

- ▷ The following formula is typeset in the usual way without modifying anything.

$$f(x) = \int \frac{\sin x}{x} dx$$

- ▷ Now we write the same equation, but now with modifying `\displayindent`, it is set to the negative `\leftskip`:

03-01-03

$$f(x) = \int \frac{\sin x}{x} dx$$

\[
\begin{aligned}
&\backslash[ \\
&\quad \backslash displayindent=-\backslash labelwidth \\
&\quad f(x) = \backslash int \backslash frac\{\sin x\}\{x\}, \backslash mathrm{d}x \\
&\backslash]
\end{aligned}

### 3.1.8 `\displaywidth`

The width of the line holding a displayed equation, which is by default `\ linewidth`. In the second example the formula is centered for a display width of `0.5\ linewidth`.

03-01-04

03-01-04

$$f(x) = \int \frac{\sin x}{x} dx$$

\[
\begin{aligned}
&\backslash[ \\
&\quad f(x) = \backslash int \backslash frac\{\sin x\}\{x\}, \backslash mathrm{d}x \\
&\backslash] \\
&\backslash[ \\
&\quad \backslash displaywidth=0.5\backslash linewidth \\
&\quad f(x) = \backslash int \backslash frac\{\sin x\}\{x\}, \backslash mathrm{d}x \\
&\backslash]
\end{aligned}

### 3.1.9 `\mathsurround`

Extra space added when switching in and out of the inline math mode (see section 1.2.7).

### 3.1.10 `\medmuskip`

See section 1.11.1 for an example.

### 3.1.11 `\mkern`

Similiar to `\kern`, but adds a math kern item to the current math list. Length must be a math unit.

### 3.1.12 `\mskip`

Similiar to `\skip`, but adds math glue to the current math list. Length must be a math unit.

### 3.1.13 `\muskip`

Assigns a length with a math unit to one of the 256 `\muskip` register.

### 3.1.14 `\muskipdef`

Defines a symbolic name for a `\muskip` register.

### 3.1.15 `\nonscript`

Ignores immediately following glue or kern in script and `scriptscript` styles, which makes a redefinition of `\mathchoice` superfluous.

### 3.1.16 `\nulldelimiterspace`

This is the width of a null or missing delimiter, e.g. `\right.` or for the left one.

### 3.1.17 `\predisplaysize`

Is the effective width of the line preceding a displayed equation, whether `\abovedisplayskip` or `\abovedisplayshortskip` is used for the vertical skip.

### 3.1.18 `\scriptspace`

The space inserted after an exponent or index, predefined as `\scriptspace=0.5pt`

### 3.1.19 `\thickmuskip`

See section 1.11.1.

### 3.1.20 `\thinmuskip`

The short version for positive skip is defined as `\def\,{\mskip\thinmuskip}` and the one for a negative skip as `\def\!{\mskip-\thinmuskip}` (see also Section 1.11.1).

$\frac{\sqrt{2}x - \sqrt{2}\bar{x}}{\sqrt{\log x} - \sqrt{\log \bar{x}}}$ $P(1/\sqrt{n}) - P(1/\sqrt{\bar{n}})$ $[0, 1) - [0, \bar{1})$ $x^2/2 - \bar{x}^2/2$	<pre>\$\sqrt{2} x\$ -- \$\sqrt{2}, x\$\\" \$\sqrt{\log x}\$ -- \$\sqrt{\log x}\$\\" \$P\left(\frac{1}{\sqrt{n}}\right)\$ --  \$P\left(\frac{1}{\sqrt{n}}\right)\$\\"[8pt] \$[0, 1)\$ -- \$[0, 1]\$\\ \$x^2/2\$ -- \$x^2/2\$\\"</pre>
<span style="border: 1px solid black; padding: 2px;">03-01-05</span>	

```
\int\int_D \mathit{d}x \mathit{d}y \quad \int\int_D \mathit{d}x \mathit{d}y \\
\int\int\int_D \mathit{d}x \mathit{d}y \mathit{d}z \quad \int\int\int_D \mathit{d}x \mathit{d}y \mathit{d}z \\
\int\int\int\int_D \mathit{d}x \mathit{d}y \mathit{d}z \mathit{d}w \quad \int\int\int\int_D \mathit{d}x \mathit{d}y \mathit{d}z \mathit{d}w
```

03-01-06

$$\int \int_D dx dy \quad \int \int_D dx dy \\ \int \int_D dx dy \quad \int \int_D dx dy \\ \int \int_D dx dy \quad \int \int_D dx dy \\ \int \int_D dx dy$$

### 3.1.21 \medmuskip

See section 1.11.1.

## 3.2 Math font macros

### 3.2.1 \delcode

Each character has not only a \catcode and \mathcode but also a \delcode which defines for a single character how it should look when used as a math delimiter.

### 3.2.2 \delimiter

\delimiter Every character can be declared as a delimiter, but TeX must know which characters should be used for the default and the big size. For L<sup>T</sup>E<sub>X</sub> the macro \DeclareMathDelimiter should be used (see section 1.8.3 on page 22).

In the following example \tdeла is the character 0x22 ( $\uparrow$ ) from font number 2 (csmy) and character 0x78 from font number 3 (cmex) for the big version. \tdelb is the same vice versa ( $\downarrow$ ).

```
\def\tdeла{\delimiter"4222378\relax}
\def\tdelb{\delimiter"5223379\relax}

\tdeла x-y\tdelb(x+y)=x^2-y^2
%
\[\tdeла\sum_{n=0}^{\infty} {1\over 2^n}\tdelb^2 = 4\]
%
\[\left.\tdeла\sum_{n=0}^{\infty} {1\over 2^n}\right.\tdelb^2 = 4\]
```

03-02-01

$$\begin{aligned} & \left\langle x - y \right\rangle^2 = x^2 - y^2 \\ & \left\langle \sum_{n=0}^{\infty} \frac{1}{2^n} \right\rangle^2 = 4 \\ & \left\langle \sum_{n=0}^{\infty} \frac{1}{2^n} \right\rangle^2 = 4 \end{aligned}$$

### 3.2.3 \displaystyle

See section 1.12 for an example.

### 3.2.4 \fam

When TeX switches into the math mode, it typesets everything using one of the 16 possible families of fonts. \fam is an internal register where other macros can check which font is the actual one. At the beginning TeX starts with \fam=-1.

```
\usepackage[T1]{fontenc}
\usepackage{kpfonts}

\begin{tabular}{ll}
\verb+\fam=-1+ & \$\fam=-1 123abcABC\alpha\beta\gamma\$ \\
\verb+\fam=0+ & \$\fam=0 123abcABC\alpha\beta\gamma\$ \\
\verb+\fam=1+ & \$\fam=1 123abcABC\alpha\beta\gamma\$ \\
\verb+\fam=2+ & \$\fam=2 123abcABC\alpha\beta\gamma\$ \\
\verb+\fam=3+ & \$\fam=3 123abcABC\alpha\beta\gamma\$ \\
\verb+\fam=4+ & \$\fam=4 123abcABC\alpha\beta\gamma\$ \\
\verb+\fam=5+ & \$\fam=5 123abcABC\alpha\beta\gamma\$ \\
\verb+\fam=6+ & \$\fam=6 123abcABC\alpha\beta\gamma\$ \\
\verb+\fam=7+ & \$\fam=7 123abcABC\alpha\beta\gamma\$ \\
\verb+\fam=8+ & \$\fam=8 123abcABC\alpha\beta\gamma\$ \\
\end{tabular}
```

$\fam=-1$ $\fam=0$ $\fam=1$ $\fam=2$ $\fam=3$ $\fam=4$ $\fam=5$ $\fam=6$ $\fam=7$ $\fam=8$	$123abcABC\alpha\beta\gamma$ $123abcABC\alpha\beta\gamma$ $123abcABC\alpha\beta\gamma$ $\infty\exists\forall\int\mathcal{A}\mathcal{B}\alpha\beta\gamma$ $\bigcup\limits_{\alpha\in ABC}\bigcap\limits_{\beta\in\mathcal{B}}\alpha\beta\gamma$ $abcABC\alpha\beta\gamma$ $123abcABC\alpha\beta\gamma$ $123abcABC\alpha\beta\gamma$ $\mathfrak{abc}\mathcal{A}\mathcal{B}\alpha\beta\gamma$ $\gg\gg\sim\in\exists\forall\alpha\beta\gamma$
---	--

03-02-02

```
\mathrm{123abcABC\alpha\beta\gamma} (\the\fam)\$\\[5pt]
\mathbf{123abcABC\alpha\beta\gamma} (\the\fam)\$\\[5pt]
\mathit{123abcABC\alpha\beta\gamma} (\the\fam)\$\\[5pt]
\mathbf{123abcABC\alpha\beta\gamma} (\the\fam)\$\\[5pt]
\mathsf{123abcABC\alpha\beta\gamma} (\the\fam)\$\\[5pt]
\mathnormal{123abcABC\alpha\beta\gamma} (\the\fam)\$\\[5pt]
\mathbf{123abcABC\alpha\beta\gamma}(0)
\mathbf{123abcABC\alpha\beta\gamma}(5)
\mathbf{123abcABC\alpha\beta\gamma}(1)
\mathbf{123abcABC\alpha\beta\gamma}(7)
\mathbf{123abcABC\alpha\beta\gamma}(8)
\mathbf{123abcABC\alpha\beta\gamma}(1)
```

03-02-03

### 3.2.5 \mathaccent

Requires three parameter as one number, the class, the font family and the character.

A

```
\def\dA{\mathaccent"7015\relax}
\Large $\dA{A}$
```

03-02-04

### 3.2.6 \mathbin

Declares a following character as a binary symbol with another spacing before and behind such a symbol.

03-02-05  $a|b \quad a \mid b$

```
\def\dA{\mathaccent"7015\relax}
\Large
\$a|b \quad a\mathbin| b$
```

### 3.2.7 \mathchar

Declares a math character by three integer numbers as Parameters, giving its class, font family, and font position. In the following example \mathchar defines a character of class 1 (big operators), font family 3 (math extension font) and number 58 (big sum character).

03-02-06 
$$a \sum_{i=1}^{\infty} b \quad a \bigcup_{i=1}^{\infty} b$$

```
\def\dA{\mathaccent"7015\relax}
\Large
\$ a\sum\limits_{i=1}^{\infty} b \quad a\mathchar"1358\limits_{i=1}^{\infty} b \$
```

### 3.2.8 \mathchardef

This is in principle the same as \mathchar, it only allows to make such definitions permanent.

03-02-07 
$$a \bigcup_{i=1}^{\infty} \sqrt{i+1}$$
  

$$a \sum_{i=1}^{\infty} \sqrt{i+1}$$

```
\bgroup
\mathchardef\sum="1358
\$a\sum\limits_{i=1}^{\infty}\sqrt{i+1}\$\\[5pt]
\egroup
\$a\sum\limits_{i=1}^{\infty}\sqrt{i+1}\$
```

### 3.2.9 \mathchoice

Specifies specific subformula sizes for the 4 main styles:

\displaystyle - \textstyle - \scriptstyle - \scriptscriptstyle.

```
\usepackage{xcolor}
\def\myRule{\color{red}%
\mathchoice{\rule{2pt}{20pt}}{\rule{1pt}{10pt}}%
{\rule{0.5pt}{5pt}}{\rule{0.25pt}{2.5pt}}\mkern2mu}%
\Large
\$ \myRule \sum\limits_{i=1}^{\infty} \frac{\sqrt{i+1}}{i^2} \$
```

03-02-08 
$$\left| \sum_{i=1}^{\infty} \frac{\sqrt{i+1}}{i^2} \right|$$

### 3.2.10 \mathclose

Assigns class 5 (closing character) to the following parameter, which can hold a single character or a subformula.

$$A : \frac{B}{C} : D$$

03-02-09

$$A : \frac{B}{C} : D$$

$$\begin{aligned} & \backslash large \\ & \$ A : \frac{B}{C} : D \$ \\ & \$ A \backslash mathopen : \frac{B}{C} \backslash mathclose : D \$ \end{aligned}$$

### 3.2.11 \mathcode

A math font is far different from a text font. A lot of the characters has to be defined with \mathcode, which defines the character with its class, font family and character number, e.g. \mathcode`<`="313C. It defines the character “<” as a realtion symbol (class 3) from the font family 1 and the character number 0x3C, which is 60 decimal.

### 3.2.12 \mathop

Assigns class 1 (large operator) to the parameter, which can be a single character or a subformula.

$$A_{i=1}^{\infty}$$

03-02-10

$$\begin{aligned} & \backslash [ A_{i=1}^{\infty} \backslash ] \\ & \backslash [ \backslash mathop{A}_{i=1}^{\infty} \backslash ] \end{aligned}$$

$$\stackrel{\infty}{\underset{i=1}{A}}$$

### 3.2.13 \mathopen

Vice versa to \mathclose (see section 3.2.10).

### 3.2.14 \mathord

Assigns class 0 (ordinary character) to the following parameter, which can be a single character or a subformula.

$$y = f(x)$$

03-02-11

$$y=f(x)$$

$$\begin{aligned} & \backslash large \\ & \$ y = f(x) \$ \\ & \$ y \backslash mathord= f(x) \$ \end{aligned}$$

### 3.2.15 \mathpunct

Assigns class 6 (punctuation) to the following parameter, which can be a single character or a subformula (see section 1.11.4 for an example).

### 3.2.16 \mathrel

Assigns class 3 (relation) to the following parameter, which can be a single character or a subformula.

$$x_1 o x_2 o x_3$$

03-02-12

$$x_1 o x_2 o x_3$$

$$\begin{aligned} & \backslash large \\ & \$ x_1 o x_2 o x_3 \$ \\ & \$ x_1 \backslash mathrel o x_2 \backslash mathrel o x_3 \$ \end{aligned}$$

### 3.2.17 \scriptfont

Specifies the scriptstyle font (used for super/subscript) for a family.

03-02-13

```
A1 A1 % run with tex
```

### 3.2.18 \scriptscriptfont

Specifies the scriptscriptstyle font for a family.

### 3.2.19 \scriptscriptstyle

Selects scriptscript style for the following characters.

### 3.2.20 \scriptstyle

Selects script style for the following characters.

### 3.2.21 \skew

Especially for italic characters double accents are often misplaced. \skew has three arguments

**horizontal shift:** A value in math units for the additional shift of the accent.

**the accent:** The symbol which is placed above the character.

**the character:** This is in general a single character, but can also include itself an accent.

$\mathcal{M}$ Smath redefines the setting of double accents. This is the reason why there are only a few cases where someone has to use \skew when the package amsmath is loaded, like in this document.

$\tilde{i}$ $\tilde{\tilde{i}}$	$\tilde{A}$ $\tilde{\tilde{A}}$	\large \$ \tilde{i} \$ \quad \$ \tilde{\tilde{i}} \$ \\[5pt] \$ \tilde{A} \$ \quad \$ \tilde{\tilde{A}} \$ \$ \tilde{\tilde{\tilde{A}}} \$ \$ \tilde{\tilde{\tilde{\tilde{A}}}} \$
------------------------------------	------------------------------------	--

03-02-14

### 3.2.22 \skewchar

Is -1 or the character (reference symbol) used to fine-tune the positioning of math accents.

### 3.2.23 \textfont

Specifies the text font for a family.

### 3.2.24 \textstyle

Selects the text style for the following characters.

### 3.3 Math macros

#### 3.3.1 \above

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

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

$$a$$

$$b$$

```
$a\above0pt b$\\[8pt]
${a\above1pt b}$\\[8pt]
${a\above2.5pt b}$\\[8pt]
$\displaystyle{a\above0pt b}$
```

03-03-01

#### 3.3.2 \abovewithdelims

$$\left(\frac{a}{b}\right)$$

$$\left(\frac{a}{b}\right)$$

$$\left[\frac{a}{b}\right]$$

$$\begin{cases} a \\ b \end{cases}$$

```
\def\fdelimA{\abovewithdelims\{}1.0pt}
\def\fdelimB{\abovewithdelims\}{2.0pt}
\def\fdelimC{\abovewithdelims\{.0pt}
$a\abovewithdelims()0pt b$\\[8pt]
${a\fdelimA b}$\\[8pt]
${a\fdelimB b}$\\[8pt]
$\displaystyle{a\fdelimC b}$
```

03-03-02

#### 3.3.3 \atop

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

$${n \choose k} = \frac{n!}{k!(n-k)!}$$

$$a$$

$$b$$

```
$a\atop b$\\[8pt]
${\{n \atop k}\} = $\\[8pt]
${n!\abovelpt k!(n-k)!}$\\[8pt]
$\displaystyle{a\atop b}$
```

03-03-03

#### 3.3.4 \atopwithdelims

$$\left(\frac{a}{b}\right)$$

$${n \choose k} = \frac{n!}{k!(n-k)!}$$

$$\begin{cases} a \\ b \end{cases}$$

```
$a\atopwithdelims() b$\\[8pt]
${\{n \atopwithdelims() k}\} = $\\[8pt]
${n!\abovelpt k!(n-k)!}$\\[8pt]
$\displaystyle{a\atopwithdelims\{. b}$
```

03-03-04

#### 3.3.5 \displaylimits

Resets the conventions for using limits with operators to the standard for the used environment.

#### 3.3.6 \eqno

Puts an equation number at the right margin, the parameter can hold anything. \eqno places only the parameter, but doesn't increase any equation counter.

$$y = f(x)$$

% run with (t4|2)

03-03-05

### 3.3.7 \everydisplay

Inserts the parameter at the start of every switch to display math mode.

03-03-06

$$f(x) = \int \frac{\sin x}{x} dx$$

```
\usepackage{xcolor}
\everydisplay{\color{red}}
\[
 f(x) = \int \frac{\sin x}{x} dx
\]
\[
 g(x) = \int \frac{\sin^2 x}{x^2} dx
\]
```

$$g(x) = \int \frac{\sin^2 x}{x^2} dx$$

### 3.3.8 \everymath

Same as , but now for the inline mode. In the following example the `displaystyle` is used (besides using color red) for every inline math expression.

03-03-07

$$f(x) = \int \frac{\sin x}{x} dx$$

```
\usepackage{xcolor}
\everymath{\color{red}\displaystyle}
\[
 f(x)=\int\frac{\sin x}{x},\mathbf{d}x
\]
Instead of  $\frac{\sin x}{x}$  now with
 $\frac{\cos x}{x}$ :
\[
 Instead of  $\frac{\sin x}{x}$ 
now with  $\frac{\cos x}{x}$ :
\[
 g(x)=\int\frac{\cos x}{x},\mathbf{d}x
\]
```

$$g(x) = \int \frac{\cos x}{x} dx$$

Pay attention for side effects on footnotes and other macros which use the math mode for superscript and other math related modes. In this case you'll get the footnotes also in red.

### 3.3.9 \left

$\text{\TeX}$  calculates the size of the following delimiter needed at the left side of a formula. Requires an additional `\right`.

### 3.3.10 \leqno

Vice versa to `\eqno` (see section 3.3.6 on the preceding page).

### 3.3.11 \limits

Typesets limits above and/or below operators (see section 1.6 on page 16).

### 3.3.12 \mathinner

Defines the following parameter as subformula.

### 3.3.13 \nolimits

The opposite of `\limits`, instead of above/below limits are placed to the right of large operators (class 1).

### 3.3.14 \over

Is equivalent to the fraction macro of L<sup>A</sup>T<sub>E</sub>X and equivalent to the \overwithdelims, see section 3.3.16.

$$\frac{a}{b} \quad \frac{\frac{m}{n}}{a+b}$$

```
$ {a\over b} \qquad
{{m\over n}\over{a+b}} $
```

03-03-08

### 3.3.15 \overline

Puts a line over the following character or subformula and has the same problems with different heights as underlines (see section 3.3.19).

$$\overline{x} + \overline{y} = \overline{z}$$

$$\overline{x + A} = \overline{z}$$

$$\overline{x + A} = \overline{z}$$

```
\overline{x}+\overline{y}=\overline{z}$
\let\ol\overline
$ \ol{x}+\ol{A}=\ol{z} $ \\[5pt]
\def\yPh{\vphantom{A}}
$ \ol{x\yPh}+\ol{A}=\ol{z\yPh} $
```

03-03-09

### 3.3.16 \overwithdelims

Is a generalized fraction command with preset fraction bar thickness.

$$\left(\frac{a}{b}\right) \quad \left[\frac{\frac{m}{n}}{a+b}\right]$$

$$\left\{ \frac{\frac{m}{n}}{a+b} \right\}$$

```
$ {a\overwithdelims() b} \qquad
{{m\over n}\overwithdelims[]{a+b}} $
```

03-03-10

### 3.3.17 \radical

Makes a radical atom from the delimiter (27-bit number) and the math field.

$$\sqrt[1]{\frac{1}{7}}$$

$$\sqrt[1]{\frac{1}{7}}$$

$$\sqrt{\frac{1}{7}}$$

```
\def\mySqrt{\radical"0270371\relax}
$ \mySqrt{\frac{1}{7}} $ \\[5pt]
\def\mySqrt{\radical"0270372\relax}
$ \mySqrt{\frac{1}{7}} $ \\[5pt]
\def\mySqrt{\radical"0270373\relax}
$ \mySqrt{\frac{1}{7}} $ \\[5pt]
\def\mySqrt{\radical"0270374\relax}
$ \mySqrt{\frac{1}{7}} $ \\[5pt]
```

03-03-11

### 3.3.18 \right

Opposite to \left, makes TeX calculate the size of the delimiter needed at the right of a formula.

03-03-12

### 3.3.19 \underline

When there is a combination of variables with and without an index, the underlines are typeset with a different depth. Using `\vphantom` in this case is a good choice.

$$\begin{aligned} \underline{x} + \underline{y} &= z \\ x + \underline{y} &= \underline{z} \\ \underline{x}_1 + \underline{y}_2 &= z_3 \end{aligned}$$

```
$\underline{x} + \underline{y} = \underline{z} \$\\
\let\ul\underline
\def\yPh{\vphantom{y}}
\$ \ul{x\yPh} + \ul{y} = \ul{z\yPh} \$\\
\$ \ul{x_1} + \ul{y_2} = \ul{z_3} $
```

### 3.3.20 \vcenter

Centers vertical material with respect to the axis.

## 3.4 Math penalties

### 3.4.1 \binoppenalty

A penalty for breaking math expressions between lines in a paragraph. TeX breaks lines only when the binary symbol is not the last one and when the penalty is below 10,000.

### 3.4.2 \displaywidowpenalty

The penalty which is added after the penultimate line immediately preceding a display math formula.

### 3.4.3 \postdisplaypenalty

Is added immediately after a math display ends.

### 3.4.4 \predisplaypenalty

Is added immediately before a math display starts.

### 3.4.5 \relpenalty

The penalty for a line break after a relation symbol (if a break is possible).



# Chapter 4

## Other math related packages

4.1 List of available math packages . . . . .	87
---	----

The following sections are not a replacement for the package documentation!

### 4.1 List of available math packages

accents	alphalph	amsart	amsbook
amsbsy	amscd	amscls	amsfonts
amslatex	amsltx11	amsmath	amsppt
amsppt1	amsproc	amssym (plain TeX)	amssymb (LaTeX)
amstex (Plain TeX)	amstext	amsthm	bez123
bitfield	brclc	breqn	cancel
cases	comma	datenumber	diagxy
doublestroke	easyeqn	easybmat	easymat
eqnarray	esvect	fixmath	ftlpoint
icomma	leftidx	mathdots	mathtools
mathematica	mil3	mtbe	Nath
numprint	random	romannum	TeXaide

The following examples depend on the listed versions of the packages:

accents.sty	2006/05/12 v1.3 Math Accent Tools
amscd.sty	1999/11/29 v2.0
amsopn.sty	2016/03/08 v2.02 operator names
bibdelim.sty	2016/10/11 v2.1 big delimiters
bm.sty	2016/07/07 v1.2b Bold Symbol Support (DPC/FMi)
braket.sty	2006/09/12 Macros for notation and sets
cancel.sty	2013/04/12 v2.2 Cancel math terms
cool.sty	2006/12/29 v1.35 COntent Oriented LaTeX
delarray.sty	2014/10/28 v1.01 array delimiter package (DPC)
dotseqn.sty	1995/03/22 v1.1 Dots leading to equation numbers
emphq.sty	2007/12/03 v2.12 Emphasizing equations (MH)
esint.sty	2005/11/20 v1.1 Nice integral symbols (ES)
eucal.sty	2009/06/22 v3.0 Euler script fonts
exscale.sty	2014/09/29 v2.1h Scaling of math expressions
framed.sty	2007/10/04 v 0.95: framed or shaded text with page breaks
pstricks.sty	2004/05/06 v0.2k LaTeX wrapper for 'PSTricks' (RN,HV)
pstricks.tex	2010/12/14 v2. 'PSTricks' (tvz,hv)
pst-node.tex	2008/11/26 v1.01 PSTricks package for nodes (tvz,hv)
delarray.sty	1994/03/14 v1.01 array delimiter package (DPC)
xypic.sty	1999/02/16 Xy-pic version 3.7
exscale.eps	Graphic file (type veps)

### 4.1.1 accents

If you want to write for example an underlined M, then you can do it by

M   M   M

\usepackage{amsmath,accents}

\underline{\$M\$} \quad \underbar{\$M\$}  
\quad \underaccent{\bar}{M}

04-01-01

As seen, there is no difference between \underline and \underbar. For some reasons it may be better to use the accent package from Javier Bezos with the \underaccents macro if you want it more like an accent.

### 4.1.2 amscd – commutative diagrams

The amscd package from the L<sup>A</sup>T<sub>E</sub>X3 project is part of the *AMSmash* bundle and has no options for the \usepackage command. amscd does not support diagonal arrows but is much easier to handle than the complex pstricks package or the xypic package. On the other hand simple diagrams can be written with the array or look at P. Taylor 1997.

```
\usepackage{amsmath,amscd}

\[
\begin{CD}
R\times S @>\text{restriction}>> S\times T \\
@V\text{proj}_VV @V\text{proj}_V V\\
R\times S @<<\text{inclusion}<< S
\end{CD}
\]
```

04-01-02

$$\begin{array}{ccc}
 R \times S \times T & \xrightarrow{\text{restriction}} & S \times T \\
 proj \downarrow & & \downarrow proj \\
 R \times S & \xleftarrow[\text{inclusion}]{} & S
 \end{array}$$

### 4.1.3 amsopn

With the `amsopn` package from the L<sup>A</sup>T<sub>E</sub>X3 project it is very easy to declare new math operators, which are written in upright mode:

04-01-03

<code>Res</code>	<code>versus</code>	<code>Res</code>	<code>\usepackage{amsmath,amsopn}</code> <code>\DeclareMathOperator{\Res}{Res}</code> <code>\underset{s=p}{\text{Res}}</code> <code>\quad\text{versus}</code> <code>\underset{s=p}{\text{Res}}</code>
------------------	---------------------	------------------	--

Table 4.1.3 shows the predefined operatornames of `amsopn`.

<code>\arccos</code>	<code>arccos</code>	<code>\arcsin</code>	<code>arcsin</code>	<code>\arctan</code>	<code>arctan</code>	Table 4.1: The predefined operators of <code>amsopn.sty</code>
<code>\arg</code>	<code>arg</code>	<code>\cos</code>	<code>cos</code>	<code>\cosh</code>	<code>cosh</code>	
<code>\cot</code>	<code>cot</code>	<code>\coth</code>	<code>coth</code>	<code>\csc</code>	<code>csc</code>	
<code>\deg</code>	<code>deg</code>	<code>\det</code>	<code>det</code>	<code>\dim</code>	<code>dim</code>	
<code>\exp</code>	<code>exp</code>	<code>\gcd</code>	<code>gcd</code>	<code>\hom</code>	<code>hom</code>	
<code>\inf</code>	<code>inf</code>	<code>\injlim</code>	<code>inj lim</code>	<code>\ker</code>	<code>ker</code>	
<code>\lg</code>	<code>lg</code>	<code>\lim</code>	<code>lim</code>	<code>\liminf</code>	<code>lim inf</code>	
<code>\limsup</code>	<code>lim sup</code>	<code>\ln</code>	<code>ln</code>	<code>\log</code>	<code>log</code>	
<code>\max</code>	<code>max</code>	<code>\min</code>	<code>min</code>	<code>\Pr</code>	<code>Pr</code>	
<code>\projlim</code>	<code>proj lim</code>	<code>\sec</code>	<code>sec</code>	<code>\sin</code>	<code>sin</code>	
<code>\sinh</code>	<code>sinh</code>	<code>\sup</code>	<code>sup</code>	<code>\tan</code>	<code>tan</code>	
<code>\tanh</code>	<code>tanh</code>					

### 4.1.4 bigdelim

This is a very useful package together with the `multirow` from AuthorPiet van Ostrum package. In the following example we need additional parentheses for a different number of rows. This is also possible with the package `array`, but not as easy as with the `bigdelim` package. The trick is that you need one separate column for a big delimiter, but with empty cells in all rows, which the delimiter spans.

```

\usepackage{amsmath,bigdelim}

\[
\begin{pmatrix}
&x_{11} &x_{12} &\dots &x_{1p} &\rdelem\{4\}\{3cm}[some text]\\
&\ldelim\{5\}\{1cm}[text] &x_{21} &x_{22} &\dots &x_{2p} \\
&\vdots\\
&x_{n_1 1} &x_{n_1 2} &\dots &x_{n_1 p}\\
&x_{n_1+1,1} &x_{n_1+1,2} &\dots &x_{n_1+1, p} \\
&&&\rdelem\{3\}\{3cm}[some more text]\\
&\vdots
\end{pmatrix}

```

```
& x_{n_1+n_2, 1} & x_{n_1+n_2,2} & \dots & x_{n_1+n_2,p} \\
& \vdots \\
\end{pmatrix}
\]
```

$$\left( \begin{array}{cccc} x_{11} & x_{12} & \dots & x_{1p} \\ x_{21} & x_{22} & \dots & x_{2p} \\ \vdots & & & \\ x_{n_1,1} & x_{n_1,2} & \dots & x_{n_1,p} \\ x_{n_1+1,1} & x_{n_1+1,2} & \dots & x_{n_1+1,p} \\ \vdots & & & \\ x_{n_1+n_2,1} & x_{n_1+n_2,2} & \dots & x_{n_1+n_2,p} \\ \vdots & & & \end{array} \right) \begin{array}{l} \text{some text} \\ \text{some more text} \end{array}$$

04-01-04

As seen in the above listing the left big delimiter is placed in the first column, all other rows start with second column. It is possible to use all columns above and below the delimiter. For the array there must be two more columns defined, in case of a big delimiter left and right. The syntax of `\ldelim` and `\rdelim` is:

```
\ldelim<delimiter>{<n rows>}{{added horizontal space}}[<text>]
\rdelim<delimiter>{<n rows>}{{added horizontal space}}[<text>]
```

Any delimiter which is possible for the `\left` or `\right` command is allowed, e.g. “`\left( \right)`”. The text is an optional argument and always typeset in text mode.

## 4.1.5 `bm`

By default the math macro `\mathbf` writes everything in bold and in upright mode, but it should be in italic mode especially for variables which is possible with the package `bm` from David Carlisle and Frank Mittelbach. For writing a whole formula in bold have a look at section [1.22 on page 39](#).

$y = f(x)$  and  $y = f(x)$

`\usepackage{amsmath,bm}`

`\mathbf{y=f(x)}` and `\bm{y=f(x)}`

04-01-05

## 4.1.6 `braket`

The package `braket` from Donald Arseneau provides macros and styles for writing math expressions inside brackets.

$$\left\{ x \in \mathbb{R} \mid 0 < |x| < \frac{5}{3} \right\}$$

`\usepackage{amsmath}`

```
\[
\left. \left\{ x \in \mathbf{R} \mid 0 < |x| < \frac{5}{3} \right. \right\}
```

04-01-06

The above example looks not quite right and it is not really easy to get the first vertical line in the same size as the outer braces. Some solution may be using `\vphantom`:

$$\left\{ x \in \mathbb{R} \mid 0 < |x| < \frac{5}{3} \right\}$$

`\usepackage{amsmath}`

```
\[
\left. \left\{ \vphantom{\frac{5}{3}} x \in \mathbf{R} \mid 0 < |x| < \frac{5}{3} \right. \right\}
```

04-01-07

The package `braket` has the macros

```
\Bra{<math expression>}
\Ket{<math expression>}
\Braket{<math expression>}
\Set{<math expression>}
```

and the same with a leading lower letter, which are not really interesting.

04-01-08

$$\begin{aligned} &\left\langle x \in \mathbb{R} \mid 0 < |x| < \frac{5}{3} \right| \\ &\left| x \in \mathbb{R} \mid 0 < |x| < \frac{5}{3} \right\rangle \\ &\left\langle x \in \mathbb{R} \mid 0 < |x| < \frac{5}{3} \right\rangle \\ &\left\langle x \in \mathbb{R} \mid 0 < |x| < \frac{5}{3} \right\rangle \\ &\left\{ x \in \mathbb{R} \mid 0 < |x| < \frac{5}{3} \right\} \end{aligned}$$

```
\usepackage{amsmath,braket}
\[
\Bra{x \in \mathbf{R} \mid 0 < |x| < \frac{5}{3}}
\Ket{x \in \mathbf{R} \mid 0 < |x| < \frac{5}{3}}
\Braket{x \in \mathbf{R} \mid 0 < |x| < \frac{5}{3}}
\Set{x \in \mathbf{R} \mid 0 < |x| < \frac{5}{3}}
```

The difference between the `\Set` and the `\Braket` macro is the handling of the vertical lines. In `\Set` only the first one gets the same size as the braces and in `\Braket` all.

04-01-09

$$\begin{aligned} &\left\langle \phi \left| \frac{\partial^2}{\partial t^2} \right| \psi \right\rangle \\ &\left\{ \phi \left| \frac{\partial^2}{\partial t^2} \right| \psi \right\} \end{aligned}$$

```
\usepackage{amsmath,braket}
\[
\Braket{\phi \mid \frac{\partial^2}{\partial t^2} \mid \psi}
\Set{\phi \mid \frac{\partial^2}{\partial t^2} \mid \psi}
```

`\Bra` and `\Ket` do nothing with the inner vertical lines.

#### 4.1.7 cancel

`cancel` from Donald Arseneau is a nice package for canceling anything in math-mode with a slash, backslash or a X, but not with a horizontal line. That must be defined by the user.

```
\usepackage{amsmath,cancel,xcolor}
\newcommand{\hcancel}[2][black]{\setbox0=\hbox{#2}%
\rlap{\raisebox{.45\ht0}{\textcolor{#1}{\rule{\wd0}{1pt}}}}#2}
\$f(x)=\dfrac{\left(x^2+1\right)\cancel{(x-1)}}{\cancel{(x-1)}(x+1)}\$\\[0.5cm]
\$ \bcancel{3}\qquad \bcancel{1234567} \$ \qquad \$ \xcancel{3}\qquad \xcancel{1234567} \$ \\
\$ \hcancel{3}\qquad \hcancel{red}{1234567} \$
```

04-01-10

$$f(x) = \frac{(x^2 + 1)(\cancel{x-1})}{(\cancel{x-1})(x + 1)}$$

$\cancel{3}$      $\bcancel{1234567}$      $\xcancel{X}$      $\xcancel{1234567}$      $\textcolor{red}{\cancel{1234567}}$

It is no problem to redefine the `\cancel` macros to get also colored lines. A horizontal line for single characters is also described in section [1.14 on page 32](#).

### 4.1.8 cool

The `cool` package from Nick Setzer defines a lot of special mathematical expressions to use them by the macro name. The following list shows only some of them, for more informations look at the example file, which comes with the package.

```
\usepackage{amsmath,cool}

$\Sin{x} \Cos{x} \Tan{x} \Csc{x} \Sec{x} \Cot{x}$ \par
\Style{ArcTrig=inverse} % the default
$\ArcSin{x} \ArcCos{x} \ArcTan{x}$\par
\Style{ArcTrig=arc}
$\ArcSin{x} \ArcCos{x} \ArcTan{x} \ArcCsc{x} \ArcSec{x} \ArcCot{x}$\par
\$displaystyle\Factorial{n} \DblFactorial{n} \Binomial{n}{k} \Multinomial{i_1,\ldots,i_n}\par
\$GammaFunc{x} \IncGamma{a}{x} \GenIncGamma{a}{x}{y} \RegIncGamma{a}{x} \RegIncGammaInv{a}{x}
\GenRegIncGamma{a}{x}{y} \GenRegIncGammaInv{a}{x}{y} \Pochhammer{a}{n} \LogGamma{x} \par
\$Hypergeometric{0}{0}{0}{0}{0}{0} \Hypergeometric{0}{1}{1}{0}{0}{0} \par
\$RegHypergeometric{0}{0}{0}{0}{0}{0} \RegHypergeometric{0}{1}{1}{0}{0}{0} \par
\$displaystyle\MeijerG{a,b}{n}{p}{m}{q}{x} \MeijerG{1,2,3,4}{5,6}{3,6,9}{12,15,18,21,24}{x} \par
\$RiemannZeta{s} \Zeta{s} \HurwitzZeta{s}{a} \Zeta{s,a} \RiemannSiegelTheta{x} \RiemannSiegelZ{x}
\$StieltjesGamma{n} \par \$MathieuC{a}{q} \MathieuS{a}{q}{z} \MathieuU{a}{q}{z} \par
\$MathieuCharacteristicA{r}{q} \MathieuCharacteristicA{r}{q} \par
\$MathieuCharacteristicB{r}{q} \MathieuCharacteristicB{r}{q} \par
\$MathieuCharacteristicExponent{a}{q} \MathieuCharacteristicExp{a}{q} \par

sin(x)cos(x)tan(x)csc(x)sec(x)cot(x)
sin^{-1}(x)cos^{-1}(x)tan^{-1}(x)
arcsin(x)arccos(x)arctan(x)csc^{-1}(x)sec^{-1}(x)cot^{-1}(x)
n!n!!\binom{n}{k} (i_1 + \dots + i_n; i_1, \dots, i_n)
\Gamma(x)\Gamma(a,x)\Gamma(a,x,y)Q(a,x)Q^{-1}(a,x)Q(a,x,y)Q^{-1}(a,x,y)(a)_n \log\Gamma(x)
{}_0F_0(;;x) {}_0F_1(;b;x)
{}_0\tilde{F}_0(;;x) {}_0\tilde{F}_1(;b;x)
G_{p,q}^{m,n}\left(x \left| \begin{matrix} a_1, \dots, a_n, a_{n+1}, \dots, a_p \\ b_1, \dots, b_m, b_{m+1}, \dots, b_q \end{matrix} \right. \right) G_{6,8}^{3,4}\left(x \left| \begin{matrix} 1, 2, 3, 4, 5, 6 \\ 3, 6, 9, 12, 15, 18, 21, 24 \end{matrix} \right. \right)
\zeta(s)\zeta(s)\zeta(s,a)\zeta(s,a)\vartheta(x)Z(x)\gamma_n
Ce(a,q,z)Se(a,q,z)
a_r(q)a_r(q)
b_r(q)b_r(q)
r(a,q)r(a,q)
```

04-01-11

### 4.1.9 delarray

Package `delarray` from David Carlisle supports different delimiters which are defined together with the beginning of an array:

```
\begin{array}{<delLeft>{cc}<delRight>}
```

defines an array with two centered columns and the delimiters  
“`<delLeft><delRight>`”, e.g. “`()`”.

$$A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$$

```
\usepackage{delarray}
\[
A=\begin{array}{(cc)}
a & b \\
c & d
\end{array}
\]
\]
```

04-01-12

The `delarray` package expects a pair of delimiters. If you need only one (like the cases structure) then use the dot for an “empty” delimiter, e.g.

04-01-13

$$A = \left\{ \begin{array}{cc} a & b \\ c & d \end{array} \right. \quad \begin{aligned} &\text{\usepackage{delarray}} \\ &\left[ \begin{array}{cc} a & b \\ c & d \end{array} \right] \end{aligned}$$

which is a useful command for a cases structure without the  $\mathcal{AM}$ Smath package, which is described in the  $\mathcal{AM}$ Smath part.

### 4.1.10 `dotseqn`

This package from Donald Arseneau fills the space between the math expression and the equation number with dots. Expect problems when using this package together with  $\mathcal{AM}$ Smath.

```
\usepackage{dotseqn}
\begin{equation} F(x) = \int f(x) \, dx + C \end{equation}
%
\begin{equation} F(x) = \int_1^\infty f(x) \, dx = 1 \end{equation}
```

04-01-14

$$F(x) = \int f(x) \, dx + C \quad \dots \quad (1)$$

$$F(x) = \int_1^\infty f(x) \, dx = 1 \quad \dots \quad (2)$$

### 4.1.11 `empheq`

This package from Morten Høgholm and Lars Madsen supports different frames for math environments of the  $\mathcal{AM}$ Smath package. It doesn't support all the environments from standard L<sup>A</sup>T<sub>E</sub>X which are not modified by  $\mathcal{AM}$ Smath, e.g. `eqnarray`, which shouldn't be used anyway.. With the optional argument of the `empheq` the preferred box type can be specified. A simple one is `\fbox`

04-01-15

$$f(x) = \int_1^\infty \frac{1}{x^2} \, dx = 1 \quad (1)$$

```
\usepackage{empheq}
\begin{empheq}[box=\fbox]{align}
f(x) = \int_1^\infty \frac{1}{x^2} \, dx = 1
\end{empheq}
```

The same is possible with the macro `\colorbox`:

04-01-16

$$f(x) = \int_1^\infty \frac{1}{x^2} \, dx = 1 \quad (1)$$

```
\usepackage{empheq,xcolor}
\begin{empheq}[box={\colorbox{yellow}}]{align}
f(x) = \int_1^\infty \frac{1}{x^2} \, dx = 1
\end{empheq}
```

The key box can hold any possible L<sup>A</sup>T<sub>E</sub>X command sequence. Boxing sub-equations is also no problem, the environment `empheq` works in the same way:

$$f(x) = \int_1^{\infty} \frac{1}{x^1} dx = 1$$

$$f(x) = \int_2^{\infty} \frac{1}{x^2} dx = 0.25$$

(1a)

(1b)

```
\usepackage{empheq,xcolor}
\begin{subequations}
\begin{empheq}[box={\fboxsep=10pt%
\colorbox{cyan}}]{align}
f(x) &= \int_1^{\infty} \frac{1}{x^1} dx = 1 \\
f(x) &= \int_2^{\infty} \frac{1}{x^2} dx = 0.25
\end{empheq}
\end{subequations}
```

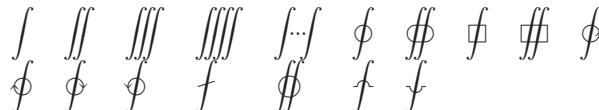
04-01-17

For more information on `empheq` package have a look at the documentation of the package which is available at any CTAN server.

### 4.1.12 esint

The package `esint` from Eddie Saudrais is a very useful if you want nice double or triple integral or curve integral symbols. The ones from the `wasysym` package are not the best. `esint` supports the following symbols:

```
\usepackage[T1]{fontenc} \usepackage{array,esint}
\begin{tabular}{*{10}{>{$\displaystyle l<{$}}}}
\int & \iint & \iiint & \iiiint & \dotsint & \oint & \ointclockwise & \ointccw & \varoint & \varointclockwise \\
\int & \iint & \iiint & \iiiint & \dotsint & \oint & \ointclockwise & \ointccw & \varoint & \varointclockwise
\end{tabular}
```



04-01-18

### 4.1.13 eucal and euscript

These packages from the American Mathematical Society should be part of your local TeX installation, because they come with the `AMSmath` packages. They do both the same, supporting a scriptwriting of only uppercase letters:

```
ABCDEFHIJKLMNOPQRSTUVWXYZ \usepackage[T1]{fontenc}
\usepackage[mathscr]{eucal}
```

04-01-19

```
$\mathscr{ABCDEFHIJKLMNOPQRSTUVWXYZ}$
```

Read the documentation for the interdependence to the `\mathcal` command. For the above example the package `eucal` was loaded with the option `mathscr` which defines only the macro name, in this case `\mathscr`. Another option maybe `mathcal` which defines the macro name `\mathcal`.

### 4.1.14 exscale

The package `exscale` from Frank Mittelbach and Rainer Schöpf supports scaling of math symbols. The following formula is written with the default fontsize where everything looks more or less well:

```
\[
\int_{-1}^{+1} \frac{f(x)}{\sqrt{1-x^2}} dx \approx \frac{\pi}{n}
\sum_{i=1}^n f\left(\cos\left(\frac{2i-1}{2n}\right)\right)
\]
```

04-01-20

$$\int_{-1}^{+1} \frac{f(x)}{\sqrt{1-x^2}} dx \approx \frac{\pi}{n} \sum_{i=1}^n f\left(\cos\left(\frac{2i-1}{2n}\right)\right)$$

Writing the same with the fontsize `\huge` gives a surprising result, which belongs to the historical development of L<sup>A</sup>T<sub>E</sub>X, the `\int` and `\sum` symbols are not stretched.

```
\huge
\[
\int_{-1}^{+1} \frac{f(x)}{\sqrt{1-x^2}} dx \approx \frac{\pi}{n} \sum_{i=1}^n f\left(\cos\left(\frac{2i-1}{2n}\right)\right)
\]
```

04-01-21

$$\int_{-1}^{+1} \frac{f(x)}{\sqrt{1-x^2}} dx \approx \frac{\pi}{n} \sum_{i=1}^n f\left(\cos\left(\frac{2i-1}{2n}\right)\right)$$

This extreme fontsize is often needed for slides and not only written “just for fun”. Using the `exscale` package all symbols get the right size.

```
\usepackage{exscale}
\huge
\[
\int_{-1}^{+1} \frac{f(x)}{\sqrt{1-x^2}} dx \approx \frac{\pi}{n} \sum_{i=1}^n f\left(\cos\left(\frac{2i-1}{2n}\right)\right)
\]
```

04-01-22

$$\int_{-1}^{+1} \frac{f(x)}{\sqrt{1-x^2}} dx \approx \frac{\pi}{n} \sum_{i=1}^n f\left(\cos\left(\frac{2i-1}{2n}\right)\right)$$

## 4.1.15 mathtools

This package from Morten Høgholm and Lars Madsen comes with a lot of additional features for typesetting math code. Sometimes it is useful when only such equations are numbered which are referenced in the text. This is possible with the switch `showonlyrefs`.

Matrices are set by default with a centered horizontal alignment, which is often not the best way. The `mathtools` package provides a starred version of the matrix environments which allow an optional argument for the horizontal alignment:

$$\begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & -1 \\ 1 & -1 & 0 \\ -11 & 11 & -11 \end{pmatrix}$$

04-01-23

```
\usepackage{mathtools}
\[
\begin{pmatrix*}[r]
1 & -1 & 0 \\
-1 & 1 & -1 \\
1 & -1 & 0 \\
-11 & 11 & -11
\end{pmatrix*}
\]
```

`mathtools` also provides some more environments for setting equations. Very interesting is the environment `lgathered`, which allows to typeset a formula in the following way:

$$\begin{aligned} x &= a + b + c \\ d + e + f + g + h \\ i + j + k \end{aligned} \tag{1}$$

```
\usepackage{mathtools}
\begin{aligned}
x &\equiv \\
&\begin{lgathered}[t]
a + b + c \\
d + e + \\
&\!\!\begin{gathered}[t]
f + g + h \\
i + j + k
\end{gathered}
\end{lgathered}
\end{aligned}
```

04-01-24

The `\!` revokes the internal horizontal space in front of the `gathered`.

#### 4.1.16 nicefrac

Typesetting fractions in the inline mode is often a bad choice, the vertical spacing increases in fact of the fraction. The `nicefrac` package from Axel Reichert defines the macro `\nicefrac`, which is used in the same way as the `\frac` command, but it typesets the fraction with a less height:

A fraction like  $\frac{2}{3}$  or  $\frac{12}{117}$  looks nice.

```
\usepackage{nicefrac}
```

A fraction like `\nicefrac{2}{3}` or `\nicefrac{12}{117}` looks nice.

04-01-25

The package is part of the `units` package bundle.

#### 4.1.17 relsize

Often consecutives math operators are used, like two sum symbols, e.g.

$$\sum_{i=1}^n \sum_{i=1}^n i^2$$

```
\[ \sum_{i=1}^n \sum_{i=1}^n i^2 ]
```

04-01-26

As seen the sums are of the same size. To increase the first operator size, someone can use the `\scalebox` macro from package `graphicx` and write an own macro:

$$\sum_{j=1}^{\infty} \sum_{i=1}^{\infty} i$$

```
\usepackage{graphicx}
\def\Sum{\ensuremath{\mathop{\%}}
\scalebox{1.2}{$\displaystyle\sum$}}}
```

04-01-27

```
\[ \Sum_{j=1}^{\infty} \sum_{i=1}^{\infty} i ]
```

Another solution is to use the `relsize` package from Matt Swift and Donald Arseneau together with the `exscale` one. `relsize` defines a useful macro `\mathlarger`. However, you need at least a scalable font:

$$\sum_{i=1}^n i^2 \quad \sum_{i=1}^n i^2$$

```
\usepackage[T1]{fontenc}
\usepackage{mathpazo}
\usepackage{relsize}
```

04-01-28

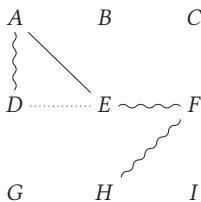
```
\[ \sum_{i=1}^n i^2 \quad
\mathlarger{\sum_{i=1}^n i^2} ]
```

### 4.1.18 xy

The `\xymatrix` macro is part of the `xy` package from Kristoffer Rose and Ross Moore which can be loaded with several options which are not so important here.<sup>1</sup>.

```
\usepackage{all}{xy}
\xymatrix{A\POS[];[d]**\dir{~},[],[dr]**\dir{-} & B & C\\
D & E\POS[];[l]**\dir{.},[],[r]**\dir{-} & F\POS[];[dl]**\dir{~}\\
G & H & I}
```

04-01-29




---

<sup>1</sup> For more information look at the package documentation or the package `xy` itself, which is often saved in `/usr/share/texmf/tex/generic` or simply run the command `texdoc xy-pic`



# Chapter 5

## Math fonts

5.1 Mathematical fonts for pdf $\text{\LaTeX}$ . . . . .	99
5.2 Mathematical fonts for Xe $\text{\LaTeX}$ /Lua $\text{\LaTeX}$ . . . . .	105

Typesetting text and math is far different. There exist a lot of free text fonts without additional math characters. This is the reason why we have to buy a commercial math font, e. g. Palatino (*pamath*) or Helvetica (*hvmath*), or to combine the free text font with another free math font.

### 5.1 Mathematical fonts for pdf $\text{\LaTeX}$

Name	page	Name	page
Computer Roman	100	Latin Modern Roman	100
Mathpazo	101	newpx	101
Antykwa Torunska	103	Kepler fonts	102
Times mit CM	103	Kerkis	104
Iwona	104	CMbright	102

Table 5.1: Some possible combination of math and text fonts

It will always be a good idea to load the package *fontenc* for a proper font encoding:

```
\usepackage[T1]{fontenc}
```

If you have another configuration of font a setting and would like to share it then drop me a line with your preamble setting.

### 5.1.1 Computer modern

This is the default font, designed by Knuth. For the PDF output the Type 1 fonts `cm-super` were used. For MiK $\text{\TeX}$  the `cm-super` font files are not installed by default.

---

**Theorem 1 (Residue Theorem).** Let  $f$  be analytic in the region  $G$  except for the isolated singularities  $a_1, a_2, \dots, a_m$ . If  $\gamma$  is a closed rectifiable curve in  $G$  which does not pass through any of the points  $a_k$  and if  $\gamma \approx 0$  in  $G$  then

$$\operatorname{Res}_{z=a} f(z) = \operatorname{Res}_a f = \frac{1}{2\pi i} \int_C f(z) dz,$$

where  $C \subset D \setminus \{a\}$  is a closed line  $n(C, a) = 1$  (e. g. a counterclockwise circle loop).

ΑΛΔΝΒCDΣΕFFΓGHΙJKLMNOΘΩΡΦΠΞQRSTUVWXYYΨΖ ABCDabcd1234

ααbβcδdδeeεfξξgγhħuijkklλmnηθϑoσςφφρρqrsττπuμνvvwωω

$$xyz\infty \propto \emptyset y = f(x) \quad \sum \prod \int \sum \sum_a^b \int_a^b \prod_a^b \sum_a^b \int_a^b \prod_a^b$$


---

### 5.1.2 Latin modern

This is the new designed font which comes with an own Type 1 version. `cm-super` is no more needed.

```
\usepackage[T1]{fontenc}
\usepackage{lmodern}
```

---

**Theorem 1 (Residue Theorem).** Let  $f$  be analytic in the region  $G$  except for the isolated singularities  $a_1, a_2, \dots, a_m$ . If  $\gamma$  is a closed rectifiable curve in  $G$  which does not pass through any of the points  $a_k$  and if  $\gamma \approx 0$  in  $G$  then

$$\operatorname{Res}_{z=a} f(z) = \operatorname{Res}_a f = \frac{1}{2\pi i} \int_C f(z) dz,$$

where  $C \subset D \setminus \{a\}$  is a closed line  $n(C, a) = 1$  (e. g. a counterclockwise circle loop).

ΑΛΔΝΒCDΣΕFFΓGHΙJKLMNOΘΩΡΦΠΞQRSTUVWXYYΨΖ ABCDabcd1234

ααbβcδdδeeεfξξgγhħuijkklλmnηθϑoσςφφρρqrsττπuμνvvwωω

$$xyz\infty \propto \emptyset y = f(x) \quad \sum \prod \int \sum \sum_a^b \int_a^b \prod_a^b \sum_a^b \int_a^b \prod_a^b$$


---

### 5.1.3 Palatino with CM

```
\usepackage[T1]{fontenc}
\usepackage{mathpazo}
```

---

**Theorem 1 (Residue Theorem).** Let  $f$  be analytic in the region  $G$  except for the isolated singularities  $a_1, a_2, \dots, a_m$ . If  $\gamma$  is a closed rectifiable curve in  $G$  which does not pass through any of the points  $a_k$  and if  $\gamma \approx 0$  in  $G$  then

$$\operatorname{Res}_{z=a} f(z) = \operatorname{Res}_a f = \frac{1}{2\pi i} \int_C f(z) dz,$$

where  $C \subset D \setminus \{a\}$  is a closed line  $n(C, a) = 1$  (e.g. a counterclockwise circle loop).

AΛΔ∇BCDΣΕFFGHIJKLMNOPΘΩΡΦΠΞQRSTUVWXYYΨΖ ABCDabcd1234  
ααββcδdδeeεfζξgγhhiijkllλmηθθoσςφφφρρqrstτπιμνννwωω

$$xyz\infty \propto \emptyset y = f(x) \quad \Sigma \int \prod \sum \sum_a^b \int_a^b \prod_a^b \sum_a^b \int_a^b \prod_a^b$$


---

The package `newpx` from Michael Sharpe also uses TeX Gyre Pagella for the test.

```
\usepackage[T1]{fontenc}
\usepackage{newpxmath}
\usepackage{newpxtext}
```

---

**Theorem 1 (Residue Theorem).** Let  $f$  be analytic in the region  $G$  except for the isolated singularities  $a_1, a_2, \dots, a_m$ . If  $\gamma$  is a closed rectifiable curve in  $G$  which does not pass through any of the points  $a_k$  and if  $\gamma \approx 0$  in  $G$  then

$$\operatorname{Res}_{z=a} f(z) = \operatorname{Res}_a f = \frac{1}{2\pi i} \int_C f(z) dz,$$

where  $C \subset D \setminus \{a\}$  is a closed line  $n(C, a) = 1$  (e.g. a counterclockwise circle loop).

AΛΔ∇BCDΣΕFFGHIJKLMNOPΘΩΡΦΠΞQRSTUVWXYYΨΖ ABCDabcd1234  
ααββcδdδeeεfζξgγhhiijkllλmηθθoσςφφφρρqrstτπιμνννwωω

$$xyz\infty \propto \emptyset y = f(x) \quad \Sigma \int \prod \sum \sum_a^b \int_a^b \prod_a^b \sum_a^b \int_a^b \prod_a^b$$


---

### 5.1.4 Keplerfonts

```
\usepackage[T1]{fontenc}
\usepackage{kpfonts}
```

**Theorem 1 (Residue Theorem).** Let  $f$  be analytic in the region  $G$  except for the isolated singularities  $a_1, a_2, \dots, a_m$ . If  $\gamma$  is a closed rectifiable curve in  $G$  which does not pass through any of the points  $a_k$  and if  $\gamma \approx 0$  in  $G$  then

$$\operatorname{Res}_{z=a} f(z) = \operatorname{Res}_a f = \frac{1}{2\pi i} \int_C f(z) dz,$$

where  $C \subset D \setminus \{a\}$  is a closed line  $n(C, a) = 1$  (e.g. a counterclockwise circle loop).

AΛΔ∇BCDΣΕFΓGHΙJKLMNOΘΩΡΦΠΞQRSTUVWXYYΨΖ ABCDabcd1234  
 $aαbβcδdδeεfζξgγhhiijjkκlλmηθδoσcφφρρρqrstτπuμvνvωω$

$xyz∞ ∝ ∅y = f(x)$

$$\sum \int \prod \int \sum \sum_a^b \int_a^b \prod_a^b \sum_a^b \int_a^b \prod_a^b$$

### 5.1.5 CMbright

```
\usepackage[T1]{fontenc}
\usepackage{cmbright}
```

**Theorem 1 (Residue Theorem).** Let  $f$  be analytic in the region  $G$  except for the isolated singularities  $a_1, a_2, \dots, a_m$ . If  $\gamma$  is a closed rectifiable curve in  $G$  which does not pass through any of the points  $a_k$  and if  $\gamma \approx 0$  in  $G$  then

$$\operatorname{Res}_{z=a} f(z) = \operatorname{Res}_a f = \frac{1}{2\pi i} \int_C f(z) dz,$$

where  $C \subset D \setminus \{a\}$  is a closed line  $n(C, a) = 1$  (e.g. a counterclockwise circle loop).

AΛΔ∇BCDΣΕFΓGHΙJKLMNOΘΩΡΦΠΞQRSTUVWXYYΨΖ ABCDabcd1234

$aαbβcδdδeεfζξgγhhiijjkκlλmηθδoσcφφρρρqrstτπuμvνvωω$

$xyz∞ ∝ ∅y = f(x)$

$$\sum \int \prod \int \sum \sum_a^b \int_a^b \prod_a^b \sum_a^b \int_a^b \prod_a^b$$

## 5.1.6 Times with CM

```
\usepackage[T1]{fontenc}
\usepackage[math]{mathptmx}
```

---

**Theorem 1 (Residue Theorem).** Let  $f$  be analytic in the region  $G$  except for the isolated singularities  $a_1, a_2, \dots, a_m$ . If  $\gamma$  is a closed rectifiable curve in  $G$  which does not pass through any of the points  $a_k$  and if  $\gamma \approx 0$  in  $G$  then

$$\underset{z=a}{\operatorname{Res}} f(z) = \underset{a}{\operatorname{Res}} f = \frac{1}{2\pi i} \int_C f(z) dz,$$

where  $C \subset D \setminus \{a\}$  is a closed line  $n(C, a) = 1$  (e. g. a counterclockwise circle loop).

AΛΔ∇BCDΣΕFΓGHΙJKLMΝΟΘΩΡΦΠΞQRSTUVWXYYΨΖ ABCDabcd1234

$aab\beta c\partial d\delta e\epsilon f\zeta\xi g\gamma h\hbar i\imath jk\ell\lambda m\eta\theta\vartheta o\sigma\varsigma\phi\wp\wp\wp qrs t\tau\pi u\mu\nu\nu w\omega\varpi$

$xyz\infty \propto \emptyset y = f(x)$

$$\Sigma \int \prod \sum \Sigma_a^b \int_a^b \prod_a^b \sum_a^b \int_a^b \prod_a^b$$


---

## 5.1.7 Antykwa Toruńska

The package `anttor` from Marcin Woliński supports the fonts made by Janusz M. Nowacki.

```
\usepackage[T1]{fontenc}
\usepackage[math]{anttor}
```

---

**Theorem 1 (Residue Theorem).** Let  $f$  be analytic in the region  $G$  except for the isolated singularities  $a_1, a_2, \dots, a_m$ . If  $\gamma$  is a closed rectifiable curve in  $G$  which does not pass through any of the points  $a_k$  and if  $\gamma \approx 0$  in  $G$  then

$$\underset{z=a}{\operatorname{Res}} f(z) = \underset{a}{\operatorname{Res}} f = \frac{1}{2\pi i} \int_C f(z) dz,$$

where  $C \subset D \setminus \{a\}$  is a closed line  $n(C, a) = 1$  (e. g. a counterclockwise circle loop).

AΛΔ∇BCDΣΕFΓGHΙJKLMΝΟΘΩΡΦΠΞQRSTUVWXYYΨΖ ABCDabcd1234

$aab\beta c\partial d\delta e\epsilon f\zeta\xi g\gamma h\hbar i\imath jk\ell\lambda m\eta\theta\vartheta o\sigma\varsigma\phi\wp\wp\wp qrs t\tau\pi u\mu\nu\nu w\omega\varpi$

$xyz\infty \propto \emptyset y = f(x)$

$$\Sigma \int \prod \sum \Sigma_a^b \int_a^b \prod_a^b \sum_a^b \int_a^b \prod_a^b$$


---

### 5.1.8 Iwona

```
\usepackage[T1]{fontenc}
\usepackage[math]{iwona}
```

**Theorem 1 (Residue Theorem).** Let  $f$  be analytic in the region  $G$  except for the isolated singularities  $a_1, a_2, \dots, a_m$ . If  $\gamma$  is a closed rectifiable curve in  $G$  which does not pass through any of the points  $a_k$  and if  $\gamma \approx 0$  in  $G$  then

$$\operatorname{Res}_{z=a} f(z) = \operatorname{Res}_a f = \frac{1}{2\pi i} \int_C f(z) dz,$$

where  $C \subset D \setminus \{a\}$  is a closed line  $n(C, a) = 1$  (e.g. a counterclockwise circle loop).

AΛΔ∇BCDΣΕFFГHIJKLMNOΘΩΡΦΠΞQRSTUVWXYYΨΖ ABCDabcd1234  
 $a\alpha b\beta c\partial d\delta e\epsilon f\zeta g\gamma h\hbar i\imath j\kappa\ell\lambda m\eta\theta\vartheta o\sigma\varsigma\phi\wp p\rho q\varrho r s t\tau\pi u\mu v\nu w\omega\varpi$

$$xyz\infty \propto \emptyset y = f(x) \quad \sum \int \prod \int \sum \sum_a^b \int_a^b \prod_a^b \sum_a^b \int_a^b \prod_a^b$$

### 5.1.9 Kerkis

```
\usepackage[T1]{fontenc}
\usepackage[math]{kerkis}
```

**Theorem 1 (Residue Theorem).** Let  $f$  be analytic in the region  $G$  except for the isolated singularities  $a_1, a_2, \dots, a_m$ . If  $\gamma$  is a closed rectifiable curve in  $G$  which does not pass through any of the points  $a_k$  and if  $\gamma \approx 0$  in  $G$  then

$$\operatorname{Res}_{z=a} f(z) = \operatorname{Res}_a f = \frac{1}{2\pi i} \int_C f(z) dz,$$

where  $C \subset D \setminus \{a\}$  is a closed line  $n(C, a) = 1$  (e.g. a counterclockwise circle loop).

AΛΔ∇BCDΣΕFFГHIJKLMNOΘΩΡΦΠΞQRSTUVWXYYΨΖ ABCDabcd1234  
 $aab\beta c\partial d\delta ee\epsilon f\zeta g\gamma h\hbar i\imath j\kappa\ell\lambda m\eta\theta\vartheta o\sigma\varsigma\phi\wp p\rho q\varrho r s t\tau\pi u\mu v\nu w\omega\varpi$

$$xyz\infty \propto \emptyset y = f(x) \quad \sum \int \prod \int \sum \sum_a^b \int_a^b \prod_a^b \sum_a^b \int_a^b \prod_a^b$$

## 5.2 Mathematical fonts for X<sub>E</sub>T<sub>E</sub>X/Lua<sub>L</sub>T<sub>E</sub>X

With the new T<sub>E</sub>X-engines X<sub>E</sub>T<sub>E</sub>X and Lua<sub>L</sub>T<sub>E</sub>X all available OpenType fonts can be used. There is now no difference between system fonts or special T<sub>E</sub>X fonts; both can be used. For math fonts we *always* load the package `unicode-math` from Will Robertson, Philipp Stephani and Khaled Hosny. The following examples were all run with Lua<sub>L</sub>T<sub>E</sub>X!

```
\usepackage{unicode-math}% loads fontspec ny default
\setmathfont[options]{...}
```

<i>Name</i>	<i>page</i>	<i>Name</i>	<i>page</i>
Latin Modern Math	105	TeXGyre Pagella	106
TeXGyre Termes	107	TeXGyre Bonum	107
TeXGyre DejaVu	108	XITS Math	108
Asana Math	109	Libertinus Math	109

Table 5.2: Some possible combination of OpenType math and text fonts

### 5.2.1 Latin modern math

The text font Latin Modern is the default if no other text font is defined.

```
\usepackage{unicode-math}
\setmathfont{Latin Modern Math}
```

**Theorem 1 (Residue Theorem).** Let  $f$  be analytic in the region  $G$  except for the isolated singularities  $a_1, a_2, \dots, a_m$ . If  $\gamma$  is a closed rectifiable curve in  $G$  which does not pass through any of the points  $a_k$  and if  $\gamma \approx 0$  in  $G$  then

$$\operatorname{Res}_{z=a} f(z) = \operatorname{Res}_a f = \frac{1}{2\pi i} \int_C f(z) dz,$$

where  $C \subset D \setminus \{a\}$  is a closed line  $n(C, a) = 1$  (e.g. a counterclockwise circle loop).

AΛΔ∇BCDΣΕFFGHIJKLMNOPΘΩΡΦΠΞQRSTUVWXYZΥΨΖ ABCDabcd1234  
 $aαbβcδdδeεfζξgγhħiivjkklλmnηθθoσςφφρρqqrstτπυμυυwωwω$

$$xyz\infty \propto \emptyset y = f(x) \quad \sum \int \prod \sum \sum_a^b \int_a^b \prod_a^b \sum_a^b \int_a^b \prod_a^b$$

## 5.2.2 TeX Gyre Pagella

```
\usepackage{unicode-math}
\setmainfont{TeX Gyre Pagella}
\setmathfont{TeX Gyre Pagella Math}
```

**Theorem 1 (Residue Theorem).** Let  $f$  be analytic in the region  $G$  except for the isolated singularities  $a_1, a_2, \dots, a_m$ . If  $\gamma$  is a closed rectifiable curve in  $G$  which does not pass through any of the points  $a_k$  and if  $\gamma \approx 0$  in  $G$  then

$$\underset{z=a}{\text{Res}} f(z) = \underset{a}{\text{Res}} f = \frac{1}{2\pi i} \int_C f(z) dz,$$

where  $C \subset D \setminus \{a\}$  is a closed line  $n(C, a) = 1$  (e.g. a counterclockwise circle loop).

ΑΛΔΔΒCDΣΕFΓGHΙJKLMΝΟΘΩΡΦΠΞQRSTUVWXYYΨΖ ABCDabcd1234  
ααbβcδdεeεfζξγγhhiijkkllλmnηθδoσςφφφρρqqrstτπuμνννwωω

$$xyz\infty \propto \emptyset y = f(x) \quad \sum \prod \prod \int \sum \sum_a^b f_a^b \prod_a^b \sum_a^b \int_a^b \prod_a^b$$

## 5.2.3 TeX Gyre Schola

```
\usepackage{unicode-math}
\setmainfont{TeX Gyre Schola}
\setmathfont{TeX Gyre Schola Math}
```

**Theorem 1 (Residue Theorem).** Let  $f$  be analytic in the region  $G$  except for the isolated singularities  $a_1, a_2, \dots, a_m$ . If  $\gamma$  is a closed rectifiable curve in  $G$  which does not pass through any of the points  $a_k$  and if  $\gamma \approx 0$  in  $G$  then

$$\underset{z=a}{\text{Res}} f(z) = \underset{a}{\text{Res}} f = \frac{1}{2\pi i} \int_C f(z) dz,$$

where  $C \subset D \setminus \{a\}$  is a closed line  $n(C, a) = 1$  (e.g. a counterclockwise circle loop).

ΑΛΔΔΒCDΣΕFΓGHΙJKLMΝΟΘΩΡΦΠΞQRSTUVWXΥΤΨΖ ABCDabcd1234  
ααbβcδdεeεfζξγγhhiijkkllλmnηθδoσςφφφρρqqrstτπuμνννwωω

$$xyz\infty \propto \emptyset y = f(x) \quad \sum \prod \prod \int \sum \sum_a^b f_a^b \prod_a^b \sum_a^b \int_a^b \prod_a^b$$

## 5.2.4 TeX Gyre Termes

```
\usepackage{unicode-math}
\setmainfont{TeX Gyre Termes}
\setmathfont{TeX Gyre Termes Math}
```

---

**Theorem 1 (Residue Theorem).** Let  $f$  be analytic in the region  $G$  except for the isolated singularities  $a_1, a_2, \dots, a_m$ . If  $\gamma$  is a closed rectifiable curve in  $G$  which does not pass through any of the points  $a_k$  and if  $\gamma \approx 0$  in  $G$  then

$$\underset{z=a}{\operatorname{Res}} f(z) = \underset{a}{\operatorname{Res}} f = \frac{1}{2\pi i} \int_C f(z) dz,$$

where  $C \subset D \setminus \{a\}$  is a closed line  $n(C, a) = 1$  (e. g. a counterclockwise circle loop).

AΛΔ∇BCDΣΕFΓGHIJKLMNOΘΩΡΦΠΞQRSTUVWXYZΨΖABCDabcd1234  
 $aab\beta c\partial d\delta ee\epsilon f\zeta\xi g\gamma h\hbar i\imath jk\kappa\ell\lambda m\eta\theta\vartheta o\sigma\varsigma\phi\varphi\rho qrs t\tau\pi u\mu v\nu w\omega\varpi$   
 $xyz\infty\propto\emptyset y=f(x)$

$$\Sigma \int \prod \int \sum \sum_a^b \int_a^b \prod_a^b \sum_a^b \int_a^b \prod_a^b$$


---

## 5.2.5 TeX Gyre Bonum

```
\usepackage{unicode-math}
\setmainfont{TeX Gyre Bonum}
\setmathfont{TeX Gyre Bonum Math}
```

---

**Theorem 1 (Residue Theorem).** Let  $f$  be analytic in the region  $G$  except for the isolated singularities  $a_1, a_2, \dots, a_m$ . If  $\gamma$  is a closed rectifiable curve in  $G$  which does not pass through any of the points  $a_k$  and if  $\gamma \approx 0$  in  $G$  then

$$\underset{z=a}{\operatorname{Res}} f(z) = \underset{a}{\operatorname{Res}} f = \frac{1}{2\pi i} \int_C f(z) dz,$$

where  $C \subset D \setminus \{a\}$  is a closed line  $n(C, a) = 1$  (e. g. a counterclockwise circle loop).

AΛΔ∇BCDΣΕFΓGHIJKLMNOΘΩΡΦΠΞQRSTUVWXYZΨΖABCDabcd1234  
 $aab\beta c\partial d\delta ee\epsilon f\zeta\xi g\gamma h\hbar i\imath jk\kappa\ell\lambda m\eta\theta\vartheta o\sigma\varsigma\phi\varphi\rho qrs t\tau\pi u\mu v\nu w\omega\varpi$   
 $xyz\infty\propto\emptyset y=f(x)$

$$\Sigma \int \prod \int \sum \sum_a^b \int_a^b \prod_a^b \sum_a^b \int_a^b \prod_a^b$$


---

## 5.2.6 TeX Gyre DejaVu

```
\usepackage{unicode-math}
\setmainfont[Scale=0.9]{DejaVu Serif}
\setsansfont[Scale=0.9]{DejaVu Sans}
\setmathfont[Scale=MatchUppercase]{TeX Gyre DejaVu Math}
```

---

**Theorem 1 (Residue Theorem).** Let  $f$  be analytic in the region  $G$  except for the isolated singularities  $a_1, a_2, \dots, a_m$ . If  $\gamma$  is a closed rectifiable curve in  $G$  which does not pass through any of the points  $a_k$  and if  $\gamma \approx 0$  in  $G$  then

$$\underset{z=a}{\operatorname{Res}} f(z) = \underset{a}{\operatorname{Res}} f = \frac{1}{2\pi i} \int_C f(z) dz,$$

where  $C \subset D \setminus \{a\}$  is a closed line  $n(C, a) = 1$  (e.g. a counterclockwise circle loop).

$$\begin{aligned} & \text{ΑΛΔΝΒCDΣΕFFΓGHIJΚLMNOΘΩΡΦΠΞQRSTUVWXYYΨΖABCDAbcd1234} \\ & aαbβcδdδeeεfζξgγhħiiijkklλmnηθθoσcφφρρρqrstτπιμυνυwωω \\ & xyz∞ ∝ φy = f(x) \quad \sum \prod \int \sum \sum_a^b \int_a^b \Pi_a^b \sum_a^b \int_a^b \prod_a^b \end{aligned}$$


---

## 5.2.7 XITS Math

```
\usepackage{unicode-math}
\setmainfont{XITS}
\setsansfont[Scale=MatchUppercase]{TeX Gyre Heros}
\setmathfont{XITS Math}
```

---

**Theorem 1 (Residue Theorem).** Let  $f$  be analytic in the region  $G$  except for the isolated singularities  $a_1, a_2, \dots, a_m$ . If  $\gamma$  is a closed rectifiable curve in  $G$  which does not pass through any of the points  $a_k$  and if  $\gamma \approx 0$  in  $G$  then

$$\underset{z=a}{\operatorname{Res}} f(z) = \underset{a}{\operatorname{Res}} f = \frac{1}{2\pi i} \int_C f(z) dz,$$

where  $C \subset D \setminus \{a\}$  is a closed line  $n(C, a) = 1$  (e.g. a counterclockwise circle loop).

$$\begin{aligned} & \text{ΑΛΔΝΒCDΣΕFFΓGHIJΚLMNOΘΩΡΦΠΞQRSTUVWXYYΨΖABCDAbcd1234} \\ & aαbβcδdδeeεfζξgγhħiiijkklλmnηθθoσcφφρρρqrstτπιμυνυwωω \\ & xyz∞ ∝ φy = f(x) \quad \sum \prod \int \sum \sum_a^b \int_a^b \Pi_a^b \sum_a^b \int_a^b \prod_a^b \end{aligned}$$


---

## 5.2.8 Asana Math

```
\usepackage{unicode-math}
\setmainfont[TeX Gyre Termes]
\setsansfont[Scale=MatchUppercase]{TeX Gyre Heros}
\setmathfont{Asana Math}
```

---

**Theorem 1 (Residue Theorem).** Let  $f$  be analytic in the region  $G$  except for the isolated singularities  $a_1, a_2, \dots, a_m$ . If  $\gamma$  is a closed rectifiable curve in  $G$  which does not pass through any of the points  $a_k$  and if  $\gamma \approx 0$  in  $G$  then

$$\operatorname{Res}_{z=a} f(z) = \operatorname{Res}_a f = \frac{1}{2\pi i} \int_C f(z) dz,$$

where  $C \subset D \setminus \{a\}$  is a closed line  $n(C, a) = 1$  (e. g. a counterclockwise circle loop).

ΑΛΔΒCDΣΕΓΓHIJKLMΝΟΘΩΡΦΠΞQRSTUVWXYYΨΖ ABCDabcd1234  
ααbβcδdδeeεfζξgyhhiijjkllλmnηθδoσcφφρρqrsstτπuμvννwωω

$$xyz\infty \propto \emptyset y = f(x) \quad \Sigma \int \prod \sum \Sigma_a^b \int_a^b \Pi_a^b \sum_a^b \int_a^b \prod_a^b$$


---

## 5.2.9 Libertinus Math

```
\usepackage{unicode-math}
\setmainfont{Libertinus}
\setsansfont[Scale=MatchUppercase]{Libertinus Sans}
\setmathfont{Libertinus Math}
```

---

**Theorem 1 (Residue Theorem).** Let  $f$  be analytic in the region  $G$  except for the isolated singularities  $a_1, a_2, \dots, a_m$ . If  $\gamma$  is a closed rectifiable curve in  $G$  which does not pass through any of the points  $a_k$  and if  $\gamma \approx 0$  in  $G$  then

$$\operatorname{Res}_{z=a} f(z) = \operatorname{Res}_a f = \frac{1}{2\pi i} \int_C f(z) dz,$$

where  $C \subset D \setminus \{a\}$  is a closed line  $n(C, a) = 1$  (e. g. a counterclockwise circle loop).

ΑΛΔΒCDΣΕΓΓHIJKLMΝΟΘΩΡΦΠΞQRSTUVWXYYΨΖ ABCDabcd1234  
ααbβcδdδeeεfζξgyhhiijjkllλmnηθδoσcφφρρqrsstτπuμvννwωω

$$xyz\infty \propto \emptyset y = f(x) \quad \Sigma \int \prod \sum \Sigma_a^b \int_a^b \Pi_a^b \sum_a^b \int_a^b \prod_a^b$$


---



# Chapter 6

## Special symbols

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In this section only those symbols are defined, which are not part of the list of all available symbols: [CTAN://info/symbols/comprehensive/symbols-a4.pdf](http://CTAN://info/symbols/comprehensive/symbols-a4.pdf). With `fontmath.ltx` L<sup>A</sup>T<sub>E</sub>X itself defines the following special symbols for using inside math:

Name	Meaning	Table 6.1: Predefined math symbols from fontmath.ltx
<code>\mathparagraph</code>	¶	
<code>\mathsection</code>	§	
<code>\mathdollar</code>	\$	
<code>\mathsterling</code>	£	
<code>\mathunderscore</code>	-	
<code>\mathellipsis</code>	...	

### 6.1 Integral symbols

Here are some more integral symbols. For all new symbols limits can be used in the usual way:

```
\def\Xint#1{\mathchoice
  {\XXint\displaystyle{#1}}{\XXint{textstyle{#1}}{\scriptstyle{#1}}{\scriptscriptstyle{#1}}%
   {\XXint\scriptstyle{\scriptscriptstyle{#1}}{\XXint{\scriptscriptstyle{#1}}{\scriptscriptstyle{#1}}{\scriptscriptstyle{#1}}}\!\!{#1}}%
 \def\RotLSymbol#1#2#3{\rotatebox[origin=c]{#1}{$#2$}#3}
 \def\rotcirclearrowleft{\mathpalette{\RotLSymbol{-30}}\circlearrowleft}
```

```
\def\XXint{\int\limits_{\int\limits_0^1}^{\int\limits_{\int\limits_{-\infty}^{\infty}}}\kern-.5\wd0}
\def\ddashint{\Xint= \def\dashint{\Xint-}
\def\clockint{\Xint\circlearrowright} \def\counterint{\Xint\rot\circlearrowleft}
```

```
$\dashint $quad$\ddashint $quad $\clockint$quad$\counterint$
[ $\ddashint_0=\dashint_{-10<\oint \limits_{-\infty}^{\infty}} = \clockint \counterint_A
]
```

$$f \ f \ \not{f} \ \not{f}$$

$$\int_0^1 = \int_1^0 < \oint_{-\infty}^{\infty} = \oint \oint_A$$

06-01-01

## 6.2 Harpoons

$\text{\LaTeX}$  knows no stretchable harpoon symbols, like  $\rightarrowtail$ . The following code defines several harpoon symbols.

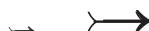
```
\usepackage{amsmath}
\makeatletter
\def\rightharpoonondownfill@{\arrowfill@{\relbar}{\relbar}{\rightharpoonondown}}
\def\rightharpoonupfill@{\arrowfill@{\relbar}{\relbar}{\rightharpoonup}}
\def\leftharpoonondownfill@{\arrowfill@{\leftharpoonondown}{\relbar}{\relbar}}
\def\leftharpoonupfill@{\arrowfill@{\leftharpoonup}{\relbar}{\relbar}}
\newcommand\xrightharpoonondown[2][]{\extarrow 0359\rightharpoonondownfill@{#1}{#2}}
\newcommand\xrightharpoonup[2][]{\extarrow 0359\rightharpoonupfill@{#1}{#2}}
\newcommand\xleftharpoonondown[2][]{\extarrow 3095\leftharpoonondownfill@{#1}{#2}}
\newcommand\xleftharpoonup[2][]{\extarrow 3095\leftharpoonupfill@{#1}{#2}}
\newcommand\xleftrightharpoons[2][]{\mathrel{%
\raise.22ex\hbox{$\extarrow 3095\leftharpoonupfill@{\phantom{#1}}{#2}$}%
\setbox0=\hbox{$\extarrow 0359\rightharpoonondownfill@{#1}{\phantom{#2}}$}%
\kern-\wd0\lower.22ex\box0}%
\newcommand\xrightleftharpoons[2][]{\mathrel{%
\raise.22ex\hbox{$\extarrow 3095\rightharpoonupfill@{\phantom{#1}}{#2}$}%
\setbox0=\hbox{$\extarrow 0359\leftharpoonondownfill@{#1}{\phantom{#2}}$}%
\kern-\wd0\lower.22ex\box0}%
\makeatother
```

$\xrightarrow{\text{over}} \xrightarrow[\text{under}]{\text{over}} \xleftarrow{\text{over}} \xleftarrow[\text{under}]{\text{over}} \xleftrightarrow{\text{over}} \xleftrightarrow[\text{under}]{\text{over}}$

06-02-01

## 6.3 Bijective mapping arrow

This uses the  $\mathrlap$  definition from section 2.11.2 on page 64 or the one from package `mathtools`. With this definition a huge symbol is also possible:



```
\usepackage{mathtools,amssymb}
\def\bijmap{\ensuremath{%
\mathrlap{\rightarrowtail}\!\rightarrow}}
\bijmap \qquad \Huge\bijmap
```

06-03-01

## 6.4 Stacked equal sign

There are several symbols stacked with an equal sign, e.g. `\doteq`, `\equiv` or `\cong` ( $\doteq$ ,  $\equiv$ ,  $\cong$ ). But there are still some missing, which are defined th Example 06-04-01.

06-04-01       $\stackrel{\text{def}}{=}$      $\stackrel{!}{=}$      $\stackrel{\widehat{=}}{=}$

```
\renewcommand\eqdef{\ensuremath{%
  \mathrel{\stackrel{\text{def}}{=}}}}
\renewcommand\eqexcl{\ensuremath{%
  \mathrel{\stackrel{!}{=}}}}
\newcommand\eqhat{\ensuremath{%
  \mathrel{\widehat{=}}}}
\eqdef \quad \eqexcl \quad \eqhat
```

## 6.5 Other symbols

06-05-01       $\approx ABC$

```
\newcommand*\threesim{%
  \mathrel{\vcenter{\offinterlineskip
    \hbox{$\sim$}\vskip-.35ex
    \hbox{$\sim$}\vskip-.35ex\hbox{$\sim$}}}}
\$ \threesim ABC \$
```

06-05-02       $x := y$   $y =: x$

```
\newcommand\Let{\mathrel{%
  \mathop{:}\!\!=}}% Upper case L!
\newcommand\tel{\mathrel{=:}\!\!\mathop{:}\!}
\$ x\Let y \$ y\tel x \$
```



# Chapter 7

## Examples

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### 7.1 Tuning math typesetting

Chapter 18 of the  $\text{\TeX}book$  is named „Fine Points of Mathematics Typing“ Knuth 1986 and it shows on 20 pages some more or less important facts when typesetting mathematical expressions. Often inline formulas contain a punctuation character like a dot, comma, colon, etc.. It is a general rule to write those characters outside the math mode. Compare

07-01-01  $a, b, c, d, e, \text{ and } f$   $\$a, \$b, \$c, \$d, \$e, \text{ and } \$f\$$

$a, b, c, d, e, \text{ and } f$

Having such math as single expressions enables  $\text{\TeX}$  to insert a linebreak at several places (see Section 1.2.6 on page 6).

Writing an ellipses as three single dots, doesn't look very nice, one should always use the  $\text{\ldots}$  command:

07-01-02  $1, \dots, 10$   $\$1, \dots, 10\$$

$1, \dots, 10$

This is correct as long as on the left and right are a comma as a separator. For sums the  $\text{\cdotp}$  command should be used instead:

$$1 + 2 + \dots + 10$$

$$x_n = x_{n-1} = \dots = n_0 = 1$$

```
$1+2+\cdots+10$  
$x_n=x_{n-1}=\cdots=n_0=1$  
\par
```

07-01-03

For a multiplication it is important which character is used, in european countries often a centered dot. In such a case it is appropriate not to use the `\cdots` command for a ellipsis. For typesetting integrals or differential equations it makes sense to define the following short macros:

$$F(x) = \int f(x) dx$$

$$v(t) = \frac{ds}{dt}$$

$$a(t) = \frac{d^2 s}{dt^2}$$

```
\usepackage{amsmath}  
\newcommand*\mathop{\!\mathbf{\cdot}}{\mathop{\cdot}}  
\newcommand*\dst{\,\frac{\mathrm{d}}{\mathrm{d} t}}  
\begin{aligned}  
F(x) &= \int !f(x)\mathop{\cdot} x\\  
v(t) &= \dst\\  
a(t) &= \frac{\mathrm{d}^2 s}{\mathrm{d} t^2}\\  
\end{aligned}
```

07-01-04

$$G(t) = \int_D \dots \int dx dy \dots$$

$$u_C(t) = \int i_C(t) dt$$

```
\usepackage{amsmath}  
\newcommand*\mathop{\!\mathbf{\cdot}}{\mathop{\cdot}}  
\begin{aligned}  
G(t) &= \underbrace{\int !\int \cdots \int}_{D} x \mathop{\cdot} y \mathop{\cdot} \dots\\  
u_C(t) &= \int !i_C(t) \mathop{\cdot} dt\\  
\end{aligned}
```

07-01-05

## 7.2 Matrix

### 7.2.1 Identity matrix

There are several possibilities to write this matrix. Here is a solution with the default array environment.

$$\begin{pmatrix} 1 & & & \\ & 1 & & 0 \\ & & 1 & \\ 0 & & & 1 \end{pmatrix}$$

```
\usepackage{amsmath}  
\[  
\left(   
\begin{array}{cccc}   
1 & & & \\   
& 1 & & 0 \\   
& & 1 & \\   
0 & & & 1 \end{array}   
\right)
```

07-02-01

### 7.2.2 System of linear equations

```
\[  
\begin{array}{l@{\!:\!=\!:@}*{5}{l@{\!:+\!:@}l}}  
y_1 & a_{11}x_1 + a_{12}x_2 + a_{13}x_3 + \dots + a_{1(n-1)}x_{n-1} + a_{1n}x_n \\  
y_2 & a_{21}x_1 + a_{22}x_2 + a_{23}x_3 + \dots + a_{2(n-1)}x_{n-1} + a_{2n}x_n \\  
y_3 & a_{31}x_1 + a_{32}x_2 + a_{33}x_3 + \dots + a_{3(n-1)}x_{n-1} + a_{3n}x_n \\  
y_4 & a_{41}x_1 + a_{42}x_2 + a_{43}x_3 + \dots + a_{4(n-1)}x_{n-1} + a_{4n}x_n \\  
y_5 & a_{51}x_1 + a_{52}x_2 + a_{53}x_3 + \dots + a_{5(n-1)}x_{n-1} + a_{5n}x_n \\  
y_6 & a_{61}x_1 + a_{62}x_2 + a_{63}x_3 + \dots + a_{6(n-1)}x_{n-1} + a_{6n}x_n \\  
y_7 & a_{71}x_1 + a_{72}x_2 + a_{73}x_3 + \dots + a_{7(n-1)}x_{n-1} + a_{7n}x_n \\  
y_8 & a_{81}x_1 + a_{82}x_2 + a_{83}x_3 + \dots + a_{8(n-1)}x_{n-1} + a_{8n}x_n \\  
y_9 & a_{91}x_1 + a_{92}x_2 + a_{93}x_3 + \dots + a_{9(n-1)}x_{n-1} + a_{9n}x_n \\  
y_{10} & a_{101}x_1 + a_{102}x_2 + a_{103}x_3 + \dots + a_{10(n-1)}x_{n-1} + a_{10n}x_n \\  
\end{array}
```

07-02-02

$$\begin{aligned}
 y_1 &= a_{11}x_1 + a_{12}x_2 + a_{13}x_3 + \dots + a_{1(n-1)}x_{n-1} + a_{1n}x_n \\
 y_2 &= a_{21}x_1 + a_{22}x_2 + a_{23}x_3 + \dots + a_{2(n-1)}x_{n-1} + a_{2n}x_n \\
 \vdots &= \vdots + \vdots + \vdots + \vdots + \vdots + \vdots \\
 y_{n-1} &= a_{(n-1)1}x_1 + a_{(n-1)2}x_2 + a_{(n-1)3}x_3 + \dots + a_{(n-1)(n-1)}x_{n-1} + a_{(n-1)n}x_n \\
 y_n &= a_{n1}x_1 + a_{n2}x_2 + a_{n3}x_3 + \dots + a_{(n)(n-1)}x_{n-1} + a_{nn}x_n
 \end{aligned}$$

### 7.2.3 Matrix with comments on top

07-02-03

$  \begin{array}{c}  \text{text1} \\ \downarrow \\ X_x \\ X_y \\ X_z \\ 0  \end{array}  $	$  \begin{array}{c}  \text{text1} \\ \downarrow \\ Y_x \\ Y_y \\ Y_z \\ 0  \end{array}  $	$  \begin{array}{c}  \text{text1} \\ \downarrow \\ Z_x \\ Z_y \\ Z_z \\ 0  \end{array}  $	$  \begin{array}{c}  \text{text1} \\ \downarrow \\ T_x \\ T_y \\ T_z \\ 1  \end{array}  $
---	---	---	---

```

\usepackage{amsmath,graphicx}
\def\rb#1{\rotatebox{90}{$\xleftarrow{\text{#1}}$}}
\begin{tabular}{c}
\begin{matrix}
X_x & Y_x & Z_x & T_x \\
X_y & Y_y & Z_y & T_y \\
X_z & Y_z & Z_z & T_z \\
0 & 0 & 0 & 1
\end{matrix}
\end{tabular}
\begin{bmatrix}
X_x & Y_x & Z_x & T_x \\
X_y & Y_y & Z_y & T_y \\
X_z & Y_z & Z_z & T_z \\
0 & 0 & 0 & 1
\end{bmatrix}
\begin{array}{l}
\backslash usepackage\{amsmath,graphicx\} \\
\backslash def\rb#1{\rotatebox{90}\{$\xleftarrow{\text{\#1}}$\}} \\
\\
\backslash begin\{tabular\}\{c\} \\
\$ \backslash begin\{matrix\} \\
\$ \backslash rb\{\text{text1}\} \& \backslash rb\{\text{text1}\} \& \backslash rb\{\text{text1}\} \& \backslash rb\{\text{text1}\} \\
\$ \backslash end\{matrix\} \$ \\
\$ \backslash begin\{bmatrix\} \\
\$ X\_x \& Y\_x \& Z\_x \& T\_x \\
\$ X\_y \& Y\_y \& Z\_y \& T\_y \\
\$ X\_z \& Y\_z \& Z\_z \& T\_z \\
\$ 0 \& 0 \& 0 \& 1 \\
\$ \backslash end\{bmatrix\} \\
\$ \backslash end\{tabular\}
\end{array}

```

## 7.3 Cases structure

Sometimes it is better to use the array environment instead of amsmath's cases environment. To get optimal horizontal spacing for the conditions, there are two matrixes in series, one  $3 \times 1$  followed by  $3 \times 3$  matrix. To minimize the horizontal space around the variable  $z$  a

```

\begin{equation}
\begin{aligned}
&\backslash begin\{array\}\{lcrcl\} \\
I(z)=&\delta_0\_{0}\left\{\begin{array}{ll}
D+z & -D \leq z \leq -p \\
D-\frac{1}{2}\left(p-\frac{z^2}{p}\right) & -p \leq z \leq p \\
D-z & p \leq z \leq D
\end{array}\right. \\
&\backslash end\{array\}\right.
\end{aligned}
\end{equation}

```

07-03-01

$$I(z) = \delta_0 \begin{cases} D+z & -D \leq z \leq -p \\ D - \frac{1}{2} \left( p - \frac{z^2}{p} \right) & -p \leq z \leq p \\ D-z & p \leq z \leq D \end{cases} \quad (1)$$

The `\phantom` command replaces exactly that place with whitespace which the argument needs.

### 7.3.1 Cases with numbered lines

This is not possible in an easy way, because `cases` uses the array environment for typesetting which has by default no numbering. However, there are some tricky ways to get numbered lines. The following three examples use the `tabular`, the `tabularx` and the `array` environment.

some text here { 
$$\begin{aligned} x &= 2 && \text{if } y > 2 \\ && (1) \\ x &= 3 && \text{if } y \leq 2 \\ && (2) \end{aligned}$$

```
\usepackage{amsmath,bigdelim}
\begin{tabular}{rc}
\ldelim\{\{2\}{2.75cm}[some text here] &
\parbox{\dimexpr\linewidth-3cm-4\tabcolsep}{%
\begin{aligned}
&\vspace*{1ex}
\begin{flalign}
x &= 2\quad\text{if } y > 2 & \\
x &= 3\quad\text{if } y \leq 2 &
\end{aligned}
\end{aligned}
\end{tabular}
```

07-03-02

```
\usepackage{amsmath}
\usepackage{tabularx,bigdelim}

\begin{tabularx}{\linewidth}{rXc}
\ldelim\{\{2\}{2.75cm}[some text here]
& $ x = 2 $\quad\text{if } y > 2 & \refstepcounter{equation}(\theequation) \\
& $ x = 3 $\quad\text{if } y \leq 2 & \refstepcounter{equation}(\theequation)
\end{tabularx}
```

some text here { 
$$\begin{aligned} x &= 2 && \text{if } y > 2 \\ && (1) \\ x &= 3 && \text{if } y \leq 2 \\ && (2) \end{aligned}$$

07-03-03

```
\usepackage{amsmath,bigdelim}

\[
\begin{array}{rc@{\qquad}c}
\begin{array}{l}
\ldelim\{\{2\}{2.75cm}[some text here] \quad \text{--- Martin ---} \\
& \& x = 2\quad\text{if } y > 2 & \refstepcounter{equation}(\theequation) \\
& \& x = 3\quad\text{if } y \leq 2 & \refstepcounter{equation}(\theequation)
\end{array}
\end{array}
```

07-03-04

some text here { 
$$\begin{aligned} x &= 2 && \text{if } y > 2 \\ && (1) \\ x &= 3 && \text{if } y \leq 2 \\ && (2) \end{aligned}$$

## 7.4 Arrays

There is a general rule that a lot of mathematical stuff should be divided in smaller pieces. But sometimes it is difficult to get a nice horizontal alignment when splitting a formula. The following ones uses the array environment to get a proper alignment.

### 7.4.1 Quadratic equation

```
\usepackage{amsmath}

\begin{equation}
\begin{array}{rl}
y &= x^2+bx+c \\
&= x^2+2\cdots\left(\frac{b}{2}x+\frac{c}{2}\right) \\
&= x^2+2\cdots\left(x+\frac{b}{2}\right)^2-\left(\frac{b}{2}\right)^2+\frac{c}{2} \\
&= \left(x+\frac{b}{2}\right)^2-\frac{b^2}{4}+\frac{c}{2} \\
&= \left(x+\frac{b}{2}\right)^2-\frac{b^2+4c}{4} \\
&= \left(x+\frac{b}{2}\right)^2-\frac{b^2+4ac}{4a} \\
y &= \frac{1}{a}\left(x+\frac{b}{2}\right)^2-\frac{b^2+4ac}{4a}
\end{array}

```

07-04-01

$$\begin{aligned}
 & \frac{b}{2}x + c \\
 &= x^2 + 2 \cdot \frac{b}{2}x + c \\
 &= \underbrace{x^2 + 2 \cdot \frac{b}{2}x + \left(\frac{b}{2}\right)^2}_{\left(x + \frac{b}{2}\right)^2} - \left(\frac{b}{2}\right)^2 + c \\
 &= \left(x + \frac{b}{2}\right)^2 - \left(\frac{b}{2}\right)^2 + c \quad | + \left(\frac{b}{2}\right)^2 - c \\
 y + \left(\frac{b}{2}\right)^2 - c &= \left(x + \frac{b}{2}\right)^2 \\
 y - y_s &= (x - x_s)^2 \\
 S(x_s; y_s) \quad \text{bzw.} \quad S\left(-\frac{b}{2}; \left(\frac{b}{2}\right)^2 - c\right) & \quad |(\text{Scheitelpunktform})
 \end{aligned} \tag{1}$$

## 7.4.2 Vectors and matrices

07-04-02

```

\usepackage{amsmath}

\begin{equation}
\begin{array}{rcl}
\underline{\begin{array}{ccccccc}
01 & \& a4 & \& 55 & \& 87 & \& 5a & \& 58 & \& db & \& 9e \\
a4 & \& 56 & \& 82 & \& f3 & \& 1e & \& c6 & \& 68 & \& e5 \\
02 & \& a1 & \& fc & \& c1 & \& 47 & \& ae & \& 3d & \& 19 \\
a4 & \& 55 & \& 87 & \& 5a & \& 58 & \& db & \& 9e & \& 03
\end{array}} & \right) & \\
\\
\left( \begin{array}{c}
s_{i,0} \\
s_{i,1} \\
s_{i,2} \\
s_{i,3}
\end{array} \right) & = & \underline{\begin{array}{c}
m_{8i+0} \\
m_{8i+1} \\
\cdots \\
m_{8i+6} \\
m_{8i+7}
\end{array}} \\
\end{array} & & \\
\underline{\begin{array}{c}
s_{i,0} \\
s_{i,1} \\
s_{i,2} \\
s_{i,3}
\end{array}} & = & \sum_{j=0}^{k-1} s_{i,j} \cdot 2^{8j} \quad i=0, 1, \dots, k-1 \\
S & = & \left( \begin{array}{cccc}
s_{0,0} & s_{0,1} & \dots & s_{0,k-1} \\
s_{1,0} & s_{1,1} & \dots & s_{1,k-1} \\
\vdots & \vdots & \ddots & \vdots \\
s_{k-1,0} & s_{k-1,1} & \dots & s_{k-1,k-1}
\end{array} \right)
\end{array}


```

$$\underline{RS} = \begin{pmatrix} 01 & a4 & 55 & 87 & 5a & 58 & db & 9e \\ a4 & 56 & 82 & f3 & 1e & c6 & 68 & e5 \\ 02 & a1 & fc & c1 & 47 & ae & 3d & 19 \\ a4 & 55 & 87 & 5a & 58 & db & 9e & 03 \end{pmatrix}$$

$$\begin{pmatrix} s_{i,0} \\ s_{i,1} \\ s_{i,2} \\ s_{i,3} \end{pmatrix} = \underline{RS} \cdot \begin{pmatrix} m_{8i+0} \\ m_{8i+1} \\ \dots \\ m_{8i+6} \\ m_{8i+7} \end{pmatrix} \quad (1)$$

$$S_i = \sum_{j=0}^3 s_{i,j} \cdot 2^{8j} \quad i = 0, 1, \dots, k-1$$

$$S = (S_{k-1}, S_{k-2}, \dots, S_1, S_0)$$

### 7.4.3 Arrays inside arrays

The array environment is a powerful one because it can be nested in several ways:

```
\usepackage{amsmath}
```

```
\[
\left(
\begin{array}{c@{}c@{}c}
\begin{array}{|cc|}\hline a_{11} & a_{12} \\ \hline a_{21} & a_{22} \\ \hline \end{array} & \theta & \theta \\ \hline 0 & \begin{array}{|cc|}\hline b_{11} & b_{12} & b_{13} \\ \hline b_{21} & b_{22} & b_{23} \\ \hline b_{31} & b_{32} & b_{33} \\ \hline \end{array} & \begin{array}{|cc|}\hline c_{11} & c_{12} \\ \hline c_{21} & c_{22} \\ \hline \end{array} & \theta \\ \hline \end{array}
\right)
```

$$\left( \begin{array}{cc|ccc} a_{11} & a_{12} & & 0 & 0 \\ a_{21} & a_{22} & & & \\ \hline 0 & 0 & \begin{array}{|ccc|} \hline b_{11} & b_{12} & b_{13} \\ \hline b_{21} & b_{22} & b_{23} \\ \hline b_{31} & b_{32} & b_{33} \\ \hline \end{array} & & 0 \\ \hline 0 & & 0 & \begin{array}{|cc|} \hline c_{11} & c_{12} \\ \hline c_{21} & c_{22} \\ \hline \end{array} & \end{array} \right)$$

07-04-03

07-04-04

$$Y^1 = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 \\ 1 & 1 & 1 & 1 \\ 2 & 1 & 3 & 1 \end{bmatrix}$$

```
\usepackage{amsmath}
\[
Y^1=
\begin{array}{c}
\begin{array}{|cccc}
\left[\begin{array}{cccc} 0 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 \\ 1 & 1 & 1 & 1 \\ 2 & 1 & 3 & 1 \end{array}\right]
\end{array}
\end{array}
\] % \hdotsfor{4} \% instead of \\[3ex]\hline
\begin{array}{|c}
\begin{array}{c}
\begin{array}{|ccccc}
\left[\begin{array}{ccccc} 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 \\ 2 & 1 & 3 & 1 & 1 \\ \hline 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 \\ 2 & 1 & 3 & 1 & 1 \end{array}\right]
\end{array}
\end{array}
\end{array}
```

## 7.4.4 Colored cells

In general there is no difference in coloring tabular or array cells. The following example shows how one can put colors in rows, columns and cells.

```
\usepackage{amsmath}
\usepackage{array}
\usepackage{colortbl}
\definecolor{umbra}{rgb}{0.8,0.8,0.5}
\def\zero{\multicolumn{1}{>}{{\color{white}c}{0}}}
\def\colCell#1#2{\multicolumn{1}{>}{{\color{#1}c}{#2}}}

\[\left[\begin{array}{*{5}{>{\color{gray}c}{0.95}}}c\right.\\
\begin{array}{c} h_{\{k,1,0\}(n)} & h_{\{k,1,1\}(n)} & h_{\{k,1,2\}(n)} & \zero & \zero \\ h_{\{k,2,0\}(n)} & h_{\{k,2,1\}(n)} & h_{\{k,2,2\}(n)} & \zero & \zero \\ h_{\{k,3,0\}(n)} & h_{\{k,3,1\}(n)} & h_{\{k,3,2\}(n)} & \zero & \zero \\ h_{\{k,4,0\}(n)} & \color{umbra}{h_{\{k,4,1\}(n)}} & h_{\{k,4,2\}(n)} & \zero & \zero \\ \zero & h_{\{k,1,0\}(n-1)} & h_{\{k,1,1\}(n-1)} & h_{\{k,1,2\}(n-1)} & \zero \\ \zero & h_{\{k,2,0\}(n-1)} & h_{\{k,2,1\}(n-1)} & h_{\{k,2,2\}(n-1)} & \zero \\ \zero & h_{\{k,3,0\}(n-1)} & h_{\{k,3,1\}(n-1)} & h_{\{k,3,2\}(n-1)} & \zero \\ \zero & \color{umbra}{h_{\{k,4,0\}(n-1)}} & h_{\{k,4,1\}(n-1)} & h_{\{k,4,2\}(n-1)} & \zero \\ \zero & \zero & h_{\{k,1,0\}(n-2)} & h_{\{k,1,1\}(n-2)} & h_{\{k,1,2\}(n-2)} \\ \zero & \zero & h_{\{k,2,0\}(n-2)} & h_{\{k,2,1\}(n-2)} & h_{\{k,2,2\}(n-2)} \\ \zero & \zero & h_{\{k,3,0\}(n-2)} & h_{\{k,3,1\}(n-2)} & h_{\{k,3,2\}(n-2)} \\ \zero & \zero & h_{\{k,4,0\}(n-2)} & h_{\{k,4,1\}(n-2)} & h_{\{k,4,2\}(n-2)} \end{array}\\
\left.\begin{array}{c} 12\times 5 \end{array}\right]
```

07-04-05

$h_{k,1,0}(n)$	$h_{k,1,1}(n)$	$h_{k,1,2}(n)$	0	0
$h_{k,2,0}(n)$	$h_{k,2,1}(n)$	$h_{k,2,2}(n)$	0	0
$h_{k,3,0}(n)$	$h_{k,3,1}(n)$	$h_{k,3,2}(n)$	0	0
$h_{k,4,0}(n)$	$h_{k,4,1}(n)$	$h_{k,4,2}(n)$	0	0
0	$h_{k,1,0}(n-1)$	$h_{k,1,1}(n-1)$	$h_{k,1,2}(n-1)$	0
0	$h_{k,2,0}(n-1)$	$h_{k,2,1}(n-1)$	$h_{k,2,2}(n-1)$	0
0	$h_{k,3,0}(n-1)$	$h_{k,3,1}(n-1)$	$h_{k,3,2}(n-1)$	0
0	$h_{k,4,0}(n-1)$	$h_{k,4,1}(n-1)$	$h_{k,4,2}(n-1)$	0
0	0	$h_{k,1,0}(n-2)$	$h_{k,1,1}(n-2)$	$h_{k,1,2}(n-2)$
0	0	$h_{k,2,0}(n-2)$	$h_{k,2,1}(n-2)$	$h_{k,2,2}(n-2)$
0	0	$h_{k,3,0}(n-2)$	$h_{k,3,1}(n-2)$	$h_{k,3,2}(n-2)$
0	0	$h_{k,4,0}(n-2)$	$h_{k,4,1}(n-2)$	$h_{k,4,2}(n-2)$

### 7.4.5 Boxed rows and columns

$$\vec{A} = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 1 & 2 & 3 & 4 \\ \boxed{1 & 2 & 3 & 4} \\ 1 & 2 & 3 & 4 \end{bmatrix}$$

```
\usepackage{amsmath}
\[
\overrightarrow{A}=\left(\begin{array}{cccc}
1 & 2 & 3 & 4 \\
1 & 2 & 3 & 4 \\
\boxed{1 & 2 & 3 & 4} \\
1 & 2 & 3 & 4
\end{array}\right)
```

07-04-06

$$\vec{A} = \begin{bmatrix} 1 & 2 & \boxed{3} & 4 \\ 1 & 2 & 3 & 4 \\ 1 & 2 & 3 & 4 \\ 1 & 2 & 3 & 4 \end{bmatrix}$$

```
\usepackage{amsmath}
\[
\overrightarrow{A}=\left(\begin{array}{cc|c|c} 
1 & 2 & 3 & 4 \\ 
1 & 2 & 3 & 4 \\ 
1 & 2 & 3 & 4 \\ 
1 & 2 & 3 & 4 
\end{array}\right)
```

07-04-07

$$\vec{A} = \begin{bmatrix} 1 & 2 & \boxed{3} & 4 \\ 1 & 2 & 3 & 4 \\ \boxed{1 & 2 & 3 & 4} \\ 1 & 2 & 3 & 4 \end{bmatrix}$$

```
\usepackage{amsmath}
\[
\overrightarrow{A}=\left(\begin{array}{cc|c|c} 
1 & 2 & 3 & 4 \\ 
1 & 2 & 3 & 4 \\ 
1 & 2 & 3 & 4 \\ 
1 & 2 & 3 & 4 
\end{array}\right)
```

07-04-08

### 7.5 Over- and underbraces

#### 7.5.1 Braces and roots

To put an underbrace in a root without enlarging the root symbol is possible with the `\makebox` macro:

$$z = \sqrt{x^2 + y^2}$$

```
\usepackage{amsmath,calc}
\[
z = \sqrt{x^2 + y^2}
```

07-05-01

#### 7.5.2 Overlapping braces and parentheses

Overlapping under- and overbraces like

```
\usepackage{amsmath,calc}
\begin{aligned*}
&\backslash quad\overbrace{\backslash quad\backslash quad}^o\backslash quad\\[-16pt] \\
&\underbrace{\backslash quad\backslash quad}_{u1} \\
&\underbrace{\backslash quad\backslash quad}_{u2}
\end{aligned*}
```

07-05-02

needs some tricky code, because we cannot have parts of the argument inside \overbrace and also \underbrace. The following Example 07-05-03 shows such a construction:

```
\usepackage{amsmath,xcolor}
\begin{aligned}
y &= 2x^2 - 3x + 5 \text{nonumber} \\
&\quad & \& \phantom{y = } \left( \frac{3}{4} \right)^2 - \left( \frac{3}{4} \right)^2 + \frac{5}{2} \\
&\quad & \& \phantom{y = } \left( x - \frac{3}{4} \right)^2 + \frac{31}{16} \\
&\quad & \& \phantom{y = } \left( x - \frac{3}{4} \right)^2 + \frac{31}{16} \\
y &\text{textcolor{blue}{\{-}} \textcolor{red}{\left( x - \frac{3}{4} \right)^2} \text{textcolor{blue}{\}} - \frac{31}{8} \\
&\quad & \& \phantom{y = } \left( x - \frac{3}{4} \right)^2 + \frac{31}{16} \\
\end{aligned}
```

07-05-03

$$\begin{aligned}
y &= 2x^2 - 3x + 5 \\
&= 2 \left( \underbrace{x^2 - \frac{3}{2}x}_{=0} + \underbrace{\left( \frac{3}{4} \right)^2 - \left( \frac{3}{4} \right)^2}_{=0} + \frac{5}{2} \right) \\
&= 2 \left( \left( x - \frac{3}{4} \right)^2 + \frac{31}{16} \right) \\
y - \frac{31}{8} &= 2 \left( x - \frac{3}{4} \right)^2
\end{aligned} \tag{1}$$

07-05-04

$$\begin{array}{c}
f(x) \overbrace{f(x)}^{\text{=0}} \\
\underbrace{u_1}_{\text{=0}} \underbrace{u_1 + u_2}_{\text{=0}}
\end{array}$$

```
\usepackage{amsmath}
\usepackage{unicode-math}
\setmathfont{STIX Two Math}% lualatex!!
\begin{aligned*}
&\underbrace{f(x)}_{=0} \\
&\overbrace{f(x)}^{\text{=0}} \\
&\underbrace{u_1}_{\text{=0}} \underbrace{u_1 + u_2}_{\text{=0}}
\end{aligned*}
```

### 7.5.3 Vertical alignment of different braces

When having several braces in one formula line, then it looks better when all braces are also on the same line, e.g.

```
\usepackage{amsmath}
\begin{equation}
\binom{x_R}{y_R} = \underbrace{r \vphantom{\binom{A}{B}}}_{\text{Scaling}} \cdots
\underbrace{\begin{pmatrix} \sin \gamma & -\cos \gamma \\ \cos \gamma & \sin \gamma \end{pmatrix}}_{\text{Rotation}}
\binom{x_K}{y_K} + \underbrace{\binom{t_x}{t_y}}_{\text{Translation}}
\end{equation}
```

$$\begin{pmatrix} x_R \\ y_R \end{pmatrix} = \underbrace{r}_{\text{Scaling}} \cdot \underbrace{\begin{pmatrix} \sin \gamma & -\cos \gamma \\ \cos \gamma & \sin \gamma \end{pmatrix}}_{\text{Rotation}} \begin{pmatrix} x_K \\ y_K \end{pmatrix} + \underbrace{\begin{pmatrix} t_x \\ t_y \end{pmatrix}}_{\text{Translation}} \quad (1)$$

07-05-05

It is again the `\vphantom` macro which reserves the needed vertical space. Nevertheless the horizontal space around the `r` of the first underbrace and the last `+` should be decreased to get a better typesetting. This is possible with `\hspace` or simply `\kern`:

```
\usepackage{amsmath}

\[
\binom{x_R}{y_R} = %
\kern-10pt\underbrace{r\vphantom{\binom{A}{B}}}_{\text{Scaling}}_{\text{Scaling}} \kern-10pt\text{\text{Scaling}}\kern-10pt + %
\cdotp\underbrace{\begin{pmatrix} \sin \gamma & -\cos \gamma \\ \cos \gamma & \sin \gamma \end{pmatrix}}_{\text{Rotation}}_{\text{Rotation}} \underbrace{\binom{x_K}{y_K}}_{\text{Translation}}_{\text{Translation}} + %
\kern-5pt\underbrace{\binom{t_x}{t_y}}_{\text{Translation}}_{\text{Translation}}
\]

\begin{pmatrix} x_R \\ y_R \end{pmatrix} = r \cdot \underbrace{\begin{pmatrix} \sin \gamma & -\cos \gamma \\ \cos \gamma & \sin \gamma \end{pmatrix}}_{\text{Scaling}}_{\text{Scaling}} \begin{pmatrix} x_K \\ y_K \end{pmatrix} + \underbrace{\begin{pmatrix} t_x \\ t_y \end{pmatrix}}_{\text{Translation}}_{\text{Translation}}
```

07-05-06

## 7.5.4 Vertical and horizontal alignment

The forgoing example simply uses `\hspace` to decrease the horizontal width between two underbraces. This may be okay for a single solution, but in general it is better to have some code which works in any case. The following example looks simple but it needs some tricky code to get vertical and horizontal alignment.

```
\usepackage{mathtools}
\def\num#1{\vphantom{#1}}
\def\vsp{\vphantom{\rangle_1}>

\begin{equation*}
\frac{300}{5069}%
\underbrace{\longmapsto\vphantom{\frac{1}{1}}}_{\Delta a=271\num{9}\vsp\,\,\,[2pt]\,\Delta b=4579\vsp\,\,\,[2pt]\,\,\,\text{\$1\$ iteration}}}%
\frac{29}{490}%
\underbrace{\longmapsto\frac{19}{321}\longmapsto}_{\Delta a=10\num{9}=\langle 271\rangle_{[29]}\num{20}\,\,\,[2pt]\,\,\,\Delta b=169=\langle 4579\rangle_{[490]}\,\,\,[2pt]\,\,\,\text{\$2\$ iterations}}\frac{9}{152}%
\underbrace{\longmapsto\frac{8}{135}\longmapsto\dots\longmapsto}_{\Delta a=1\num{7}=\langle 10\rangle_{[9]}\num{119}\,\,\,[2pt]\,\,\,\Delta b=17=\langle 169\rangle_{[152]}\,\,\,[2pt]\,\,\,\text{\$8\$ iterations}}\frac{1}{16}%
\underbrace{\longmapsto\dots\longmapsto\vphantom{\frac{8}{135}}}_{\Delta a=0=\langle 1\rangle_{[1]}\num{76}\,\,\,[2pt]\,\,\,\Delta b=1=\langle 17\rangle_{[16]}\,\,\,[2pt]\,\,\,\text{\$8\$ iterations}}\frac{1}{1}
\end{equation*}
```

07-05-07

$$\begin{array}{ccccccccc}
 \frac{300}{5069} & \xrightarrow{\Delta a=271} & \frac{29}{490} & \xrightarrow{\Delta a=10 =\langle 271 \rangle_{29}} & \frac{19}{321} & \xrightarrow{\Delta a=1 =\langle 10 \rangle_9} & \frac{9}{152} & \xrightarrow{\Delta a=17=\langle 169 \rangle_{152}} & \frac{8}{135} \\
 & \underbrace{\hspace{1cm}}_{1 \text{ iteration}} & & \underbrace{\hspace{1cm}}_{2 \text{ iterations}} & & & \underbrace{\hspace{1cm}}_{8 \text{ iterations}} & & \underbrace{\hspace{1cm}}_{8 \text{ iterations}}
 \end{array}
 \begin{array}{ccccccccc}
 & & & & & & \frac{1}{16} & \xrightarrow{\Delta a=0=\langle 1 \rangle_1} & \frac{1}{1} \\
 & & & & & & & \underbrace{\hspace{1cm}}_{8 \text{ iterations}} & 
 \end{array}$$

It uses the macro `\mathclap` defined in section 2.11.2 on page 64 or from package `mathtools`, which gives a better result. It is also possible to use `\makebox[0pt]{...}` but it works only in text mode and this needs some more `$...$`.

## 7.6 Integrals

The following example uses the the `esint` package<sup>1</sup>, which gives nice integral symbols. For partial differentiation we define an own macro which makes things easier to write.

```
\usepackage{amsmath}
\usepackage[partialup]{kpfonts}
\usepackage{esint}
\def\Q#2{\frac{\partial #1}{\partial #2}}
```

The `\emph{first theorem of Green}` is:

```
\[
\underset{\mathcal{G}}{\iint} \left( u \nabla^2 v + \nabla u \cdot \nabla v \right) d^3 V
= \underset{\mathcal{S}}{\oint} u \nabla v \cdot dA
```

The `\emph{second theorem of Green}` is:

```
\[
\underset{\mathcal{G}}{\iint} \left( u \nabla^2 v - v \nabla^2 u \right) d^3 V
= \underset{\mathcal{S}}{\oint} \left( u \frac{\partial v}{\partial n} - v \frac{\partial u}{\partial n} \right) dA
```

07-06-01

The *first theorem of Green* is:

$$\iiint_{\mathcal{G}} [u \nabla^2 v + (\nabla u \cdot \nabla v)] d^3 V = \iint_{\mathcal{S}} u \frac{\partial v}{\partial n} d^2 A$$

The *second theorem of Green* is:

$$\iiint_{\mathcal{G}} [u \nabla^2 v - v \nabla^2 u] d^3 V = \iint_{\mathcal{S}} \left( u \frac{\partial v}{\partial n} - v \frac{\partial u}{\partial n} \right) d^2 A$$

## 7.7 Horizontal alignment

### 7.7.1 Over more than one page

Sometimes it may be useful to have a vertical alignment over the whole page with a mix of formulas and text. Section 2.13 on page 66 shows the use of

<sup>1</sup> See section 7.6.

\intertext. There is another trick to get all formulas vertical aligned. Let's have the following formulas distributed over the whole page:

$f(x) = a$ $g(x) = x^2 - 4x$ $f(x) - g(x) = x^2 + x^3 + x$ $g(x) = x^2 + x^3 + x^4 + x^5 + b$	<pre>\usepackage{amsmath} \begin{aligned} f(x) &amp;= a \\ g(x) &amp;= x^2 - 4x \\ f(x)-g(x) &amp;= x^2+x^3+x \\ g(x) &amp;= x^2+x^3+x^4+x^5+b \end{aligned}</pre>
--	--

07-07-01

They all have a different length of the left and right side. Now we want to write some text and other objects between them, but let the alignment untouched. We choose the longest left and the longest right side and take them for scaling with the \phantom command:

```
\phantom{\mbox{$f(x)-g(x)$}} & \phantom{\mbox{$= x^2+x^3+x^4+x^5+b$}}
```

This is the first (empty) line in every equation where now all other lines are aligned to this one. For example:

```
\usepackage{amsmath}
\newcommand\x{blah blah blah blah blah blah blah }
\addtolength\abovedisplayskip{-5cm}% decrease the skip
\addtolength\abovedisplayskip{-5cm}

\rule{\columnwidth}{1pt}
\x\x\x
\begin{align}
\phantom{\mbox{$f(x)-g(x)$}} & \phantom{\mbox{$= x^2+x^3+x^4+x^5+b$}}\nonumber\\
f(x) &= a \\
g(x) &= x^2-4x
\end{align}
%
\x\x\x
\begin{align}
\phantom{\mbox{$f(x)-g(x)$}} & \phantom{\mbox{$= x^2+x^3+x^4+x^5+b$}}\nonumber\\
f(x)-g(x) &= x^2+x^3+x
\end{align}
%
\x\x\x
\begin{align}
\phantom{\mbox{$f(x)-g(x)$}} & \phantom{\mbox{$= x^2+x^3+x^4+x^5+b$}}\nonumber\\
g(x) &= x^2+x^3+x^4+x^5+b
\end{align}
%
\x\x\x
\rule{\columnwidth}{1pt}
```

07-07-02

---

blah  
blah blah blah blah blah blah blah

$$f(x) = a \tag{1}$$

$$g(x) = x^2 - 4x \tag{2}$$

blah  
blah blah blah blah blah blah blah

$$f(x) - g(x) = x^2 + x^3 + x \tag{3}$$

blah  
blah blah blah blah blah blah blah

$$g(x) = x^2 + x^3 + x^4 + x^5 + b \tag{4}$$

blah  
blah blah blah blah blah blah blah

---

The phantom line is empty but leaves the vertical space for a line. This could be corrected with decreasing the `\abovedisplayskip` length and done all inside a group.

Another case of aligning equations inside an itemize environment is the following one. With the `\makebox` macro one can have the same size on the left side of the equal sign to get a vertical alignment.

```
\usepackage{amsmath}
\newsavebox{\lW}
\sbox{\lW}{\P_{\{3\}}+\P_{\{2\}}-\P_{\{1\}}}

\begin{itemize}
\item first function \\
  $\displaystyle\sum_a \in A$ \\
  $\sin(P_1) = blabla$ \\
\item but another one \\
  $\sin(P_1) = blabla$ \\
\item or perhaps \\
  $P_3 + P_2 - P_1 = blablub$ \\
\end{itemize}
```

07-07-03

- first function

$$P_1 = \sum_a \in A$$

- but another one

$$\sin(P_1) = blabla$$

- or perhaps

$$P_3 + P_2 - P_1 = blablub$$

## 7.7.2 Special text columns

This one comes from Hartmut Henkel and offers a special form of placing additional text between the equation and the equation number. This makes only sense when you load the documentclass with the option `fleqn`. The example places the additional text at `0.5\textwidth`, changing this value is no problem.

```
\usepackage{amsmath}
\makeatletter
\fleqntrue
\let\old@mathmargin=\@mathmargin
\@mathmargin=-1sp
\let\oldmathindent=\mathindent
\let\mathindent=\@mathmargin
\newsavebox{\myendhook} % for the tabulars
\def\tagform@#1{{(\maketag@@@{\ignorespaces#1\unskip\@@italiccorr})}
  \makebox[0pt][r]{% after the equation number
    \makebox[0.5\textwidth][l]{\usebox{\myendhook}}}% empty box
\makeatother
\sbox{\myendhook}{%
\footnotesize
\begin{tabular}{@{}ll}
\$a_0\$ & Bohrscher Radius ($\mathsf{= 0,53\AA}$)\\
\$e\$ & Elementarladung\\
\$N_{si}\$ & Anzahl der Siliziumatome\\
& & pro Einheitsvolumen\\
\$m\$ & Atomgewicht\\
\$Z\$ & Kernladungszahl
\end{tabular}}
\begin{equation}
\varrho_\mathrm{e} = \frac{4\pi}{3} \cdot \frac{Z_{Si}^2}{m_i} \cdot Z_i \cdot \left(1 + \frac{m_i - Si}{m_i}\right)^{-1/2} \cdot a_0 \cdot e^2
\end{equation}
\begin{equation}
z = 9
\end{equation}

```

07-07-04

text  
 text text text text text text text text text text text text text text text  
 text text text text text text

$$\varepsilon = \frac{E \odot 4 \odot \pi \odot \varepsilon_0 \odot a_0 \odot \left( Z_i^{\frac{2}{3}} + Z_{Si}^{\frac{2}{3}} \right)^{\frac{1}{2}} \frac{a_0}{N_{Si}} \frac{e}{m} }{Z_i \odot Z_{Si} \odot e 2 \odot \left( 1 + \frac{m_i}{m_{Si}} \right)}; \begin{array}{ll} \text{Bohrscher Radius} (= 0,53 \text{ \AA}) \\ \text{Elementarladung} \\ \text{Anzahl der Siliziumatome} \\ \text{pro Einheitsvolumen} \\ \text{Atomgewicht} \\ \text{Kernladungszahl} \end{array} \quad (1)$$

$$a2 + b2 = c2 \quad \text{abc} \quad (2)$$

$$z = 9 \quad (3)$$

text  
 text text text text text text text text text text text text text text text  
 text text text text text text text

This solution works only with  $\mathcal{A}\mathcal{M}\mathcal{S}\mathbf{math}$ , without you have to redefine the  $\text{\LaTeX}$  macro, which creates the equation number. It may make sense to have all inside a group  $\text{\begingroup... \endgroup}$  if the environment  $\text{equation}$  is also used with its original definition.

### 7.7.3 Centered vertical dots

By default the vertical dots of  $\text{\vdots}$  are aligned to the left of the  $=$  symbol and not centered.

$$a_1 = b_1 \quad c_1 = d_1 \quad (1)$$

$$a_2 = b_2 \quad c_2 = d_2 \quad (2)$$

$$a : b \quad \vdots$$

$$a_n = b_n \quad c_n = d_n \quad (3)$$

```
\usepackage{amsmath}
\newsavebox{\eqbox}
\sbox{\eqbox}{\$ \null=\null \$}
\newcommand{\Vdots}{\makebox[\wd\eqbox]{\vdots}}
```

```
\begin{aligned}
a_1 &= b_1 & c_1 &= d_1 \\
a_2 &= b_2 & c_2 &= d_2 \\
a &: b & \vdots \\
a_n &= b_n & c_n &= d_n
\end{aligned}

```

## 7.8 Node connections

This is a typical application for PSTricks and it needs the package  $\text{pst-node}$  and doesn't work with  $\text{pdflatex}$ . Use  $\text{vlatex}$ ,  $\text{ps4pdf}$  or  $\text{ps2pdf}$ .

```
\usepackage{amsmath,pst-node}% needs a xelatex run
\definecolor{lila}{rgb}{0.6,0.2,0.5}
\definecolor{darkyellow}{rgb}{1,0.9,0}
\def\xstrut{\vphantom{\frac{(A)^1}{(B)^1}}}
\psset{nodesep=3pt}

\fbox{\parbox{\dimexpr\linewidth-2\fboxsep-2\fboxrule}{%
Die Bindungsenergie im Tröpfchenmodell setzt sich aus folgenden Teilen zusammen:
\begin{itemize}
\item dem \rnode{b}{Oberflächenanteil}
\item dem \rnode{a}{Volumenanteil},\\
\begin{equation}
```

```

E =
\begin{array}{l}
\text{\rnode[t]{ae}}{\text{\psframebox*[fillcolor=darkyellow,linestyle=none]{\xstrut a_vA}}} + \\
\text{\rnode[t]{be}}{\text{\psframebox*[fillcolor=lightgray,linestyle=none]{\xstrut -a_fA^{2/3}}}} + \\
\text{\rnode[t]{ce}}{\text{\psframebox*[fillcolor=green,linestyle=none]{\xstrut -a_c\frac{Z(Z-1)}{A^{1/3}}}}}} + \\
\text{\rnode[t]{de}}{\text{\psframebox*[fillcolor=cyan, linestyle=none]{\xstrut -a_s\frac{(A-2Z)^2}{A}}}} + \\
\text{\rnode[t]{ee}}{\text{\psframebox*[fillcolor=yellow,linestyle=none]{\xstrut E_p}}}
\end{array} \\
\text{\end{equation}}\\
\text{\item dem \rnode[c]{Coulomb-Anteil}} \\
\text{\item der \rnode[d]{Symmetrienergie}} \\
\text{\item sowie einem \rnode[e]{Paarbildungsbeitrag}.} \\
\text{\end{itemize}} \\
\text{\nccurve[angleA=-90,angleB=90]{->}{a}{ae}} \\
\text{\nccurve[angleB=45]{->}{b}{be}} \text{\nccurve[angleB=-90]{->}{c}{ce}} \\
\text{\nccurve[angleB=-90]{->}{d}{de}} \text{\nccurve[angleB=-90]{->}{e}{ee}} \\

```

Die Bindungsenergie im Tröpfchenmodell setzt sich aus folgenden Teilen zusammen:

- dem Oberflächenanteil
- dem Volumenanteil,

$$E = a_v A + -a_f A^{2/3} + -a_c \frac{Z(Z-1)}{A^{1/3}} + -a_s \frac{(A-2Z)^2}{A} + E_p \quad (1)$$

- dem Coulomb-Anteil
- der Symmetrienergie
- sowie einem Paarbildungsbeitrag.

07-08-01

## 7.9 Special placement of displayed equations

### 7.9.1 Formulas side by side

Sometimes it may be useful to have numbered formulas side by side like the following ones:

```
\usepackage{amsmath, array}
\newcounter{subequation} \newlength\mtabskip \mtabskip=-1.25cm
\newcommand{\eqnCnt}[1][]{\refstepcounter{subequation}\begin{aligned}#1\end{aligned}%
\addtocounter{equation}{-1}}
\def\mtabLong{long}
\makeatletter
\newenvironment{mtabular}[2][\empty]
{\parindent=0pt
\def\xarraycr{\global\stepcounter{equation}\setcounter{subequation}{0}%
\@ifnextchar[\argarraycr[\argarraycr[\mtabskip]]}
\let\theoldequation\theequation%
\renewcommand\theequation{\theoldequation.\alph{subequation}}
\def\mtabOption{\#1}%
\setcounter{subequation}{0}%
\tabcolsep=0pt
\ifx\mtabOption\mtabLong\longtable{\#2}\else\tabular{\#2}\fi
{\ifx\mtabOption\mtabLong\endlongtable\else\endtabular\fi
\let\theequation\theoldequation\stepcounter{equation}}}

\begin{mtabular}{*2{m{0.35\linewidth}m{0.15\linewidth}}}
\begin{aligned} & \oint E \, ds = 0 \end{aligned} & \begin{aligned} & \nabla \cdot B = 0 \end{aligned} \\ & \begin{aligned} & a = \frac{c}{d} \end{aligned} & \begin{aligned} & b = 1 \end{aligned} \\ & \begin{aligned} & c = 1 \end{aligned} & \begin{aligned} & \int 2x \, dx = x^2 + C \end{aligned} \end{mtabular}
\end{mtabular}
And again a default display equation:
\begin{aligned} F(x) &= \int_0^\infty \frac{1}{x} \, dx \end{aligned}
A Reference to Eq.~\ref{eqn:blah} and \ref{eqn:blub} \ldots
```

07-09-01

$$\oint E \, ds = 0 \quad (1.a) \quad \nabla \cdot B = 0 \quad (1.b)$$

$$a = \frac{c}{d} \quad (2.a) \quad b = 1 \quad (2.b) \text{ And}$$

$$c = 1 \quad (3.a) \quad \int 2x \, dx = x^2 + C \quad (3.b)$$

again a default display equation:

$$F(x) = \int_0^\infty \frac{1}{x} \, dx \quad (4)$$

A Reference to Eq. 1.b and 3.a ...

The new environment `mtabular` has two arguments, one optional and one which is the same as the one from the `tabular` environment. With the option `long` it is possible to have all the formulas in a `longtable` environment, which allows a pagebreak. The new macro `\eqnCnt` controls the counting of these equations as subequations for one tabular line. This macro can have an optional argument for a label. At least it counts the equations. If the equation number

is not centered to the foregoing equation, then it needs some more horizontal space in the tabular column.

```
\eqnCnt[<optional label>]
```

The vertical space is controlled by the length `\mtabskip`, which is by default `-1.25cm` and can be modified in the usual way. The following tabular is defined as a longtable to enable pagebreaks.

```
\usepackage{amsmath, longtable}% mtabular code is in the hidden part of the preamble
```

07-09-02

```
\def\arraystretch{3}% Only for demonstration here
\begin{mtabular}[long]{*2{m{0.35\linewidth}m{0.15\linewidth}}}
\begin{align*} \oint E \, ds = 0 \end{align*} & \eqnCnt
& \begin{align*} \nabla \cdot \mathbf{B} = 0 \end{align*} & \eqnCnt \\
\begin{align*} a = \frac{c}{d} \end{align*} & \begin{align*} b = 1 \end{align*} & \eqnCnt \\
& \begin{align*} \int 2x \, , \, \mathbf{d} \cdot \mathbf{x} = x^2 + C \end{align*} & \eqnCnt \\
\begin{align*} \oint E \, ds = 0 \end{align*} & \begin{align*} \nabla \cdot \mathbf{B} = 0 \end{align*} & \eqnCnt \\
& \begin{align*} a = \frac{c}{d} \end{align*} & \eqnCnt \\
& \begin{align*} b = 1 \end{align*} & \eqnCnt \\
\begin{align*} c = 1 \end{align*} & \begin{align*} \int 2x \, , \, \mathbf{d} \cdot \mathbf{x} = x^2 + C \end{align*} & \eqnCnt \\
\begin{align*} \oint E \, ds = 0 \end{align*} & \begin{align*} \nabla \cdot \mathbf{B} = 0 \end{align*} & \eqnCnt \\
& \begin{align*} a = \frac{c}{d} \end{align*} & \eqnCnt \\
& \begin{align*} b = 1 \end{align*} & \eqnCnt \\
\begin{align*} c = 1 \end{align*} & \begin{align*} \int 2x \, , \, \mathbf{d} \cdot \mathbf{x} = x^2 + C \end{align*} & \eqnCnt \\
\begin{align*} \oint E \, ds = 0 \end{align*} & \begin{align*} \nabla \cdot \mathbf{B} = 0 \end{align*} & \eqnCnt \\
& \begin{align*} a = \frac{c}{d} \end{align*} & \eqnCnt \\
& \begin{align*} b = 1 \end{align*} & \eqnCnt \\
\begin{align*} c = 1 \end{align*} & \begin{align*} \int 2x \, , \, \mathbf{d} \cdot \mathbf{x} = x^2 + C \end{align*} & \eqnCnt \\
\end{mtabular}
```

As seen in `\ref{blub2}` and `\ref{blah2}`, everything is nonsense `\ldots`  
 And again a default display equation:

```
\begin{align}
F(x) &= \int_0^\infty \frac{1}{x} \, , \, \mathbf{d} \cdot \mathbf{x}
\end{align}
```

$\overbrace{\quad}^{\longrightarrow} E ds = 0 \quad (1.a) \quad (\odot B = 0 \quad (1.b)$ $a = \frac{c}{d} \quad (2.a) \quad b = 1 \quad (2.b)$ $c = 1 \quad (3.a) \quad \overbrace{\quad}^{\longrightarrow} 2x dx = x^2 + C \quad (3.b)$ $\overbrace{\quad}^{\longrightarrow} E ds = 0 \quad (4.a) \quad (\odot B = 0 \quad (4.b)$ $a = \frac{c}{d} \quad (5.a) \quad b = 1 \quad (5.b)$ $c = 1 \quad (6.a) \quad \overbrace{\quad}^{\longrightarrow} 2x dx = x^2 + C \quad (6.b)$ $\overbrace{\quad}^{\longrightarrow} E ds = 0 \quad (7.a) \quad (\odot B = 0 \quad (7.b)$ $a = \frac{c}{d} \quad (8.a) \quad b = 1 \quad (8.b)$	$c = 1 \quad (9.a) \quad \overbrace{\quad}^{\longrightarrow} 2x dx = x^2 + C \quad (9.b)$ $a = \frac{c}{d} \quad (10.a) \quad b = 1 \quad (10.b)$ $c = 1 \quad (11.a) \quad \overbrace{\quad}^{\longrightarrow} 2x dx = x^2 + C \quad (11.b)$ $c = 1 \quad (12.a) \quad \overbrace{\quad}^{\longrightarrow} 2x dx = x^2 + C \quad (12.b)$
--	--

As seen in equation 9.a and equation 7.b, everything is nonsense  
... And again a default display equation:

$$F.x / = \overbrace{\quad}^{\longrightarrow} \int_0^1 \frac{1}{x} dx \quad (13)$$

## 7.9.2 Formulas inside an itemize environment

Without any modification it is not possible to get a numbered equation at the same height as the symbol of the itemize environment. This depends on the `\abovedisplayskip`. The formula has to be raised up for exactly this length.

•  $f = l \quad (1)$

```
\usepackage{amsmath}
\def\itemMath#1{%
\raisebox{-\abovedisplayskip}{%
\parbox{0.75\linewidth}{%
\begin{equation}#1\end{equation}}}}
\begin{itemize}
\item \itemMath{ f = l }
\item \itemMath{ g(x) = \int f(x), \mathrm{d}x }
\end{itemize}
```

•  $g.x / = \overbrace{\quad}^{\longrightarrow} f.x / dx \quad (2)$

## 7.10 Roots

There exists no special symbol for roots which are longer than one line. In such cases the root should be split into two or more one, like  $\sqrt{a \cdot b \cdot c} = \sqrt{a} \cdot \sqrt{a} \cdot \sqrt{b} \cdot \sqrt{c}$  if possible. If nothing helps one can use `\overline{rule{Opt}{2.5ex}}` for following lines of the root. The following example uses the `\multline` environment to get only one equation number:

```
\usepackage{amsmath}
\begin{multline}
d(P,Q)|_{\text{Stat.,Dependent}}=\\
\sqrt{\left(a_{11}(x_{1}-y_{1})^2+a_{22}(x_{2}-y_{2})^2+\right.}\\
\left.\ldots+a_{pp}(x_p-y_p)^2\right)+} \\
\overline{\rule{0pt}{2.5ex}}
```

```
\left[2a_{12}(x_{1}-y_{1})(x_{2}-y_{2})+2a_{13}\right.\\
\left.(x_{1}-y_{1})(x_{3}-y_{3})+\right.\\
\overline{\left.\rule{0pt}{2.5ex}\right.}\\
\left.\left.\left.\vdots +2a_{p-1,p}(x_{p-1}-y_{p-1})(x_p-y_p)\right]\right]

```

$d.P, Q/_{Stat.,Dependent} =$

$$\frac{\sqrt{\left[a_{11}x_1^2 + a_{22}x_2^2 + \dots + a_{pp}x_p^2\right] + \left[2a_{12}x_1x_2 + 2a_{13}x_1x_3 + \dots + 2a_{p-1,p}x_{p-1}x_p\right]}}{(1)}$$

07-10-01

Alternative:

```
\usepackage{amsmath}
```

```
\begin{multiline}
d(P,Q)|_{Stat.,Dependent}=\Bigg(
\Big(\left[a_{11}(x_{1}-y_{1})^2+a_{22}(x_{2}-y_{2})^2+\right.\\
\left.\vdots +a_{pp}(x_{p}-y_{p})^2\right]+\Big)\\
\left[2a_{12}(x_{1}-y_{1})(x_{2}-y_{2})+2a_{13}\right.\\
\left.(x_{1}-y_{1})(x_{3}-y_{3})+\right.\\
\left.\left.\vdots +2a_{p-1,p}(x_{p-1}-y_{p-1})(x_p-y_p)\right]\right)^{1/2}
\end{multiline}
```

$d.P, Q/_{Stat.,Dependent} =$

$$\frac{\left(a_{11}x_1^2 + a_{22}x_2^2 + \dots + a_{pp}x_p^2\right) + \left(2a_{12}x_1x_2 + 2a_{13}x_1x_3 + \dots + 2a_{p-1,p}x_{p-1}x_p\right)}{(1)}$$

07-10-02

# Chapter 8

## Unicode symbol list

### 8.0.1 Symbolverzeichnis für Unicode

Dieser Abschnitt stellt alle verfügbaren Unicode-Symbole zusammen, wozu die Datei `unicode-math-table.tex` verwendet wird, die bereits eine Liste aller Symbole mit zugehörigem Makro enthält. Das Paket `unicode-math` stellt diese entsprechend zur Verfügung. Fehlende Ausgaben in der Liste der Symbole beruhen immer auf der Tatsache, dass die hier verwendete mathematische Schrift kein entsprechendes Symbol vorhält.

Sind bei Symbolen Grenzen angegeben (Integral, Simme, Produkt), so ist zu beachten, dass diese formal nicht zum Zeichen an sich gehören und hier nur die möglichen Positionen verdeutlichen sollen. Alle bereits in Plain TeX definierten Symbole sind mit <sup>(p)</sup>, alle in Standard”=LaTeX definierten sind mit <sup>(l)</sup> und alle durch das Paket `amssymb` definierten, sind <sup>(a)</sup> markiert. In Klammern ist die derzeitige Anzahl an vorhandenen Symbolen angegeben.

- |  |   |  |
|--|---|--|
| ▷ Latin Modern Math<br><a href="#">(29)</a>                            | ▷ DejaVu Math <a href="#">(29)</a>  | ▷ Libertinus Math <a href="#">(24)</a>   |
| ▷ XITS Math <a href="#">(62)</a>                                       | ▷ Neo Euler <a href="#">(30)</a>  | ▷ GFSNeoHellenic Math<br><a href="#">(58)</a>  |
| ▷ Cambria Math <a href="#">(60)</a><br>Asana Math <a href="#">(60)</a> | ▷ Bonum Math <a href="#">(29)</a><br>Schola Math <a href="#">(29)</a><br>Termes Math <a href="#">(29)</a> | ▷ Lucida Math <a href="#">(52)</a><br>Fira Math <a href="#">(11)</a><br>Minion Math <a href="#">(12)</a> |
| ▷ TG Pagella Math <a href="#">(29)</a>                                 | ▷ STIX2 Math <a href="#">(62)</a>   |  |

Typ	Seite	Typ	Seite	Typ	Seite	Typ	Seite
\mathaccent	139	\mathaccentwide	140	\mathbotaccent	140	\mathbotaccentwide	141
\mathalpha	197	\mathbin	142	\mathclose	137	\mathfence	138
\mathop	188	\mathopen	136	\mathord	150	\mathover	195
\mathpunct	138	\mathrel	169	\mathunder	196		

## \mathopen

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+00028	(	(	(	(	(	(	(	(	(	(	(	(	(	(	(	(	\lparen
u+0005b	[	[	[	[	[	[	[	[	[	[	[	[	[	[	[	[	\lbrack
u+0007b	{	{	{	{	{	{	{	{	{	{	{	{	{	{	{	{	\lbrace <sup>(p)</sup>
u+0221a	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	\sqrt <sup>(p)</sup>
u+0221b	³✓	³✓	³✓		³✓			³✓	³✓	³✓	³✓	³✓	³✓	³✓	³✓	³✓	\cube-root
u+0221c	⁴✓	⁴✓	⁴✓			⁴✓			⁴✓	⁴✓		⁴✓	⁴✓	⁴✓	⁴✓	⁴✓	\fourth-root
u+02308	⌈	⌈	⌈	⌈	⌈	⌈	⌈	⌈	⌈	⌈	⌈	⌈	⌈	⌈	⌈	⌈	\lceil <sup>(p)</sup>
u+0230a	⌋	⌋	⌋	⌋	⌋	⌋	⌋	⌋	⌋	⌋	⌋	⌋	⌋	⌋	⌋	⌋	\lfloor <sup>(p)</sup>
u+0231c	⌜	⌜	⌜	⌜	⌜	⌜	⌜	⌜	⌜	⌜	⌜	⌜	⌜	⌜	⌜	⌜	\ulcorner
u+0231e	⌞	⌞	⌞	⌞	⌞	⌞	⌞	⌞	⌞	⌞	⌞	⌞	⌞	⌞	⌞	⌞	\llcorner
u+023b0	ſ	ſ				ſ			ſ	ſ							\lmoustache <sup>(p)</sup>
u+02772	{								{								\lbrbrak
u+027c5	⌚	⌚							⌚								\lbag
u+027cc	)								)	﴿							\long-division
u+027e6	⟦	⟦	⟦	⟦	⟦	⟦	⟦	⟦	⟦	⟦	⟦	⟦	⟦	⟦	⟦	⟦	\lBrack
u+027e8	⟨	⟨	⟨	⟨	⟨	⟨	⟨	⟨	⟨	⟨	⟨	⟨	⟨	⟨	⟨	⟨	\langle <sup>(p)</sup>
u+027ea	⟪	⟪	⟪	⟪	⟪	⟪	⟪	⟪	⟪	⟪	⟪	⟪	⟪	⟪	⟪	⟪	\lAngle
u+027ec	⟲		⟲						⟲	⟲	⟲						\lBrbrak
u+027ee	(	(	(	(	(	(	(	(	(	(	(	(	(	(	(	(	\lgroup <sup>(p)</sup>
u+02983	❴	❴	❴						❴	❴	❴						\lBrace
u+02985	❴	❴	❴						❴	❴	❴						\lParen
u+02987	﴿	﴿	﴿						﴿	﴿	﴿						\llparenthesis
u+02989	﴿	﴿	﴿						﴿	﴿	﴿						\llangle
u+0298b	〔	〔	〔						〔	〔	〔						\lbrackubar
u+0298d	〔	〔	〔						〔	〔	〔						\lbrackultick

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+0298f	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\lbrack-lltick
u+02991	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\langle-dot
u+02993	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\lparen-less
u+02995	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\Lparengtr
u+02997	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\lblk-br-brak
u+029d8	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\lvzigzag
u+029da	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\Lvzigzag
u+029fc	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\lcurvyan-gle

## \mathclose

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+00021	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	!	\mathexclam
u+00029	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)	\rparen
u+0005d	]	]	]	]	]	]	]	]	]	]	]	]	]	]	]	]	\rbrack
u+0007d	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\rbrace <sup>(p)</sup>
u+02309	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\rceil <sup>(p)</sup>
u+0230b	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\rfloor <sup>(p)</sup>
u+0231d	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\urcorner
u+0231f	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\lrcorner
u+023b1	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\rmoustache <sup>(p)</sup>
u+02773	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\rbrbrak
u+027c6	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\rbag
u+027e7	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\rBrack
u+027e9	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\rangle <sup>(p)</sup>
u+027eb	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\rangleAngle
u+027ed	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	‑	\Rbrbrak

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+027ef	)	)	⇒	)	)	)	)	)	)	)	)	)	)	)	)	)	\rgroup <sup>(p)</sup>
u+02984	⦶	⦷	⦸	⦹	⦺	⦻	⦼	⦽	⦾	⦿	⦻	⦻	⦻	⦻	⦻	⦻	\rBrace
u+02986	⦵	⦶	⦷	⦸	⦹	⦺	⦼	⦽	⦾	⦿	⦻	⦻	⦻	⦻	⦻	⦻	\rParen
u+02988	⦶	⦷	⦸	⦹	⦺	⦼	⦽	⦽	⦾	⦿	⦻	⦻	⦻	⦻	⦻	⦻	\rrparenthesis
u+0298a	⦶	⦷	⦸	⦹	⦺	⦼	⦽	⦽	⦾	⦿	⦻	⦻	⦻	⦻	⦻	⦻	\rrangle
u+0298c	⦵	⦶	⦷	⦸	⦹	⦺	⦼	⦽	⦾	⦿	⦻	⦻	⦻	⦻	⦻	⦻	\rbrackubar
u+0298e	⦵	⦶	⦷	⦸	⦹	⦺	⦼	⦽	⦾	⦿	⦻	⦻	⦻	⦻	⦻	⦻	\rbracklrtick
u+02990	⦶	⦷	⦸	⦹	⦺	⦼	⦽	⦽	⦾	⦿	⦻	⦻	⦻	⦻	⦻	⦻	\rbrackurtick
u+02992	⦶	⦷	⦸	⦹	⦺	⦼	⦽	⦽	⦾	⦿	⦻	⦻	⦻	⦻	⦻	⦻	\rangledot
u+02994	⦶	⦷	⦸	⦹	⦺	⦼	⦽	⦽	⦾	⦿	⦻	⦻	⦻	⦻	⦻	⦻	\rparengtr
u+02996	⦶	⦷	⦸	⦹	⦺	⦼	⦽	⦽	⦾	⦿	⦻	⦻	⦻	⦻	⦻	⦻	\Rparenless
u+02998	⦶	⦷	⦸	⦹	⦺	⦼	⦽	⦽	⦾	⦿	⦻	⦻	⦻	⦻	⦻	⦻	\rbblkbrbrak
u+029d9	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	\rvzigzag
u+029db	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	\Rvzigzag
u+029fd	›	›	›	›	›	›	›	›	›	›	›	›	›	›	›	›	\rcurvyangle

## \mathfence

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+0007c	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	\vert <sup>(p)</sup>
u+02016	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	\Vert <sup>(p)</sup>
u+02980	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	\Vvert

## \mathpunct

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+0002c	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	\mathcomma
u+0003a	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	\mathcolon
u+0003b	;	;	;	;	;	;	;	;	;	;	;	;	;	;	;	;	\mathsemicolon

## \mathaccent

Um die Akzente korrekt zu platzieren, muss die jeweilige OpenType-Schrift entsprechende Informationen zur Verfügung stellen.

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+00300	$\grave{x}$	\grave{(p)}															
u+00301	$\acute{x}$	\acute{(p)}															
u+00302	$\hat{x}$	\hat{(p)}															
u+00303	$\tilde{x}$	\tilde{(p)}															
u+00304	$\bar{x}$	\bar{(p)}															
u+00305	$\breve{x}$	\overline{(p)}															
u+00306	$\check{x}$	\breve{(p)}															
u+00307	$\dot{x}$	\dot{(p)}															
u+00308	$\ddot{x}$	\ddot{(p)}															
u+00309	$\grave{\check{x}}$	\gravehook{(p)}															
u+0030a	$\circledcirc{x}$	\circirc{(p)}															
u+0030c	$\check{\grave{x}}$	\checkgrave{(p)}															
u+00310	$\grave{\circ}$	$\grave{\circ}$							$\grave{\circ}$	$\grave{\circ}$	$\grave{\circ}$						\candra
u+00312	$\grave{\circ}$	$\grave{\circ}$							$\grave{\circ}$	$\grave{\circ}$	$\grave{\circ}$						\oturnedcomma
u+00315	$\grave{\cdot}$	$\grave{\cdot}$							$\grave{\cdot}$	$\grave{\cdot}$	$\grave{\cdot}$						\ocommatopright
u+0031a	$\grave{\ddot{x}}$	$\grave{\ddot{x}}$							$\grave{\ddot{x}}$	$\grave{\ddot{x}}$	$\grave{\ddot{x}}$						\droang
u+020d0	$\vec{x}$	\leftharpoonaccent															
u+020d1	$\vec{\vec{x}}$	\rightharpoonaccent															
u+020d2	$\not{x}$	\vertoverset															
u+020d7	$\vec{\vec{x}}$	\vec{(p)}															
u+020db	$\cdots\vec{x}$	\dddot{(p)}															
u+020dc	$\cdots\vec{\vec{x}}$	\ddot{(p)}															
u+020e7	$\overline{x}]$	$\overline{x}]$							$\overline{x}]$	$\overline{x}]$	$\overline{x}]$				$\overline{x}]$	$\overline{x}]$	\annuity
u+020e9	$\overline{x}]$	\widebridgeabove															
u+020f0	$\overset{*}{x}$	$\overset{*}{x}$			$\overset{*}{x}$	\asteraccent											

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
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## \mathaccentswide

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+00302	$\hat{x}$	$\hat{x}$ \widehat{ <sup>(p)</sup> }															
u+00303	$\tilde{x}$	$\tilde{x}$ \widetilde{ <sup>(p)</sup> }															
u+00305	$\bar{x}$	$\bar{x}$ \wideoverline{ <sup>(p)</sup> }															
u+00306	$\breve{x}$	$\breve{x}$ \widebreve{ <sup>(p)</sup> }															
u+0030c	$\check{x}$	$\check{x}$ \widecheck{ <sup>(p)</sup> }															
u+020d0	$\overleftarrow{x}$	$\overleftarrow{x}$ \overleftarrow{ <sup>(p)</sup> }															
u+020d1	$\overrightarrow{x}$	$\overrightarrow{x}$ \overrightarrow{ <sup>(p)</sup> }															
u+020d6	$\overleftarrow{\overleftarrow{x}}$	$\overleftarrow{\overleftarrow{x}}$ \overleftarrow{\overleftarrow{ <sup>(p)</sup> }}															
u+020d7	$\overrightarrow{\overrightarrow{x}}$ \overrightarrow{\overrightarrow{ <sup>(p)</sup> }}																
u+020e1	$\overleftrightarrow{x}$	$\overleftrightarrow{x}$ \overleftrightarrow{ <sup>(p)</sup> }															

## Bottom accents, \mathbotaccent

### Wide bottom accents, \mathbotaccentwide

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Ternes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+00330	$\tilde{x}$	$\mathfrak{x}$	$\mathfrak{x}$		$\mathfrak{x}$	$\mathfrak{x}$	$\text{\widetilde{e}}$										
u+00332	$\underline{x}$	$\underline{x}$	$\underline{x}$	$\underline{x}$	$\underline{x}$	$\underline{x}$	$\underline{x}$	$\underline{x}$	$\underline{x}$	$\underline{x}$	$\underline{x}$	$\underline{x}$	$\underline{x}$	$\underline{x}$	$\underline{x}$	$\underline{x}$	$\text{\mathbf{underbrace{e}}}$
u+0034d	$\leftrightarrow x$	$\mathfrak{x}$	$\mathfrak{x}$		$\mathfrak{x}$	$\leftrightarrow$		$\text{\underleftarrow{e}}$									
u+020ec	$\underline{\mathfrak{x}}$	$\underline{\mathfrak{x}}$		$\mathfrak{x}$	$\mathfrak{x}$	$\text{\underbrace{\mathfrak{e}}_{\mathfrak{h}}}$											
u+020ed	$\mathfrak{x}$	$\mathfrak{x}$		$\mathfrak{x}$	$\mathfrak{x}$	$\text{\underbrace{\mathfrak{e}}_{\mathfrak{p}}}$											
u+020ee	$\hat{x}$	$\hat{x}$		$\hat{x}$	$\hat{x}$	$\text{\underbrace{\hat{e}}_{\mathfrak{h}}}$											
u+020ef	$\downarrow x$	$\downarrow x$		$\downarrow x$	$\downarrow x$	$\text{\underbrace{\downarrow e}_{\mathfrak{r}}}$											

## \mathbin

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+0002b	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	\mathplus
u+000b1	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	\pm <sup>(p)</sup>
u+000b7	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	\cdot
u+000d7	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	\times <sup>(p)</sup>
u+000f7	÷	÷	÷	÷	÷	÷	÷	÷	÷	÷	÷	÷	÷	÷	÷	÷	\div <sup>(p)</sup>
u+02020	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	\dag-ger <sup>(p)</sup>
u+02021	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	\ddagger-ger <sup>(p)</sup>
u+02022	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	\sm-blk-circle
u+02040	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)	\tieconcat
u+02044	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	\frac-slash
u+0214b	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	\upand
u+02212	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	\minus
u+02213	干	干	干	干	干	干	干	干	干	干	干	干	干	干	干	干	\mp <sup>(p)</sup>
u+02214	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	\dotplus <sup>(a)</sup>
u+02215	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	\di-vs-slash
u+02216	\	\	\	\	\	\	\	\	\	\	\	\	\	\	\	\	\smallsetminus
u+02217	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	\ast <sup>(p)</sup>
u+02218	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦	◦	\vysmwhtcircle
u+02219	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	\vysm-blk-circle
u+02227	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^	^	\wedge <sup>(p)</sup>
u+02228	∨	∨	∨	∨	∨	∨	∨	∨	∨	∨	∨	∨	∨	∨	∨	∨	\vee <sup>(p)</sup>
u+02229	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	\cap <sup>(p)</sup>
u+0222a	∪	∪	∪	∪	∪	∪	∪	∪	∪	∪	∪	∪	∪	∪	∪	∪	\cup <sup>(p)</sup>

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+02238	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	\dotminus
u+0223e	₂	₂	₂	₂	₂	₂	₂	₂	₂	₂	₂	₂	₂	₂	₂	₂	\invlazys
u+02240	₷	₷	₷	₷	₷	₷	₷	₷	₷	₷	₷	₷	₷	₷	₷	₷	\wr <sup>(p)</sup>
u+0228c	₸	₸	₸	₸	₸	₸	₸	₸	₸	₸	₸	₸	₸	₸	₸	₸	\cuppleftarrow
u+0228d	₵	₵	₵	₵	₵	₵	₵	₵	₵	₵	₵	₵	₵	₵	₵	₵	\cupdot
u+0228e	₹	₹	₹	₹	₹	₹	₹	₹	₹	₹	₹	₹	₹	₹	₹	₹	\uplus <sup>(p)</sup>
u+02293	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	\sqcap <sup>(p)</sup>
u+02294	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	\sqcupcup <sup>(p)</sup>
u+02295	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕	\oplus <sup>(p)</sup>
u+02296	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	\ominus <sup>(p)</sup>
u+02297	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	\otimes <sup>(p)</sup>
u+02298	⊘	⊘	⊘	⊘	⊘	⊘	⊘	⊘	⊘	⊘	⊘	⊘	⊘	⊘	⊘	⊘	\oslash <sup>(p)</sup>
u+02299	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	\odot <sup>(p)</sup>
u+0229a	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	\circledcirc <sup>(a)</sup>
u+0229b	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	\circledast <sup>(a)</sup>
u+0229c	⊜	⊜	⊜	⊜	⊜	⊜	⊜	⊜	⊜	⊜	⊜	⊜	⊜	⊜	⊜	⊜	\circled-equal
u+0229d	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	⊖	\circled-dash <sup>(a)</sup>
u+0229e	田	田	田	田	田	田	田	田	田	田	田	田	田	田	田	田	\boxplus <sup>(a)</sup>
u+0229f	田	田	田	田	田	田	田	田	田	田	田	田	田	田	田	田	\boxminus <sup>(a)</sup>
u+022a0	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	\boxtimes <sup>(a)</sup>
u+022a1	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	\boxdot <sup>(a)</sup>
u+022ba	⠄	⠄	⠄	⠄	⠄	⠄	⠄	⠄	⠄	⠄	⠄	⠄	⠄	⠄	⠄	⠄	\intercal <sup>(a)</sup>

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+022bb	∨	∨	∨	∨	∨	∨	∨	∨	∨	∨	∨	∨	∨	∨	∨	∨	\vee-bar <sup>(a)</sup>
u+022bc	Ȑ	Ȑ	Ȑ	Ȑ	Ȑ	Ȑ	Ȑ	Ȑ	Ȑ	Ȑ	Ȑ	Ȑ	Ȑ	Ȑ	Ȑ	Ȑ	\bar-wedge <sup>(a)</sup>
u+022bd	ȑ	ȑ	ȑ	ȑ	ȑ	ȑ	ȑ	ȑ	ȑ	ȑ	ȑ	ȑ	ȑ	ȑ	ȑ	ȑ	\barvee
u+022c4	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	\smwht-diamond
u+022c5	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	\cdot <sup>(p)</sup>
u+022c6	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	\star <sup>(p)</sup>
u+022c7	✳	✳	✳	✳	✳	✳	✳	✳	✳	✳	✳	✳	✳	✳	✳	✳	\di-videontimes <sup>(a)</sup>
u+022c9	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	\ltimes <sup>(a)</sup>
u+022ca	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	\rtimes <sup>(a)</sup>
u+022cb	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	\left-threetimes <sup>(a)</sup>
u+022cc	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	\right-threetimes <sup>(a)</sup>
u+022ce	Ƴ	Ƴ	Ƴ	Ƴ	Ƴ	Ƴ	Ƴ	Ƴ	Ƴ	Ƴ	Ƴ	Ƴ	Ƴ	Ƴ	Ƴ	Ƴ	\curlyvee <sup>(a)</sup>
u+022cf	⼈	⼈	⼈	⼈	⼈	⼈	⼈	⼈	⼈	⼈	⼈	⼈	⼈	⼈	⼈	⼈	\curlywedge <sup>(a)</sup>
u+022d2	߱	߱	߱	߱	߱	߱	߱	߱	߱	߱	߱	߱	߱	߱	߱	߱	\Cap <sup>(a)</sup>
u+022d3	ߩ	ߩ	ߩ	ߩ	ߩ	ߩ	ߩ	ߩ	ߩ	ߩ	ߩ	ߩ	ߩ	ߩ	ߩ	ߩ	\Cup <sup>(a)</sup>
u+02305	߸	߸	߸	߸	߸	߸	߸	߸	߸	߸	߸	߸	߸	߸	߸	߸	\varbarwedge
u+02306	߹	߹	߹	߹	߹	߹	߹	߹	߹	߹	߹	߹	߹	߹	߹	߹	\vardoublebarwedge
u+0233d	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	\obar
u+025b3	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	\bigtriangleup
u+025b7	▷	▷		▷	▷	▷	▷	▷	▷	▷	▷	▷	▷	▷	▷	▷	\triangleright <sup>(p)</sup>
u+025c1	◁	◁		◁	◁	◁	◁	◁	◁	◁	◁	◁	◁	◁	◁	◁	\triangleleft <sup>(p)</sup>

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+025cb	○	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○	\mdl-gwht-circle
u+025eb	□	□	□							□	□	□	□	□	□	□	\boxbar
u+027c7	▽	▽	▽							▽	▽	▽	▽	▽	▽	▽	\weedot
u+027d1	Ⓐ	Ⓐ	Ⓐ							Ⓐ	Ⓐ	Ⓐ	Ⓐ	Ⓐ	Ⓐ	Ⓐ	\wedge-dot
u+027e0	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	\lozengemimus
u+027e1	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	\concavediamond
u+027e2	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	\concavediamondtick-left
u+027e3	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	\concavediamondtick-right
u+027e4	-□	□	□							-□	-□	-□	-□	-□	-□	-□	\whitesquaretick-left
u+027e5	□-	□	□							□-	□-	□-	□-	□-	□-	□-	\whitesquaretick-right
u+029b5	⊖	⊖	⊖							⊖	⊖	⊖	⊖	⊖	⊖	⊖	\circlehbar
u+029b6	⊖	⊖	⊖							⊖	⊖	⊖	⊖	⊖	⊖	⊖	\circled-vert
u+029b7	⊖	⊖	⊖							⊖	⊖	⊖	⊖	⊖	⊖	⊖	\circled-parallel
u+029b8	⊖	⊖	⊖							⊖	⊖	⊖	⊖	⊖	⊖	⊖	\obslash
u+029b9	⊖	⊖	⊖							⊖	⊖	⊖	⊖	⊖	⊖	⊖	\op-erp
u+029c0	⊖	⊖	⊖							⊖	⊖	⊖	⊖	⊖	⊖	⊖	\olessthan

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+029c1		⌚	⌚	⌚							⌚	⌚				⌚	\greaterthan
u+029c4		▣	▣	▣							▣	▣				▣	\boxdiag
u+029c5		▣	▣	▣							▣	▣				▣	\boxbslash
u+029c6		✳	✳	✳							✳	✳				✳	\boxast
u+029c7		▣	▣	▣							▣	▣				▣	\boxcircle
u+029c8		▣	▣	▣							▣	▣				▣	\boxbox
u+029cd		△	△	△							△	△	△			△	\triangleboxserifs
u+029d6		☒	☒	☒							☒	☒				☒	\hourglass
u+029d7		☒	☒	☒							☒	☒				☒	\blackhourglass
u+029e2		ᴱ	ᴱ	ᴱ							ᴱ	ᴱ				ᴱ	\shuffle
u+029eb		♦	♦	♦		♦					♦	♦				♦	\mdlgblklozenge
u+029f5		＼	＼	＼		＼					＼	＼	＼	＼		＼	\setminusnus <sup>(p)</sup>
u+029f6		˥	˥	˥							˥	˥	˥			˥	\dsol
u+029f7		˧	˧	˧							˧	˧	˧			˧	\rsolbar
u+029fa		#	#	#							#	#				#	\doubleplus
u+029fb		#	#	#							#	#				#	\tripleplus
u+029fe		+	+	+							+	+				+	\tpplus
u+029ff		˥	˥	˥							˥	˥				˥	\tmminus
u+02a22		°	°	°							°	°	°	°		°	\ringplus
u+02a23		†	†	†							†	†	†	†		†	\plushat
u+02a24		߿	߿	߿							߿	߿	߿	߿		߿	\simplus

Fortsetzung ...

USV	LM	XITS	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+02a25	+	+	+	+						+		+	+	+	+	\plusdot	
u+02a26	+	+	+	+						+		+	+	+	+	\plussim	
u+02a27	+	+	+							+		+	+	+	+	\plussubtwo	
u+02a28	*	*	*							*		*	*	*	*	\plustrif	
u+02a29	-	-	-							-		-	-	-	-	\commamimus	
u+02a2a	-	-	-							-		-	-	-	-	\minusdot	
u+02a2b	.	.	.							.		.	.	.	.	\minusfdots	
u+02a2c	.	.	.							.		.	.	.	.	\minusrdots	
u+02a2d	⊕	⊕	⊕							⊕		⊕	⊕	⊕	⊕	\opluslhrim	
u+02a2e	⊕	⊕	⊕							⊕		⊕	⊕	⊕	⊕	\oplusrhrim	
u+02a2f	×	×	×	×	×	×	×	×	×	×		×	×	×	×	\vectimes	
u+02a30	×	×	×							×		×	×	×	×	\dotstimes	
u+02a31	×	×	×							×		×	×	×	×	\timesbar	
u+02a32	×	×	×							×		×	×	×	×	\bttimes	
u+02a33	※	※	※							※		※	※	※	※	\smashtimes	
u+02a34	⊗	⊗	⊗							⊗		⊗	⊗	⊗	⊗	\otimeslhrim	
u+02a35	⊗	⊗	⊗							⊗		⊗	⊗	⊗	⊗	\otimesrhrim	
u+02a36	◊	◊	◊							◊		◊	◊	◊	◊	\otimeshat	
u+02a37	⊗	⊗	⊗							⊗		⊗	⊗	⊗	⊗	\Otimes	
u+02a38	÷	÷	÷							÷		÷	÷	÷	÷	\odiv	
u+02a39	△	△	△							△		△	△	△	△	\triangleplus	

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+02a3a		△	△	△							△	△	△	△	△	△	\tri-anglemimus
u+02a3b		△	△	△							△	△	△	△	△	△	\triangle-times
u+02a3c	—	—	—	—							—	—	—	—	—	—	\intprod
u+02a3d	Γ	Γ	Γ	Γ							Γ	Γ	Γ	Γ	Γ	Γ	\intprod
u+02a3e	◊	◊	◊	◊							◊	◊	◊	◊	◊	◊	\fcmp
u+02a3f	∏	∏	∏	∏	∏	∏	∏	∏	∏	∏	∏	∏	∏	∏	∏	∏	\amalg <sup>(p)</sup>
u+02a40	□	□	□	□							□	□	□	□	□	□	\capdot
u+02a41	□	□	□	□							□	□	□	□	□	□	\uminus
u+02a42	□	□	□	□							□	□	□	□	□	□	\barcup
u+02a43	□	□	□	□							□	□	□	□	□	□	\barcap
u+02a44	□	□	□	□							□	□	□	□	□	□	\capwedge
u+02a45	□	□	□	□							□	□	□	□	□	□	\cupvee
u+02a46	□	□	□	□							□	□	□	□	□	□	\cupovercap
u+02a47	□	□	□	□							□	□	□	□	□	□	\capovercup
u+02a48	□	□	□	□							□	□	□	□	□	□	\cupbarcap
u+02a49	□	□	□	□							□	□	□	□	□	□	\capbarcup
u+02a4a	□	□	□	□							□	□	□	□	□	□	\twocups
u+02a4b	□	□	□	□							□	□	□	□	□	□	\twocaps
u+02a4c	□	□	□	□							□	□	□	□	□	□	\closedvarcup
u+02a4d	□	□	□	□							□	□	□	□	□	□	\closedvarcap
u+02a4e	□	□	□	□							□	□	□	□	□	□	\Sqcap

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+02a4f		Ѐ									Ѐ						\Sqcup
u+02a50		Ѐ	Ѐ	Ѐ							Ѐ	Ѐ	Ѐ	Ѐ	Ѐ	Ѐ	\closed-var-cups-mash-prod
u+02a51	Ѐ	Ѐ	Ѐ							Ѐ	Ѐ	Ѐ	Ѐ	Ѐ	Ѐ	Ѐ	\wed-geodot
u+02a52	Ѷ	Ѷ	ѷ							Ѷ	ѷ	ѷ	ѷ	ѷ	ѷ	ѷ	\veeodot
u+02a53	Ӑ	Ӑ	Ӑ							Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	\Wedge
u+02a54	Ѷ	Ѷ	ѷ							Ѷ	ѷ	ѷ	ѷ	ѷ	ѷ	ѷ	\Vee
u+02a55	Ӑ	Ӑ	Ӑ							Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	\wed-geon-wedge
u+02a56	Ѷ	Ѷ	ѷ							Ѷ	ѷ	ѷ	ѷ	ѷ	ѷ	ѷ	\veeon-vee
u+02a57	Ѷ	Ѷ	ѷ							Ѷ	ѷ	ѷ	ѷ	ѷ	ѷ	ѷ	\bigslope-d-vee
u+02a58	Ԇ	Ԇ	Ԇ							Ԇ	Ԇ	Ԇ	Ԇ	Ԇ	Ԇ	Ԇ	\bigslope-d-wedge
u+02a5a	Ӑ	Ӑ	Ӑ							Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	\wedgemid-vert
u+02a5b	Ѷ	Ѷ	ѷ							Ѷ	ѷ	ѷ	ѷ	ѷ	ѷ	ѷ	\veemid-vert
u+02a5c	Ӑ	Ӑ	Ӑ							Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	\mid-bar-wedge
u+02a5d	߻	߻	߻							߻	߻	߻	߻	߻	߻	߻	\mid-barvee
u+02a5e	܂	܂	܂		܂					܂	܂	܂	܂	܂	܂	܂	\double-bar-wedge <sup>(a)</sup>
u+02a5f	܂	܂	܂		܂					܂	܂	܂	܂	܂	܂	܂	\wedge-bar
u+02a60	܂	܂	܂							܂	܂	܂	܂	܂	܂	܂	\wedge-double-bar
u+02a61	݂	݂	݂							݂	݂	݂	݂	݂	݂	݂	\varvee-bar
u+02a62	܂	܂	܂							܂	܂	܂	܂	܂	܂	܂	\double-barvee

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+02a63		॥	॥	॥	॥	॥	॥	॥	॥	॥	॥	॥	॥	॥	॥	॥	\veedoublebar
u+02a64		≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	≡	\dsub
u+02a65																	\rsub
u+02a71																	\eqqplus
u+02a72																	\pluseqq
u+02af4																	\ininterleave
u+02af5	…	≡															\nhVvert
u+02af6	…	≡															\three-dotcolon
u+02afb	///	///	///								///	///	///	///	///	///	\trslash
u+02afd	//	//	//								//	//	//	//	//	//	\sslash
u+02afe	□	□	□								□	□	□	□	□	□	\talloblong

## \mathord

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+00023	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	\mathoctothorpe
u+00024	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\mathdollar
u+00025	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	\mathpercent
u+00026	&	&	&	&	&	&	&	&	&	&	&	&	&	&	&	&	\mathampersand
u+0002e	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	\mathperiod
u+0002f	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	\mathslash
u+0003f	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	\mathquestion

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+00040	@	@	@	@	@	@	@	@	@	@	@	@	@	@	@	@	\mathat-sign
u+0005c	\	\	\	\	\	\	\	\	\	\	\	\	\	\	\	\	\backslash^{(p)}
u+000a3	£	£	£	£	£	£	£	£	£	£	£	£	£	£	£	£	\mathsterling
u+000a5	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	\mathyen
u+000a7	§	§	§	§	§	§	§	§	§	§	§	§	§	§	§	§	\mathsection
u+000ac	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	\neg^{(p)}
u+000b6	¶	¶	¶	¶	¶	¶	¶	¶	¶	¶	¶	¶	¶	¶	¶	¶	\mathparagraph
u+001b5	Ζ	Ζ			Ζ			Ζ	Ζ								\Zbar
u+003f6	϶				϶			϶	϶	϶	϶	϶	϶	϶	϶	϶	\upbackepsilon
u+02015	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	\horizbar
u+02017	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	\twolowline
u+02025	..		..							..	..	..					\enleadertwodots
u+02026	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	\uni-codeelipsis
u+02032	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	\prime^{(p)}
u+02033	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	\dprime
u+02034	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	'''	\trprime
u+02035	`	`	`	`	`	`	`	`	`	`	`	`	`	`	`	`	\backprime^{(a)}
u+02036	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	“	\backdprime
u+02037	„	„	„	„	„	„	„	„	„	„	„	„	„	„	„	„	\backtrprime
u+02038	^									^							\caretinsert
u+0203c	!!	!!	!!							!!	!!	!!	!!				\Exclam
u+02043	-									-							\hyphenbullet
u+02047	??									??	??	??	??				\Question
u+02057	„„	„„	„„	„„	„„	„„	„„	„„	„„	„„	„„	„„	„„	„„	„„	„„	\qprime
u+020ac	€	€	€	€	€	€	€	€	€	€	€	€	€	€	€	€	\euro
u+020dd	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	\enclosecircle
u+020de	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	\enclosesquare

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Six2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+020df	◊	◊◊◊	◊	◊	◊◊◊◊◊◊	◊◊◊◊◊◊	◊◊◊◊◊◊	◊◊◊◊◊◊	◊◊◊◊◊◊	◊◊◊◊◊◊	◊◊◊◊◊◊	◊◊◊◊◊◊	◊◊◊◊◊◊	◊◊◊◊◊◊	◊◊◊◊◊◊	◊◊◊◊◊◊	\enclosediamond
u+020e4	△	△	△	△	△△△△△△	△△△△△△	△△△△△△	△△△△△△	△△△△△△	△△△△△△	△△△△△△	△△△△△△	△△△△△△	△△△△△△	△△△△△△	△△△△△△	\enclosetriangle
u+02107	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	\Eulerconst
u+0210e	h	h	h	h	h	h	h	h	h	h	h	h	h	h	h	h	\Planckconst
u+02127	ʊ	ʊ	ʊ	ʊ	ʊ	ʊ	ʊ	ʊ	ʊ	ʊ	ʊ	ʊ	ʊ	ʊ	ʊ	ʊ	\mho
u+02132	Ƒ	Ƒ	Ƒ	Ƒ	Ƒ	Ƒ	Ƒ	Ƒ	Ƒ	Ƒ	Ƒ	Ƒ	Ƒ	Ƒ	Ƒ	Ƒ	\Finv <sup>(a)</sup>
u+0213c	҂	҂	҂	҂	҂	҂	҂	҂	҂	҂	҂	҂	҂	҂	҂	҂	\Bbbpi
u+02141	҃	҃	҃	҃	҃	҃	҃	҃	҃	҃	҃	҃	҃	҃	҃	҃	\Game <sup>(a)</sup>
u+02142	҄	҄	҄	҄	҄	҄	҄	҄	҄	҄	҄	҄	҄	҄	҄	҄	\sansLturned
u+02143	҅	҅	҅	҅	҅	҅	҅	҅	҅	҅	҅	҅	҅	҅	҅	҅	\sansLmirrored
u+02144	ㅅ	ㅅ	ㅅ	ㅅ	ㅅ	ㅅ	ㅅ	ㅅ	ㅅ	ㅅ	ㅅ	ㅅ	ㅅ	ㅅ	ㅅ	ㅅ	\Yup
u+02145	Ԁ	Ԁ	Ԁ	Ԁ	Ԁ	Ԁ	Ԁ	Ԁ	Ԁ	Ԁ	Ԁ	Ԁ	Ԁ	Ԁ	Ԁ	Ԁ	\mitBbbD
u+02146	ԁ	ԁ	ԁ	ԁ	ԁ	ԁ	ԁ	ԁ	ԁ	ԁ	ԁ	ԁ	ԁ	ԁ	ԁ	ԁ	\mitBbbd
u+02147	ԑ	ԑ	ԑ	ԑ	ԑ	ԑ	ԑ	ԑ	ԑ	ԑ	ԑ	ԑ	ԑ	ԑ	ԑ	ԑ	\mitBbbe
u+02148	ឬ	ឬ	ឬ	ឬ	ឬ	ឬ	ឬ	ឬ	ឬ	ឬ	ឬ	ឬ	ឬ	ឬ	ឬ	ឬ	\mitBbbi
u+02149	᠁	᠁	᠁	᠁	᠁	᠁	᠁	᠁	᠁	᠁	᠁	᠁	᠁	᠁	᠁	᠁	\mitBbbj
u+0214a	᠁᠁	᠁᠁	᠁᠁	᠁᠁	᠁᠁	᠁᠁	᠁᠁	᠁᠁	᠁᠁	᠁᠁	᠁᠁	᠁᠁	᠁᠁	᠁᠁	᠁᠁	᠁᠁	\PropertyLine
u+021a8	⤒	⤒	⤒	⤒	⤒	⤒	⤒	⤒	⤒	⤒	⤒	⤒	⤒	⤒	⤒	⤒	\updownnarrowbar
u+021b4	⤓	⤓	⤓	⤓	⤓	⤓	⤓	⤓	⤓	⤓	⤓	⤓	⤓	⤓	⤓	⤓	\linefeed
u+021b5	⤔	⤔	⤔	⤔	⤔	⤔	⤔	⤔	⤔	⤔	⤔	⤔	⤔	⤔	⤔	⤔	\carriageturn
u+021b8	⤕	⤕	⤕	⤕	⤕	⤕	⤕	⤕	⤕	⤕	⤕	⤕	⤕	⤕	⤕	⤕	\barovernorthwestarrow
u+021b9	⤖	⤖	⤖	⤖	⤖	⤖	⤖	⤖	⤖	⤖	⤖	⤖	⤖	⤖	⤖	⤖	\barleftrightarrowrightbarrow
u+021ba	⤗	⤗	⤗	⤗	⤗	⤗	⤗	⤗	⤗	⤗	⤗	⤗	⤗	⤗	⤗	⤗	\acwopencclearrow
u+021bb	⤘	⤘	⤘	⤘	⤘	⤘	⤘	⤘	⤘	⤘	⤘	⤘	⤘	⤘	⤘	⤘	\cwopencclearrow
u+021de	₩	₩	₩	₩	₩	₩	₩	₩	₩	₩	₩	₩	₩	₩	₩	₩	\nHupar

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+021df		‡	‡	‡							‡	‡	‡	‡	‡	‡	\nHdown-narrow
u+021e0		↔…	↔…	↔…		↔…				↔…	↔…	↔…	↔…	↔…	↔…	↔…	\left-dasharrow
u+021e1		↑…	↑…	↑…		↑…				↑…	↑…	↑…	↑…	↑…	↑…	↑…	\updasharrow
u+021e2		→…	→…	→…		→…				→…	→…	→…	→…	→…	→…	→…	\right-dasharrow
u+021e3		↓…	↓…	↓…		↓…				↓…	↓…	↓…	↓…	↓…	↓…	↓…	\down-dasharrow
u+021e6		⟲	⟲	⟲	⟲	⟲	⟲	⟲	⟲	⟲	⟲	⟲	⟲	⟲	⟲	⟲	\left-whitearrow
u+021e7		↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	\up-whitearrow
u+021e8		⇒	⇒	⇒	⇒	⇒	⇒	⇒	⇒	⇒	⇒	⇒	⇒	⇒	⇒	⇒	\rightwhitearrow
u+021e9		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	\down-whitearrow
u+021ea		⊟	⊟	⊟						⊟	⊟	⊟	⊟	⊟	⊟	⊟	\whitearrowupfrombar
u+02200	∀	∀	∀	∀	∀	∀	∀	∀	∀	∀	∀	∀	∀	∀	∀	∀	\forall <sup>(p)</sup>
u+02201	∁	∁	∁	∁	∁	∁	∁	∁	∁	∁	∁	∁	∁	∁	∁	∁	\complement <sup>(a)</sup>
u+02203	Ǝ	Ǝ	Ǝ	Ǝ	Ǝ	Ǝ	Ǝ	Ǝ	Ǝ	Ǝ	Ǝ	Ǝ	Ǝ	Ǝ	Ǝ	Ǝ	\exists <sup>(p)</sup>
u+02204	Ǝ̄	Ǝ̄	Ǝ̄	Ǝ̄	Ǝ̄	Ǝ̄	Ǝ̄	Ǝ̄	Ǝ̄	Ǝ̄	Ǝ̄	Ǝ̄	Ǝ̄	Ǝ̄	Ǝ̄	Ǝ̄	\nexists <sup>(a)</sup>
u+02205	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	\varnothing
u+02206	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	\incre-
u+0220e	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	\QED
u+0221a	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	\surd <sup>(p)</sup>
u+0221e	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	\infty <sup>(p)</sup>
u+0221f	∟	∟	∟	∟	∟	∟	∟	∟	∟	∟	∟	∟	∟	∟	∟	∟	\righttriangle
u+02220	∠	∠	∠	∠	∠	∠	∠	∠	∠	∠	∠	∠	∠	∠	∠	∠	\angle <sup>(p)</sup>
u+02221	⦿	⦿	⦿	⦿	⦿	⦿	⦿	⦿	⦿	⦿	⦿	⦿	⦿	⦿	⦿	⦿	\measuredangle <sup>(a)</sup>
u+02222	⦾	⦾	⦾	⦾	⦾	⦾	⦾	⦾	⦾	⦾	⦾	⦾	⦾	⦾	⦾	⦾	\sphericalangle <sup>(a)</sup>

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Six2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+02234	∴	∴	∴	∴	∴	∴	∴	∴	∴	∴	∴	∴	∴	∴	∴	∴	\therefore <sup>(a)</sup>
u+02235	∴	∴	∴	∴	∴	∴	∴	∴	∴	∴	∴	∴	∴	∴	∴	∴	\because <sup>(a)</sup>
u+0223f	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	\sinewave
u+022a4	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	\top <sup>(p)</sup>
u+022a5	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	\bot <sup>(p)</sup>
u+022b9	+̄	+̄	+̄	+̄	+̄	+̄	+̄	+̄	+̄	+̄	+̄	+̄	+̄	+̄	+̄	+̄	\hermit-matrix
u+022be	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	\measuredrectangle
u+022bf	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	\vartriangle
u+022ef	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	\unicodedots
u+02300	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	∅	\diameter
u+02302	⌂	⌂	⌂	⌂	⌂	⌂	⌂	⌂	⌂	⌂	⌂	⌂	⌂	⌂	⌂	⌂	\house
u+02310	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	\invnot
u+02311	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	\sqlozenge
u+02312	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)	\proline
u+02313	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)	\profsurf
u+02317	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#	\viewdata
u+02319	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	¬	\turned-not
u+02320	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	ƒ	\inttop
u+02321	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	\intbottom
u+0232c	◇								◇								\varhexagonrbonds
u+02332	►	▼								►							\conictaper
u+02336	⊤	⊤								⊤							\topbot
u+02340	†	†								†							\APLnot-backslash
u+02353	□	□								□							\APLbox-upcaret
u+02370	?	?								?							\APLboxquestion
u+0237c	↖	↖								↖							\rangleangle-downzigzagarrow
u+02394	○	○								○							\hexagon

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+0239b	(	(	(	,	(	(	(	(	(	(	(	(	(	(	)	)	\lparenend
u+0239c				,												\lparenextender	
u+0239d	(	(	(	,	(	(	(	(	(	(	(	(	(	(	)	\lparenend	
u+0239e	)	)	)	,	)	)	)	)	)	)	)	)	)	)	)	\rparenend	
u+0239f				,												\rparenextender	
u+023a0	)	)	)	,	)	)	)	)	)	)	)	)	)	)	)	\rparenend	
u+023a1	[	[	[	,	[	[	[	[	[	[	[	[	[	[	]	\lbrackuend	
u+023a2				,												\lbrackextender	
u+023a3	[	[	[	,	[	[	[	[	[	[	[	[	[	[	]	\lbrackend	
u+023a4	]	]	]	,	]	]	]	]	]	]	]	]	]	]	]	\rbrackuend	
u+023a5				,												\rbrackextender	
u+023a6	]	]	]	,	]	]	]	]	]	]	]	]	]	]	]	\rbrackend	
u+023a7	{	{	{	,	{	{	{	{	{	{	{	{	{	{	}	\lbraceuend	
u+023a8	{	{	{	,	{	{	{	{	{	{	{	{	{	{	}	\lbracemid	
u+023a9	{	{	{	,	{	{	{	{	{	{	{	{	{	{	}	\lbraceend	

Fortsetzung...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Six2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+023aa				,	-	-	-	-	-	-	-	-	-	-	-	-	\vbraceextender
u+023ab	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	\rbraceuend
u+023ac	{	{	{	{	{	{	{	{	{	{	{	{	{	{	{	{	\rbracemid
u+023ad	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	\rbrace-lend
u+023ae				-	-	-	-	-	-	-	-	-	-	-	-	-	\intextender
u+023af	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	\arrowextender
u+023b2	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	\sumtop
u+023b3	∠	∠	∠	∠	∠	∠	∠	∠	∠	∠	∠	∠	∠	∠	∠	∠	\sumbot-ton
u+023b6	▀	▀	▀	▀	▀	▀	▀	▀	▀	▀	▀	▀	▀	▀	▀	▀	\bbbrktbrk
u+023b7	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	\sqrtbot-ton
u+023b8	─	─	─	─	─	─	─	─	─	─	─	─	─	─	─	─	\lvboxline
u+023b9	─	─	─	─	─	─	─	─	─	─	─	─	─	─	─	─	\rvboxline
u+023ce	↶	↶	↶	↶	↶	↶	↶	↶	↶	↶	↶	↶	↶	↶	↶	↶	\varcarriagereturn
u+023e0	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)	)	\obrbrak
u+023e1	(	(	(	(	(	(	(	(	(	(	(	(	(	(	(	(	\ubrbrak
u+023e2	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	\trapezium
u+023e3	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	\benenr
u+023e4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	\strns
u+023e5	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	\fltns
u+023e6	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\acurrent
u+023e7	*ꝑ	*ꝑ	*ꝑ	*ꝑ	*ꝑ	*ꝑ	*ꝑ	*ꝑ	*ꝑ	*ꝑ	*ꝑ	*ꝑ	*ꝑ	*ꝑ	*ꝑ	*ꝑ	\elinters
u+02422	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	\blanksymbol
u+02423	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	\mathvisiblespace
u+02506	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	\bdtriplevdash

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+02580		█									█			█	█	█	\block-uphalf
u+02584		█									█			█	█	█	\block-lowhalf
u+02588	█	█	█		█	█		█	█	█	█		█	█	█	█	\blockfull
u+0258c	█	█									█			█	█	█	\blockleft-half
u+02590		█									█			█	█	█	\block-righthalf
u+02591	█	█	█		█	█		█	█	█	█		█	█	█	█	\blockqtr-shaded
u+02592	█	█	█	█		█	█	█	█	█	█		█	█	█	█	\blockhalf-shaded
u+02593	█	█			█	█		█	█	█	█		█	█	█	█	\block-threeqtr-shaded
u+025a0	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	\mdlgblk-square
u+025a1	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	\mdlgwht-square
u+025a2	○										○		○	○	○	○	\squoval
u+025a3	□										□		□	□	□	□	\blackin-whitesquare
u+025a4	█										█		█	█	█	█	\square-hfill
u+025a5	█										█		█	█	█	█	\squarevfill
u+025a6	█										█		█	█	█	█	\squarehvfill
u+025a7	█										█		█	█	█	█	\squarenwsefill
u+025a8	█										█		█	█	█	█	\squareeneswfill
u+025a9	█										█		█	█	█	█	\squarecrossfill
u+025aa	▪	█		█	█	█	█	█	█	█	█		█	█	█	█	\smbblk-square
u+025ab	▫	□		□	□	□	□	□	□	□	□		▫	▫	▫	▫	\smwht-square
u+025ac	█	█			█	█	█	█	█	█	█		█	█	█	█	\hrectangleblack
u+025ad	□	□	□	□	□	□	□	□	□	□	□		□	□	□	□	\hrectangle
u+025ae	█										█		█	█	█	█	\vrectangleblack
u+025af	□										□		□	□	□	□	\vrectangle

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Six2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+025b0	■	■	■							■	■	■	■	■	■	■	\parallelogramblack
u+025b1	□	□	□							□		□	□	□	□	□	\parallelogram
u+025b2	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	\bigblacktriangleup
u+025b4	▲		▲		▲					▲		▲		▲		▲	\blacktriangle <sup>(a)</sup>
u+025b6	▶	▶	▶	▶	▶	▶	▶	▶	▶	▶	▶	▶	▶	▶	▶	▶	\blacktriangleangleright <sup>(a)</sup>
u+025b8	▶		▶		▶					▶		▶		▶		▶	\smallblacktriangleright
u+025b9	▷		▷		▷					▷		▷		▷		▷	\smalltriangleangleright
u+025ba	▶		▶		▶					▶		▶		▶		▶	\blackpointerright
u+025bb	▷		▷		▷					▷		▷		▷		▷	\whitepointerright
u+025bc	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	\bigblacktriangledown
u+025bd	▽	▽	▽	▽	▽	▽	▽	▽	▽	▽	▽	▽	▽	▽	▽	▽	\bigtriangleangledown <sup>(p)</sup>
u+025be	▼		▼		▼					▼		▼		▼		▼	\blacktriangledown <sup>(a)</sup>
u+025bf	▽		▽		▽					▽		▽		▽		▽	\triangledown <sup>(a)</sup>
u+025c0	◀	◀	◀	◀	◀	◀	◀	◀	◀	◀	◀	◀	◀	◀	◀	◀	\blacktriangleleft <sup>(a)</sup>
u+025c2	◀		◀		◀					◀		◀		◀		◀	\smallblacktriangleleft
u+025c3	△		△		△					△		△		△		△	\smalltriangleleft
u+025c4	◀		◀		◀					◀		◀		◀		◀	\blackpointerleft
u+025c5	△		△		△					△		△		△		△	\whitepointerleft
u+025c6	◆		◆		◆					◆	◆	◆	◆	◆	◆	◆	\mdlgblkdiamond
u+025c7	◇		◇		◇					◇	◇	◇	◇	◇	◇	◇	\mdlgwhtdiamond

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+025c8		◆		◆						◆		◆	◆	◆	◆	◆	\blackin-whitediamond
u+025c9		●		●						● ●		● ● ●					\fisheye
u+025ca	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	\mdlgwht-lozenge
u+025cc	○		○							○		○		○		○	\dottedcircle
u+025cd	◐									◐		◐		◐		◐	\circlevertfill
u+025ce	◎		◎							◎ ○		◎ ◎		◎		◎	\bullseye
u+025cf	●	●	●	●	●	●	●	●	●	● ●	● ●	● ●	● ●	● ●	● ●	● ●	\mdlgblk-circle
u+025d0	◐	◐								◐ ○		◐ ○		◐ ○		◐ ○	\circlelefthalfblack
u+025d1	◐	◐								◐ ○		◐ ○		◐ ○		◐ ○	\circlerighthalfblack
u+025d2	◑	◑								◑ ○		◑ ○		◑ ○		◑ ○	\circlebottomhalfblack
u+025d3	◑	◑								◑ ○		◑ ○		◑ ○		◑ ○	\circletophalfblack
u+025d4	◐									◐ ○		◐ ○		◐ ○		◐ ○	\circlequadblack
u+025d5	●									● ○		● ○		● ○		● ○	\blackcircleulquadwhite
u+025d6	◐	◐								◐ ○		◐ ○		◐ ○		◐ ○	\blacklefthalfcircle
u+025d7	◑	◑								◑ ○		◑ ○		◑ ○		◑ ○	\blackrighthalfcircle
u+025d8	◻		◻							◻		◻		◻		◻	\inversebullet
u+025d9	◻									◻		◻ ◻		◻		◻	\inversewhitecircle
u+025da	◻									◻		◻ ◻		◻		◻	\invwhiteupperhalfcircle
u+025db	◻									◻		◻ ◻		◻		◻	\invwhitelowerhalfcircle

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Six2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+025dc		‘ ’								‘ ’		‘ ’	‘ ’	‘ ’			\ularc
u+025dd		‘ ’								‘ ’		‘ ’	‘ ’	‘ ’			\urarc
u+025de										‘ ’		‘ ’	‘ ’	‘ ’			\lrarc
u+025df										‘ ’		‘ ’	‘ ’	‘ ’			\llarc
u+025e0										‘ ’		‘ ’	‘ ’	‘ ’			\topsemicircle
u+025e1		‘ ’								‘ ’		‘ ’	‘ ’	‘ ’			\botsemicircle
u+025e2		◀								◀		◀	◀	◀			\lrbblacktriangle
u+025e3		◀								◀		◀	◀	◀			\llblacktriangle
u+025e4		◀								◀		◀	◀	◀			\ulblacktriangle
u+025e5		◀								◀		◀	◀	◀			\urblacktriangle
u+025e6	○	○		○	○	○	○	○	○	○	○	○	○	○	○	○	\smwhtcircle
u+025e7		□		□						□		□	□	□			\squareleftblack
u+025e8		□		□						□		□	□	□			\squarerightblack
u+025e9		□		□						□		□	□	□			\squareulblack
u+025ea		□		□						□		□	□	□			\squarerlblack
u+025ec	△		△							△		△	△	△			\triangleleftdot
u+025ed	△		△							△		△	△	△			\trianglelefteleftblack
u+025ee	△		△							△		△	△	△			\trianglerightleftblack
u+025ef	○	○		○	○	●	○	○	○	○	○	○	○	○	○	○	\lgwhtcircle
u+025f0		□		□						□		□	□	□			\squareulquad
u+025f1		□		□						□		□	□	□			\squarerlquad
u+025f2		□		□						□		□	□	□			\squarerlquad
u+025f3		□		□						□		□	□	□			\squareurquad
u+025f4		○								○		○	○	○			\circlearulequad

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+025f5	⊕									⊕		⊕	⊕	⊕	⊕	⊕	\circcler-lquad
u+025f6	⊖									⊖		⊖	⊖	⊖	⊖	⊖	\circcler-rquad
u+025f7	⊗									⊗		⊗	⊗	⊗	⊗	⊗	\circclerquad
u+025f8	▷	▷								▷	▷	▷	▷	▷	▷	▷	\ultriangle
u+025f9		▷									▷	▷	▷	▷	▷	▷	\urtriangle
u+025fa		▷									▷	▷	▷	▷	▷	▷	\lltriangle
u+025fb	□		□		□					□	□	□	□	□	□	□	\mdwht-square
u+025fc	■		■		■					■		■	■	■	■	■	\mdblk-square
u+025fd	□			□						□		□	□	□	□	□	\mdsmwht-square
u+025fe	■				■					■		■	■	■	■	■	\mdsmblk-square
u+025ff	△					★				△		△		△	△	△	\ltriangle
u+02605	★		★			★				★	★						★ \bigstar <sup>(a)</sup>
u+02606	☆		☆							☆							☆ \bigwhitestar
u+02609	⊙									⊙	⊙						\astrosun
u+02621	⊲									⊲							\danger
u+0263b	☺									☺	☺			☺			\blacksmiley
u+0263c	☀									☀	☀			*			\sun
u+0263d	🌙									🌙	🌙			*			\rightmoon
u+0263e	🌙									🌙	🌙						\leftmoon
u+02640	♀									♀	♀			♀			\female
u+02642	♂									♂	♂			♂			\male
u+02660	♠	♠	♠	♠	♠	♠	♠	♠	♠	♠	♠	♠	♠	♠	♠	♠	\spadesuit <sup>(p)</sup>
u+02661	♥	♥	♥	♥	♥	♥	♥	♥	♥	♥	♥	♥	♥	♥	♥	♥	\heartsuit <sup>(p)</sup>
u+02662	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	\diamondsuit <sup>(p)</sup>
u+02663	♣	♣		♣	♣	♣	♣	♣	♣	♣	♣	♣	♣	♣	♣	♣	\clubsuit <sup>(p)</sup>
u+02664	♠	♠		♠	♠	♠	♠	♠	♠	♠	♠	♠	♠	♠	♠	♠	\varspadesuit
u+02665	♥	♥		♥	♥	♥	♥	♥	♥	♥	♥	♥	♥	♥	♥	♥	\varheart-suit
u+02666	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	\vardiamondsuit
u+02667	♣	♣		♣	♣	♣	♣	♣	♣	♣	♣	♣	♣	♣	♣	♣	\varclubsuit

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Six2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+02669		♪		♪							♪ ♪						\quarter-note
u+0266a	♪	♪		♪	♪	♪	♪	♪	♪	♪	♪	♪	♪	♪	♪		\eighth-note
u+0266b	♩	♩	♩								♩ ♩			♩			\two notes
u+0266d	♭	♭	♭	♭	♭	♭	♭	♭	♭	♭	♭	♭	♭	♭	♭	♭	\flat <sup>(p)</sup>
u+0266e	♯	♯	♯	♯	♯	♯	♯	♯	♯	♯	♯	♯	♯	♯	♯	♯	\natural <sup>(p)</sup>
u+0266f	♯♯	♯♯	♯♯	♯♯	♯♯	♯♯	♯♯	♯♯	♯♯	♯♯	♯♯	♯♯	♯♯	♯♯	♯♯	♯♯	\sharp <sup>(p)</sup>
u+0267e			⑧								⑧						\acidfree
u+02680			□								□						□ \dicei
u+02681			□.								□.						□ \diceii
u+02682			□:								□:						□ \diceiii
u+02683			□□								□□						□ \diceiv
u+02684			□□								□□						□ \dicev
u+02685			□□								□□						□ \dicevi
u+02686	○										○						○ \circledright-dot
u+02687		◎									◎						◎ \circledt-wodots
u+02688	●										●						● \blackcircledright-dot
u+02689	●										●						● \blackcircledt-wodots
u+026a5	○♀										♀ ♀						\Hermaphrodite
u+026aa	○				○					○				○	○	○ ○	\mdwht-circle
u+026ab	●					●				●				●	●	● ●	\mdblkcircle
u+026ac	○					○				○ ○				○	○	○ ○	\mdsmwht-circle
u+026b2	○									○							\neuter
u+02713	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	\checkmark
u+02720	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	\maltese
u+0272a	★									★							★ \circledstar
u+02736	*	*								*				*		*	\varstar
u+0273d	*									*							\dingasterisk
u+0279b	→									→							\draftinarrow

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+027c0		↖	↖							↖	↖	↖	↖		↖		\threedangle
u+027c1		△	△							△	△	△	△		△		\whiteinwhitetriangle
u+027c3		⊓	⊓							⊓	⊓	⊓	⊓		⊓		\subset-circ
u+027c4		⊔	⊔							⊔	⊔	⊔	⊔		⊔		\supset-circ
u+027d0		◊	◊	◊						◊	◊	◊	◊		◊		\diamonddot
u+0292b		✗	✗	✗						✗	✗	✗	✗		✗		\rdiagovf-diag
u+0292c		✗	✗	✗						✗	✗	✗	✗		✗		\fdiagovr-diag
u+0292d		☒	☒	☒						☒	☒	☒	☒		☒		\seovnearrow
u+0292e		☒	☒	☒						☒	☒	☒	☒		☒		\neovnearrow
u+0292f		☒	☒	☒						☒	☒	☒	☒		☒		\fdiagownearrow
u+02930		☒	☒	☒						☒	☒	☒	☒		☒		\rdiagovsearrow
u+02931		☒	☒	☒						☒	☒	☒	☒		☒		\neovnarrow
u+02932		☒	☒	☒						☒	☒	☒	☒		☒		\nwovnarrow
u+02934		↗	↗	↗						↗	↑	↗	↗		↗		\up-rightcurvearrow
u+02935		↘	↘	↘						↘	↓	↘	↘		↘		\down-rightcurvedarrow
u+02981		●	●	●		●				●	●	●	●		●		\mdsmblk-circle
u+02999		⋮	⋮	⋮						⋮	⋮	⋮	⋮		⋮		\fourvdots
u+0299a		~~	~~	~~						~~	~~	~~	~~		~~		\vzigzag
u+0299b		▷	▷	▷						▷	▷	▷	▷		▷		\measuredangleleft
u+0299c		└	└	└						└	└	└	└		└		\rightanglesqr
u+0299d		└	└	└						└	└	└	└		└		\rightanglemdot

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Six2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+0299e		↳	↳	↳							↳	↳			↳	↳	\angles
u+0299f		↖	↖	↖							↖	↖			↖	↖	\angdnr
u+029a0		↗	↗	↗	↗						↗	↗	↗		↗	↗	\gtlpar
u+029a1		↘	↘	↘	↘						↘	↘	↘		↘	↘	\sphericalangleup
u+029a2		↙	↙	↙	↙						↙	↙	↙		↙	↙	\turnangle
u+029a3		↙	↙	↙	↙						↙	↙	↙		↙	↙	\revangle
u+029a4		↖	↖	↖	↖						↖	↖	↖		↖	↖	\anglebar
u+029a5		↙	↙	↙	↙						↙	↙	↙		↙	↙	\revanglebar
u+029a6		↖	↖	↖	↖						↖	↖	↖		↖	↖	\wideangledown
u+029a7		↖	↖	↖	↖						↖	↖	↖		↖	↖	\wideangleup
u+029a8		⤠	⤠	⤠							⤠	⤠	⤠		⤠	⤠	\measanglerutone
u+029a9		⤡	⤡	⤡							⤡	⤡	⤡		⤡	⤡	\measanglelotonw
u+029aa		⤢	⤢	⤢							⤢	⤢	⤢		⤢	⤢	\measanglerdtose
u+029ab		⤣	⤣	⤣							⤣	⤣	⤣		⤣	⤣	\measangleldtosw
u+029ac		⤤	⤤	⤤							⤤	⤤	⤤		⤤	⤤	\measangleurtone
u+029ad		⤥	⤥	⤥							⤥	⤥	⤥		⤥	⤥	\measangleltonw
u+029ae		⤦	⤦	⤦							⤦	⤦	⤦		⤦	⤦	\measangleldtose
u+029af		⤧	⤧	⤧							⤧	⤧	⤧		⤧	⤧	\measangleldtosw
u+029b0		∅	∅	∅							∅	∅	∅	∅	∅	∅	\revemptyset
u+029b1		∅	∅	∅							∅	∅	∅	∅	∅	∅	\emptysetstobar
u+029b2		∅	∅	∅							∅	∅	∅	∅	∅	∅	\emptysetstocirc
u+029b3		∅	∅	∅							∅	∅	∅	∅	∅	∅	\emptysetstoarr
u+029b4		∅	∅	∅							∅	∅	∅	∅	∅	∅	\emptysetstoarrl
u+029ba		⊕	⊕	⊕							⊕	⊕	⊕	⊕	⊕	⊕	\obot
u+029bb		⊗	⊗	⊗							⊗	⊗	⊗	⊗	⊗	⊗	\olcross

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+029bc		⊗	⊗	⊗						⊗	⊗				⊗	⊗	\odot-slashdot
u+029bd		◊	◊	◊						◊	◊			◊	◊	◊	\uparrow-rowoncircle
u+029be		◎	◎	◎						◎	◎			◎	◎	◎	\circled-whitebullet
u+029bf		○	○	○						○	○			○	○	○	\circled-bullet
u+029c2		○°	○°	○°						○°	○°			○°	○°	○°	\circscir
u+029c3		○=	○=	○=						○=	○=			○=	○=	○=	\cirE
u+029c9		▣	▣	▣						▣	▣			▣	▣	▣	\boxonbox
u+029ca		△·	△·	△·						△·	△·			△·	△·	△·	\trianglecdot
u+029cb		△	△	△						△	△			△	△	△	\triangleubar
u+029cc		△\\$	△	△						△\\$	△			△\\$	△	△\\$	\triangles
u+029dc		∞	∞	∞						∞	∞			∞	∞	∞	\iinfin
u+029dd		ꝝ	ꝝ	ꝝ						ꝝ	ꝝ			ꝝ	ꝝ	ꝝ	\tieinfty
u+029de		ꝝ	ꝝ	ꝝ						ꝝ	ꝝ			ꝝ	ꝝ	ꝝ	\nvinfty
u+029e0		□	□	□						□	□			□	□	□	\laplac
u+029e7		†	†	†						†	†			†	†	†	\thermod
u+029e8		▽	▽	▽						▽	▽			▽	▽	▽	\downtriangleleft-black
u+029e9		▽	▽	▽						▽	▽			▽	▽	▽	\downtriangleright-black
u+029ea		◆	◆	◆						◆	◆			◆	◆	◆	\blackdiamonddownnarrow
u+029ec		♀	♀	♀						♀	♀			♀	♀	♀	\circledownarrow
u+029ed		●	●	●						●	●			●	●	●	\blackcircledownarrow
u+029ee		▬	▬	▬						▬	▬			▬	▬	▬	\erbarsquare
u+029ef		▬	▬	▬						▬	▬			▬	▬	▬	\errbar-black-square
u+029f0		❖	❖	❖						❖	❖			❖	❖	❖	\errbardiamond

Fortsetzung...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Six2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+029f1	◆	◆	◆								◆	◆			◆	◆	\errbar-blackdiamond
u+029f2	◐	◐	◐								◐	◐			◐	◐	\errbarcircle
u+029f3	●	●	●								●	●			●	●	\errbar-blackcircle
u+02ae1	⠇	⠇	⠇								⠇	⠇	⠇		⠇	⠇	\perps
u+02af1	⠄	⠄	⠄								⠄	⠄	⠄		⠄	⠄	\topcir
u+02b12	◻	◻	◻								◻	◻	◻		◻	◻	\square-topblack
u+02b13	◻	◻	◻								◻	◻	◻		◻	◻	\square-botblack
u+02b14	▣	▣	▣								▣	▣	▣		▣	▣	\squareur-black
u+02b15	▣	▣	▣								▣	▣	▣		▣	▣	\squareell-black
u+02b16	◇	◆									◇	◆	◆		◇	◆	\diamondmondleft-black
u+02b17	◇	◆									◇	◆	◆		◇	◆	\diamondmondright-black
u+02b18	◇	◆									◇	◆	◆		◇	◆	\diamondmond-topblack
u+02b19	◇	◆									◇	◆	◆		◇	◆	\diamondmond-botblack
u+02b1a	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	\dotted-square
u+02b1b	■	■	■								■	■	■		■	■	\lgbblk-square
u+02b1c	□	□	□								□	□	□		□	□	\lgwht-square
u+02b1d	▪	▪	▪								▪	▪	▪		▪	▪	\vysmblk-square
u+02b1e	▫	▫	▫								▫	▫	▫		▫	▫	\vysmwht-square
u+02b1f	★	★									★	★	★		★	★	\pentagonblack
u+02b20	◇	◇									◇	◇	◇		◇	◇	\pentagon
u+02b21	○	○									○	○	○		○	○	\varhexagon
u+02b22	⬢	⬢									⬢	⬢	⬢		⬢	⬢	\varhexagonblack
u+02b23	⬢	⬢									⬢	⬢	⬢		⬢	⬢	\hexagonblack
u+02b24	●	●									●	●	●		●	●	\lgblkcircle

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+02b25	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	\mdbblkdiamond
u+02b26	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	\mdwhtdiamond
u+02b27	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	\mdbblklozenge
u+02b28	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	\mdwhtlozenge
u+02b29	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	\smbblkdiamond
u+02b2a	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	\smbblklozenge
u+02b2b	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	◊	\smwhtlozenge
u+02b2c	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	\blkhorzoval
u+02b2d	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	\whthorzoval
u+02b2e	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	\blkvertoval
u+02b2f	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	\whtvertoval
u+02b50	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	\medwhitestar
u+02b51	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	★	\medblackstar
u+02b52	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	☆	\smwhitestar
u+02b53	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	\rightpentagonblack
u+02b54	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	\rightpentagon
u+03012	〒	〒	〒	〒	〒	〒	〒	〒	〒	〒	〒	〒	〒	〒	〒	〒	\postal-mark
u+03030	~~	~~	~~	~~	~~	~~	~~	~~	~~	~~	~~	~~	~~	~~	~~	~~	\hzigzag
u+1d7ce	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	\mbfzero
u+1d7cf	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	\mbfone
u+1d7d0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	\mbftwo
u+1d7d1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	\mbfthree
u+1d7d2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	\mbffour
u+1d7d3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	\mbffive
u+1d7d4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	\mbfsix
u+1d7d5	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	\mbfseven
u+1d7d6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	\mbfeight

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Six2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d7d7	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	\mbfnine
u+1d7d8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	\Bbbzero
u+1d7d9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	\Bbbone
u+1d7da	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	\Bbbtwo
u+1d7db	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	\Bbbthree
u+1d7dc	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	\Bbbfour
u+1d7dd	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	\Bbbfive
u+1d7de	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	\Bbbsix
u+1d7df	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	\Bbbseven
u+1d7e0	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	\Bbbeight
u+1d7e1	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	\Bbbnine
u+1d7e2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	\msan-szero
u+1d7e3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	\msan-sone
u+1d7e4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	\msanstwo
u+1d7e5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	\msansthree
u+1d7e6	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	\msans-four
u+1d7e7	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	\msans-five
u+1d7e8	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	\msanssix
u+1d7e9	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	\msans-seven
u+1d7ea	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	\msans-eight
u+1d7eb	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	\msans-nine
u+1d7ec	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	\mbfsan-szero
u+1d7ed	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	\mbfsan-sone
u+1d7ee	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	\mbf-sanstwo
u+1d7ef	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	\mbf-sansthree
u+1d7f0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	\mbfsans-four
u+1d7f1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	\mbfsans-five
u+1d7f2	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	\mbf-sanssix
u+1d7f3	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	\mbfsans-seven

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d7f4	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	\mbfsans-seight
u+1d7f5	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	\mbfsans-nine
u+1d7f6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	\mttzero
u+1d7f7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	\mtttonne
u+1d7f8	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	\mtttwo
u+1d7f9	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	\mttthree
u+1d7fa	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	\mttfour
u+1d7fb	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	\mttfive
u+1d7fc	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	\mttsix
u+1d7fd	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	\mttseven
u+1d7fe	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	\mtteight
u+1d7ff	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	\mttnine

## \mathrel{}

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+0003c	^	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	\less
u+0003d																	\equal
u+0003e	>	<	>	<	>	<	>	<	>	<	>	<	>	<	>	<	\greater
u+02050																	\closure
u+02190	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	\leftarrowarrow <sup>(p)</sup>
u+02191	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	\uparrowarrow <sup>(p)</sup>
u+02192	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	\rightarrowarrow <sup>(p)</sup>
u+02193	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	\downarrowarrow <sup>(p)</sup>
u+02194	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	\leftrightarrowarrow <sup>(p)</sup>
u+02195	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	\updownarrowarrow <sup>(p)</sup>
u+02196	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	\narrowarrow <sup>(p)</sup>
u+02197	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	\nearrowarrow <sup>(p)</sup>
u+02198	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	\searrowarrow <sup>(p)</sup>
u+02199	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	\swarrowarrow <sup>(p)</sup>
u+0219a	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	\nleftarrowarrow <sup>(a)</sup>
u+0219b	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	\nrightarrowarrow <sup>(a)</sup>
u+0219c	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	\leftwavearrow
u+0219d	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	\rightwavearrow

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+0219e	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\twoheadleftarrow <sup>(a)</sup>
u+0219f	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\twoheaduparrow
u+021a0	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\twoheadrightarrow <sup>(a)</sup>
u+021a1	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\twoheaddowarrow
u+021a2	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\leftarrowtail <sup>(a)</sup>
u+021a3	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\rightarrowtail <sup>(a)</sup>
u+021a4	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\mapsfrom
u+021a5	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\mapsup
u+021a6	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\mapsto <sup>(p)</sup>
u+021a7	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\mapdown
u+021a9	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\hookleftarrow <sup>(p)</sup>
u+021aa	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\hookrightarrow <sup>(p)</sup>
u+021ab	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\looparrowleft <sup>(a)</sup>
u+021ac	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\looparrowright <sup>(a)</sup>
u+021ad	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\leftrightsquigarrow <sup>(a)</sup>
u+021ae	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\nlefrightharrow <sup>(a)</sup>
u+021af	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\downzigzagarrow
u+021b0	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\Lsh <sup>(a)</sup>
u+021b1	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\Rsh <sup>(a)</sup>
u+021b2	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\Ldsh
u+021b3	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\Rdsh
u+021b6	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\curvearrowleft <sup>(a)</sup>
u+021b7	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\curvearrowright <sup>(a)</sup>
u+021bc	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\leftharpoonup <sup>(p)</sup>
u+021bd	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\leftharpoonown <sup>(p)</sup>
u+021be	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\upharpoonright <sup>(a)</sup>
u+021bf	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\upharpoonleft <sup>(a)</sup>
u+021c0	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\rightharpoonup <sup>(p)</sup>
u+021c1	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\rightharpoonondown <sup>(p)</sup>
u+021c2	⤠	⤡	⤢	⤣	⤤	⤥	⤦	⤧	⤨	⤩	⤪	⤫	⤬	⤭	⤮	⤯	\downharpoonright <sup>(a)</sup>

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+021c3	↙	↙	↙	↙	↙	↙	↙	↙	↙	↙	↙	↙	↙	↙	↙	↙	\downharpoon-left <sup>(a)</sup>
u+021c4	↗↖	↗↖	↗↖	↗↖	↗↖	↗↖	↗↖	↗↖	↗↖	↗↖	↗↖	↗↖	↗↖	↗↖	↗↖	↗↖	\rightleftarrows <sup>(a)</sup>
u+021c5	↗↘	↗↘	↗↘	↗↘	↗↘	↗↘	↗↘	↗↘	↗↘	↗↘	↗↘	↗↘	↗↘	↗↘	↗↘	↗↘	\updownarrows
u+021c6	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	\leftrightarrows <sup>(a)</sup>
u+021c7	↖ ↖	↖ ↖	↖ ↖	↖ ↖	↖ ↖	↖ ↖	↖ ↖	↖ ↖	↖ ↖	↖ ↖	↖ ↖	↖ ↖	↖ ↖	↖ ↖	↖ ↖	↖ ↖	\leftleftarrows <sup>(a)</sup>
u+021c8	↖ ↘	↖ ↘	↖ ↘	↖ ↘	↖ ↘	↖ ↘	↖ ↘	↖ ↘	↖ ↘	↖ ↘	↖ ↘	↖ ↘	↖ ↘	↖ ↘	↖ ↘	↖ ↘	\upuparrows <sup>(a)</sup>
u+021c9	↖ ↙	↖ ↙	↖ ↙	↖ ↙	↖ ↙	↖ ↙	↖ ↙	↖ ↙	↖ ↙	↖ ↙	↖ ↙	↖ ↙	↖ ↙	↖ ↙	↖ ↙	↖ ↙	\rightrightarrows <sup>(a)</sup>
u+021ca	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓	\downdownarrows <sup>(a)</sup>
u+021cb	↶↶	↶↶	↶↶	↶↶	↶↶	↶↶	↶↶	↶↶	↶↶	↶↶	↶↶	↶↶	↶↶	↶↶	↶↶	↶↶	\leftrightharpoons <sup>(a)</sup>
u+021cc	⤒⤒	⤒⤒	⤒⤒	⤒⤒	⤒⤒	⤒⤒	⤒⤒	⤒⤒	⤒⤒	⤒⤒	⤒⤒	⤒⤒	⤒⤒	⤒⤒	⤒⤒	⤒⤒	\rightleftharpoons <sup>(l)</sup>
u+021cd	⤓⤓	⤓⤓	⤓⤓	⤓⤓	⤓⤓	⤓⤓	⤓⤓	⤓⤓	⤓⤓	⤓⤓	⤓⤓	⤓⤓	⤓⤓	⤓⤓	⤓⤓	⤓⤓	\nLeftarrow <sup>(a)</sup>
u+021ce	⤔⤔	⤔⤔	⤔⤔	⤔⤔	⤔⤔	⤔⤔	⤔⤔	⤔⤔	⤔⤔	⤔⤔	⤔⤔	⤔⤔	⤔⤔	⤔⤔	⤔⤔	⤔⤔	\nLeftrightarrow <sup>(a)</sup>
u+021cf	⤕⤕	⤕⤕	⤕⤕	⤕⤕	⤕⤕	⤕⤕	⤕⤕	⤕⤕	⤕⤕	⤕⤕	⤕⤕	⤕⤕	⤕⤕	⤕⤕	⤕⤕	⤕⤕	\nRightarrow <sup>(a)</sup>
u+021d0	⤖⤖	⤖⤖	⤖⤖	⤖⤖	⤖⤖	⤖⤖	⤖⤖	⤖⤖	⤖⤖	⤖⤖	⤖⤖	⤖⤖	⤖⤖	⤖⤖	⤖⤖	⤖⤖	\Leftarrow <sup>(p)</sup>
u+021d1	⤗⤗	⤗⤗	⤗⤗	⤗⤗	⤗⤗	⤗⤗	⤗⤗	⤗⤗	⤗⤗	⤗⤗	⤗⤗	⤗⤗	⤗⤗	⤗⤗	⤗⤗	⤗⤗	\Uparrow <sup>(p)</sup>
u+021d2	⤘⤘	⤘⤘	⤘⤘	⤘⤘	⤘⤘	⤘⤘	⤘⤘	⤘⤘	⤘⤘	⤘⤘	⤘⤘	⤘⤘	⤘⤘	⤘⤘	⤘⤘	⤘⤘	\Rightarrow <sup>(p)</sup>
u+021d3	⤙⤙	⤙⤙	⤙⤙	⤙⤙	⤙⤙	⤙⤙	⤙⤙	⤙⤙	⤙⤙	⤙⤙	⤙⤙	⤙⤙	⤙⤙	⤙⤙	⤙⤙	⤙⤙	\Downarrow <sup>(p)</sup>
u+021d4	⤚⤚	⤚⤚	⤚⤚	⤚⤚	⤚⤚	⤚⤚	⤚⤚	⤚⤚	⤚⤚	⤚⤚	⤚⤚	⤚⤚	⤚⤚	⤚⤚	⤚⤚	⤚⤚	\Leftrightarrow <sup>(p)</sup>
u+021d5	⤛⤛	⤛⤛	⤛⤛	⤛⤛	⤛⤛	⤛⤛	⤛⤛	⤛⤛	⤛⤛	⤛⤛	⤛⤛	⤛⤛	⤛⤛	⤛⤛	⤛⤛	⤛⤛	\Updownarrow <sup>(p)</sup>
u+021d6	⤜⤜	⤜⤜	⤜⤜	⤜⤜	⤜⤜	⤜⤜	⤜⤜	⤜⤜	⤜⤜	⤜⤜	⤜⤜	⤜⤜	⤜⤜	⤜⤜	⤜⤜	⤜⤜	\Narrow
u+021d7	⤝⤝	⤝⤝	⤝⤝	⤝⤝	⤝⤝	⤝⤝	⤝⤝	⤝⤝	⤝⤝	⤝⤝	⤝⤝	⤝⤝	⤝⤝	⤝⤝	⤝⤝	⤝⤝	\Nearrow
u+021d8	⤞⤞	⤞⤞	⤞⤞	⤞⤞	⤞⤞	⤞⤞	⤞⤞	⤞⤞	⤞⤞	⤞⤞	⤞⤞	⤞⤞	⤞⤞	⤞⤞	⤞⤞	⤞⤞	\Searrow
u+021d9	⤟⤟	⤟⤟	⤟⤟	⤟⤟	⤟⤟	⤟⤟	⤟⤟	⤟⤟	⤟⤟	⤟⤟	⤟⤟	⤟⤟	⤟⤟	⤟⤟	⤟⤟	⤟⤟	\Swarrow
u+021da	⤠⤠	⤠⤠	⤠⤠	⤠⤠	⤠⤠	⤠⤠	⤠⤠	⤠⤠	⤠⤠	⤠⤠	⤠⤠	⤠⤠	⤠⤠	⤠⤠	⤠⤠	⤠⤠	\Lleftarrow <sup>(a)</sup>
u+021db	⤡⤡	⤡⤡	⤡⤡	⤡⤡	⤡⤡	⤡⤡	⤡⤡	⤡⤡	⤡⤡	⤡⤡	⤡⤡	⤡⤡	⤡⤡	⤡⤡	⤡⤡	⤡⤡	\Rrightarrow <sup>(a)</sup>
u+021dc	⤢⤢	⤢⤢	⤢⤢	⤢⤢	⤢⤢	⤢⤢	⤢⤢	⤢⤢	⤢⤢	⤢⤢	⤢⤢	⤢⤢	⤢⤢	⤢⤢	⤢⤢	⤢⤢	\leftsquigarrow
u+021dd	⤣⤣	⤣⤣	⤣⤣	⤣⤣	⤣⤣	⤣⤣	⤣⤣	⤣⤣	⤣⤣	⤣⤣	⤣⤣	⤣⤣	⤣⤣	⤣⤣	⤣⤣	⤣⤣	\rightsquigarrow <sup>(a)</sup>
u+021e4	⤤⤤	⤤⤤	⤤⤤						⤤⤤	⤤⤤	⤤⤤	⤤⤤	⤤⤤	⤤⤤	⤤⤤	⤤⤤	\barleftarrow
u+021e5	⤥⤥	⤥⤥	⤥⤥						⤥⤥	⤥⤥	⤥⤥	⤥⤥	⤥⤥	⤥⤥	⤥⤥	⤥⤥	\rightarrowbar
u+021f4	⤦⤦	⤦⤦	⤦⤦	⤦⤦					⤦⤦	⤦⤦	⤦⤦	⤦⤦	⤦⤦	⤦⤦	⤦⤦	⤦⤦	\circleonrightarrow
u+021f5	⤧⤧	⤧⤧	⤧⤧	⤧⤧	⤧⤧	⤧⤧	⤧⤧	⤧⤧	⤧⤧	⤧⤧	⤧⤧	⤧⤧	⤧⤧	⤧⤧	⤧⤧	⤧⤧	\downuparrows
u+021f6	⤨⤨	⤨⤨	⤨⤨	⤨⤨	⤨⤨	⤨⤨	⤨⤨	⤨⤨	⤨⤨	⤨⤨	⤨⤨	⤨⤨	⤨⤨	⤨⤨	⤨⤨	⤨⤨	\rightthreearrows
u+021f7	⤩⤩	⤩⤩	⤩⤩	⤩⤩	⤩⤩	⤩⤩	⤩⤩	⤩⤩	⤩⤩	⤩⤩	⤩⤩	⤩⤩	⤩⤩	⤩⤩	⤩⤩	⤩⤩	\nvleftarrow

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+021f8	⤧	⤧	⤧	⤧									⤧	⤧	⤧	⤧	\nvrightarrow
u+021f9	⤨	⤨	⤨	⤨									⤨	⤨	⤨	⤨	\nvlefrightrightarrow
u+021fa	⤩	⤩	⤩	⤩									⤩	⤩	⤩	⤩	\nVleftarrow
u+021fb	⤪	⤪	⤪	⤪									⤪	⤪	⤪	⤪	\nVrightarrow
u+021fc	⤫	⤫	⤫	⤫									⤫	⤫	⤫	⤫	\nVleftrightrightarrow
u+021fd	⤬	⤬	⤬	⤬									⤬	⤬	⤬	⤬	\leftarrowtriangle
u+021fe	⤭	⤭	⤭	⤭									⤭	⤭	⤭	⤭	\rightarrowtriangle
u+021ff	⤮	⤮	⤮	⤮									⤮	⤮	⤮	⤮	\leftrightarrowtriangle
u+02208	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\in <sup>(p)</sup>
u+02209	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\notin <sup>(l)</sup>
u+0220a	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\smallin
u+0220b	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\ni <sup>(p)</sup>
u+0220c	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\nni
u+0220d	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\smallnni
u+0221d	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\propto <sup>(p)</sup>
u+02223	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	\mid <sup>(p)</sup>
u+02224	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	⤠	\nmid <sup>(a)</sup>
u+02225	⤡	⤡	⤡	⤡	⤡	⤡	⤡	⤡	⤡	⤡	⤡	⤡	⤡	⤡	⤡	⤡	\parallel <sup>(p)</sup>
u+02226	⤢	⤢	⤢	⤢	⤢	⤢	⤢	⤢	⤢	⤢	⤢	⤢	⤢	⤢	⤢	⤢	\nparallel <sup>(a)</sup>
u+02236	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	\mathratio	
u+02237	::	::	::	::	::	::	::	::	::	::	::	::	::	::	::	::	Colon
u+02239	:-	:-	:-	:-	:-	:-	:-	:-	:-	:-	:-	:-	:-	:-	:-	:-	dashcolon
u+0223a	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	\dotsminusdots
u+0223b	⠷	⠷	⠷	⠷	⠷	⠷	⠷	⠷	⠷	⠷	⠷	⠷	⠷	⠷	⠷	⠷	\kernelcontraction
u+0223c	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\sim <sup>(p)</sup>
u+0223d	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\backsim <sup>(a)</sup>
u+02241	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\nsim <sup>(a)</sup>
u+02242	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\eqsim <sup>(a)</sup>
u+02243	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\simeq <sup>(p)</sup>
u+02244	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\nsime
u+02243	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\sime
u+02244	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\nsimeq
u+02245	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\cong <sup>(l)</sup>
u+02246	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\simneqq
u+02247	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\ncong <sup>(a)</sup>
u+02248	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\approx <sup>(p)</sup>

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Minion	Macro
u+02249	≈	≈	≈	≈	≈	≈	≈	≈	≈	≈	≈	≈	≈	≈	\napprox
u+0224a	≈(a)	≈(a)	≈(a)	≈(a)	≈(a)	≈(a)	≈(a)	≈(a)	≈(a)	≈(a)	≈(a)	≈(a)	≈(a)	≈(a)	\approxeq <sup>(a)</sup>
u+0224b	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	\approxident
u+0224c	≈(b)	≈(b)	≈(b)	≈(b)	≈(b)	≈(b)	≈(b)	≈(b)	≈(b)	≈(b)	≈(b)	≈(b)	≈(b)	≈(b)	\backcong
u+0224d	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	\asym <sup>(p)</sup>
u+0224e	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	\Bumpeq <sup>(a)</sup>
u+0224f	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	\bumpeq <sup>(a)</sup>
u+02250	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	\doteq <sup>(l)</sup>
u+02251	≈(n)	≈(n)	≈(n)	≈(n)	≈(n)	≈(n)	≈(n)	≈(n)	≈(n)	≈(n)	≈(n)	≈(n)	≈(n)	≈(n)	\Doteq <sup>(a)</sup>
u+02252	≈(o)	≈(o)	≈(o)	≈(o)	≈(o)	≈(o)	≈(o)	≈(o)	≈(o)	≈(o)	≈(o)	≈(o)	≈(o)	≈(o)	\fallingdotseq <sup>(a)</sup>
u+02253	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	≈(p)	\risingdotseq <sup>(a)</sup>
u+02254	≈(q)	≈(q)	≈(q)	≈(q)	≈(q)	≈(q)	≈(q)	≈(q)	≈(q)	≈(q)	≈(q)	≈(q)	≈(q)	≈(q)	\colonreq
u+02255	≈(r)	≈(r)	≈(r)	≈(r)	≈(r)	≈(r)	≈(r)	≈(r)	≈(r)	≈(r)	≈(r)	≈(r)	≈(r)	≈(r)	\eqcolon
u+02256	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	≈(s)	\eqcirc <sup>(a)</sup>
u+02257	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	≈(t)	\circeq <sup>(a)</sup>
u+02258	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	\arceq
u+02259	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	\wedgeqeq
u+0225a	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	\veeeq
u+0225b	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	\stareq
u+0225c	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	\triangleq <sup>(a)</sup>
u+0225d	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	\eqdef
u+0225e	≈(m)	≈(m)	≈(m)	≈(m)	≈(m)	≈(m)	≈(m)	≈(m)	≈(m)	≈(m)	≈(m)	≈(m)	≈(m)	≈(m)	\measeq
u+0225f	≈(?)	≈(?)	≈(?)	≈(?)	≈(?)	≈(?)	≈(?)	≈(?)	≈(?)	≈(?)	≈(?)	≈(?)	≈(?)	≈(?)	\questeq
u+02260	≠(p)	≠(p)	≠(p)	≠(p)	≠(p)	≠(p)	≠(p)	≠(p)	≠(p)	≠(p)	≠(p)	≠(p)	≠(p)	≠(p)	\ne <sup>(p)</sup>
u+02261	≠(q)	≠(q)	≠(q)	≠(q)	≠(q)	≠(q)	≠(q)	≠(q)	≠(q)	≠(q)	≠(q)	≠(q)	≠(q)	≠(q)	\equiv <sup>(p)</sup>
u+02262	≠(r)	≠(r)	≠(r)	≠(r)	≠(r)	≠(r)	≠(r)	≠(r)	≠(r)	≠(r)	≠(r)	≠(r)	≠(r)	≠(r)	\nequiv
u+02263	≠(s)	≠(s)	≠(s)	≠(s)	≠(s)	≠(s)	≠(s)	≠(s)	≠(s)	≠(s)	≠(s)	≠(s)	≠(s)	≠(s)	\Equiv
u+02264	≠(t)	≠(t)	≠(t)	≠(t)	≠(t)	≠(t)	≠(t)	≠(t)	≠(t)	≠(t)	≠(t)	≠(t)	≠(t)	≠(t)	\leq <sup>(p)</sup>
u+02265	≠(u)	≠(u)	≠(u)	≠(u)	≠(u)	≠(u)	≠(u)	≠(u)	≠(u)	≠(u)	≠(u)	≠(u)	≠(u)	≠(u)	\geq <sup>(p)</sup>
u+02266	≠(v)	≠(v)	≠(v)	≠(v)	≠(v)	≠(v)	≠(v)	≠(v)	≠(v)	≠(v)	≠(v)	≠(v)	≠(v)	≠(v)	\leqq <sup>(a)</sup>
u+02267	≠(w)	≠(w)	≠(w)	≠(w)	≠(w)	≠(w)	≠(w)	≠(w)	≠(w)	≠(w)	≠(w)	≠(w)	≠(w)	≠(w)	\geqq <sup>(a)</sup>
u+02268	≠(x)	≠(x)	≠(x)	≠(x)	≠(x)	≠(x)	≠(x)	≠(x)	≠(x)	≠(x)	≠(x)	≠(x)	≠(x)	≠(x)	\lneqq <sup>(a)</sup>
u+02269	≠(y)	≠(y)	≠(y)	≠(y)	≠(y)	≠(y)	≠(y)	≠(y)	≠(y)	≠(y)	≠(y)	≠(y)	≠(y)	≠(y)	\gneqq <sup>(a)</sup>
u+0226a	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	≈(l)	\ll <sup>(p)</sup>
u+0226b	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	≈(u)	\gg <sup>(p)</sup>
u+0226c	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	≈(v)	\between <sup>(a)</sup>
u+0226d	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	≈(w)	\nasym
u+0226e	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	≈(x)	\nless <sup>(a)</sup>
u+0226f	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	≈(y)	\ngtr <sup>(a)</sup>
u+02270	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	≈(z)	\nleq <sup>(a)</sup>

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+02271	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\ngeq <sup>(a)</sup>
u+02272	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\lessim <sup>(a)</sup>
u+02273	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\grtsim <sup>(a)</sup>
u+02274	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\nlessim <sup>(a)</sup>
u+02275	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\ngtrsim <sup>(a)</sup>
u+02276	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\lessgr <sup>(a)</sup>
u+02277	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\grtless <sup>(a)</sup>
u+02278	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\nlessgr <sup>(a)</sup>
u+02279	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\ngtrless <sup>(a)</sup>
u+0227a	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\prec <sup>(p)</sup>
u+0227b	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\succ <sup>(p)</sup>
u+0227c	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\preccurlyeq <sup>(a)</sup>
u+0227d	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\succcurlyeq <sup>(a)</sup>
u+0227e	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\precsim <sup>(a)</sup>
u+0227f	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\succcsim <sup>(a)</sup>
u+02280	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\nprec <sup>(a)</sup>
u+02281	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\nsucc <sup>(a)</sup>
u+02282	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\subset <sup>(p)</sup>
u+02283	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\supset <sup>(p)</sup>
u+02284	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\nsubset <sup>(p)</sup>
u+02285	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\nsupset <sup>(p)</sup>
u+02286	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\subsequeq <sup>(p)</sup>
u+02287	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\supseteq <sup>(p)</sup>
u+02288	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\nsubseteq <sup>(a)</sup>
u+02289	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\nsupseteq <sup>(a)</sup>
u+0228a	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\subsetneq <sup>(a)</sup>
u+0228b	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\supsetneq <sup>(a)</sup>
u+0228f	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\sqsubsetsubset
u+02290	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\sqsupsubset
u+02291	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\sqsubsetsubset <sup>(p)</sup>
u+02292	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\sqsupseteq <sup>(p)</sup>
u+022a2	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\vdash <sup>(p)</sup>
u+022a3	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\dashv <sup>(p)</sup>
u+022a6	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\assert
u+022a7	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\models <sup>(p)</sup>
u+022a8	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\vDash <sup>(a)</sup>
u+022a9	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\Vdash <sup>(a)</sup>
u+022aa	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\VvDash <sup>(a)</sup>
u+022ab	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\VDash
u+022ac	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	𠂔	\nvDash <sup>(a)</sup>

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Minion	Macro
u+022ad	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\nvDash <sup>(a)</sup>
u+022ae	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\nVdash <sup>(a)</sup>
u+022af	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\nVDash <sup>(a)</sup>
u+022b0	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\prurel
u+022b1	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\scurel
u+022b2	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\vartriangleleft <sup>(a)</sup>
u+022b3	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\vartriangleright <sup>(a)</sup>
u+022b4	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\trianglelefteq <sup>(a)</sup>
u+022b5	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\trianglerighteq <sup>(a)</sup>
u+022b6	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\origof
u+022b7	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\imageof
u+022b8	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\multimap <sup>(a)</sup>
u+022c8	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\bowtie <sup>(p)</sup>
u+022cd	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\backsimeq <sup>(a)</sup>
u+022d0	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\Subset <sup>(a)</sup>
u+022d1	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\Supset <sup>(a)</sup>
u+022d4	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\pitchfork <sup>(a)</sup>
u+022d5	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\equalparallel
u+022d6	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\lessdot <sup>(a)</sup>
u+022d7	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\gtrdot <sup>(a)</sup>
u+022d8	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\lll <sup>(a)</sup>
u+022d9	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\ggg <sup>(a)</sup>
u+022da	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\lesseqgr <sup>(a)</sup>
u+022db	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\gtreqless <sup>(a)</sup>
u+022dc	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\eqless
u+022dd	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\egtr
u+022de	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\curlyeqprec <sup>(a)</sup>
u+022df	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\curlyeqsucc <sup>(a)</sup>
u+022e0	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\npreccurlyeq
u+022e1	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\nsucccurlyeq
u+022e2	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\nsqsubseteq
u+022e3	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\nsqsubseteqeq
u+022e4	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\sqsubsetneq
u+022e5	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\sqsubsetneqq
u+022e6	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\lnsim <sup>(a)</sup>
u+022e7	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\gnsim <sup>(a)</sup>
u+022e8	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\preccnsim <sup>(a)</sup>
u+022e9	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\succcnsim <sup>(a)</sup>

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro	
u+022ea	⦠	⦡	⦢	⦣	⦤	⦥	⦦	⦧	⦨	⦩	⦪	⦫	⦬	⦭	⦮	⦯	\nvartriangleleft	
u+022eb	⦠	⦡	⦢	⦣	⦥	⦦	⦧	⦨	⦩	⦪	⦪	⦫	⦬	⦭	⦮	⦯	\nvartriangleright	
u+022ec	⦠	⦡	⦢	⦣	⦤	⦥	⦦	⦧	⦨	⦩	⦪	⦫	⦬	⦭	⦮	⦯	\ntrianglelefteq <sup>(a)</sup>	
u+022ed	⦠	⦡	⦢	⦣	⦤	⦥	⦦	⦧	⦨	⦩	⦪	⦫	⦬	⦭	⦮	⦯	\ntrianglerighteq <sup>(a)</sup>	
u+022ee	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	\vdots <sup>(p)</sup>	
u+022f0	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	\adots	
u+022f1	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	\ddots <sup>(p)</sup>	
u+022f2	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	\disin	
u+022f3	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	\varisins	
u+022f4	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	\isins	
u+022f5	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	\isindot	
u+022f6	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	\varisinobar	
u+022f7	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	\isinobar	
u+022f8	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	\isinvb	
u+022f9	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	\isinE	
u+022fa	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	\nisd	
u+022fb	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	\varnis	
u+022fc	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	\nis	
u+022fd	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	\varniobar	
u+022fe	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	\niobar	
u+022ff	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	\bagmember	
u+02322	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	\frown <sup>(p)</sup>	
u+02323	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	( )	\smile <sup>(p)</sup>	
u+0233f	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+\APLnotslash	
u+025b5	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	\vartriangle <sup>(a)</sup>	
u+027c2	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	⊤	\perp <sup>(p)</sup>	
u+027c8	⊐	⊐	⊐	⊐	⊐	⊐	⊐	⊐	⊐	⊐	⊐	⊐	⊐	⊐	⊐	⊐	\bsolhsub	
u+027c9	⊑	⊑	⊑	⊑	⊑	⊑	⊑	⊑	⊑	⊑	⊑	⊑	⊑	⊑	⊑	⊑	\suphsol	
u+027d2	⊏	⊏	⊏	⊏	⊏	⊏	⊏	⊏	⊏	⊏	⊏	⊏	⊏	⊏	⊏	⊏	\upin	
u+027d3	⊐⊏	⊐⊏	⊐⊏	⊐⊏	⊐⊏	⊐⊏	⊐⊏	⊐⊏	⊐⊏	⊐⊏	⊐⊏	⊐⊏	⊐⊏	⊐⊏	⊐⊏	⊐⊏	\pullback	
u+027d4	⊐⊐	⊐⊐	⊐⊐	⊐⊐	⊐⊐	⊐⊐	⊐⊐	⊐⊐	⊐⊐	⊐⊐	⊐⊐	⊐⊐	⊐⊐	⊐⊐	⊐⊐	⊐⊐	\pushout	
u+027da	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	\DashVDash
u+027db	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	# # # # #	\dashVdash
u+027dc	○ ○ ○ ○ ○	○ ○ ○ ○ ○	○ ○ ○ ○ ○	○ ○ ○ ○ ○	○ ○ ○ ○ ○	○ ○ ○ ○ ○	○ ○ ○ ○ ○	○ ○ ○ ○ ○	○ ○ ○ ○ ○	○ ○ ○ ○ ○	○ ○ ○ ○ ○	○ ○ ○ ○ ○	○ ○ ○ ○ ○	○ ○ ○ ○ ○	○ ○ ○ ○ ○	○ ○ ○ ○ ○	○ ○ ○ ○ ○	\multimapinv
u+027dd	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	\vlongdash	
u+027de	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	━ ━ ━ ━ ━	\longdashv	
u+027df	◦ ◦ ◦	◦ ◦ ◦	◦ ◦ ◦	◦ ◦ ◦	◦ ◦ ◦	◦ ◦ ◦	◦ ◦ ◦	◦ ◦ ◦	◦ ◦ ◦	◦ ◦ ◦	◦ ◦ ◦	◦ ◦ ◦	◦ ◦ ◦	◦ ◦ ◦	◦ ◦ ◦	◦ ◦ ◦	\cirbot	
u+027f0	⤙ ⤙ ⤙	⤙ ⤙ ⤙	⤙ ⤙ ⤙	⤙ ⤙ ⤙	⤙ ⤙ ⤙	⤙ ⤙ ⤙	⤙ ⤙ ⤙	⤙ ⤙ ⤙	⤙ ⤙ ⤙	⤙ ⤙ ⤙	⤙ ⤙ ⤙	⤙ ⤙ ⤙	⤙ ⤙ ⤙	⤙ ⤙ ⤙	⤙ ⤙ ⤙	⤙ ⤙ ⤙	\UUparrow	

Fortsetzung ...

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+02910	>→→>	>→→>	>→→>							>→→>							\drbkarrow
u+02911	→→→→	→→→→	→→→→							→→→→							\rightdotarrow
u+02912	→→→→	→→→→	→→→→							→→→→							\baruparrow
u+02913	→→→→	→→→→	→→→→							→→→→							\downarrowarrowbar
u+02914	→→→→	→→→→	→→→→							→→→→							\nvrightarrowtail
u+02915	→→→→	→→→→	→→→→							→→→→							\nVrightarrowtail
u+02916	→→→→	→→→→	→→→→							→→→→							\twoheadrightarrowarrowtail
u+02917	→→→→	→→→→	→→→→							→→→→							\nvtwoheadrightarrowarrowtail
u+02918	→→→→	→→→→	→→→→							→→→→							\nVtwoheadrightarrowarrowtail
u+02919	→→→→	→→→→	→→→→							→→→→							\lefttail
u+0291a	→→→→	→→→→	→→→→							→→→→							\righttail
u+0291b	→→→→	→→→→	→→→→							→→→→							\leftdbltail
u+0291c	→→→→	→→→→	→→→→							→→→→							\rightdbltail
u+0291d	→→→→	→→→→	→→→→							→→→→							\diamondleftarrowrow
u+0291e	→→→→	→→→→	→→→→							→→→→							\rightarrowdiamond
u+0291f	→→→→	→→→→	→→→→							→→→→							\diamondleftarrowrowbar
u+02920	→→→→	→→→→	→→→→							→→→→							\barrightarrowdiamond
u+02921	→→→→	→→→→	→→→→							→→→→							\nwsearrow
u+02922	→→→→	→→→→	→→→→							→→→→							\nesarrow
u+02923	→→→→	→→→→	→→→→							→→→→							\hknarrow
u+02924	→→→→	→→→→	→→→→							→→→→							\hknearrow
u+02925	→→→→	→→→→	→→→→							→→→→							\hksearrow
u+02926	→→→→	→→→→	→→→→							→→→→							\hkswarrow
u+02927	→→→→	→→→→	→→→→							→→→→							\tona
u+02928	→→→→	→→→→	→→→→							→→→→							\toea
u+02929	→→→→	→→→→	→→→→							→→→→							\tosa
u+0292a	→→→→	→→→→	→→→→							→→→→							\towa
u+02933	→→→→	→→→→	→→→→				→→			→→→→							\rightcurvedarrow
u+02936	→→→→	→→→→	→→→→							→→→→							\leftdowncurvedarrow
u+02937	→→→→	→→→→	→→→→							→→→→							\rightdowncurvedarrow

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Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+02938	↗	↗	↗	↗						↗		↗	↗	↗	↗	↗	\cwrightarrow
u+02939	↖	↖	↖	↖						↖		↖	↖	↖	↖	↖	\acwleftarrow
u+0293a	⤒	⤒	⤒	⤒						⤒		⤒	⤒	⤒	⤒	⤒	\acwoverarrow
u+0293b	⤓	⤓	⤓	⤓						⤓		⤓	⤓	⤓	⤓	⤓	\acwunderarrow
u+0293c	⤔	⤔	⤔	⤔						⤔		⤔	⤔	⤔	⤔	⤔	\curvearrowrightminus
u+0293d	⤕	⤕	⤕	⤕						⤕		⤕	⤕	⤕	⤕	⤕	\curvearrowleftplus
u+0293e	⤖	⤖	⤖	⤖						⤖		⤖	⤖	⤖	⤖	⤖	\cwundercurvearrow
u+0293f	⤗	⤗	⤗	⤗						⤗		⤗	⤗	⤗	⤗	⤗	\ccwundercurvearrow
u+02940	⤘	⤘	⤘	⤘						⤘		⤘	⤘	⤘	⤘	⤘	\acwcirclearrow
u+02941	⤙	⤙	⤙	⤙						⤙		⤙	⤙	⤙	⤙	⤙	\cwcirclearrow
u+02942	⤚	⤚	⤚	⤚						⤚		⤚	⤚	⤚	⤚	⤚	\rightarrowshortleftarrow
u+02943	⤛	⤛	⤛	⤛						⤛		⤛	⤛	⤛	⤛	⤛	\leftarrowshortrightarrow
u+02944	⤜	⤜	⤜	⤜						⤜		⤜	⤜	⤜	⤜	⤜	\shortrightarrowshortleftarrow
u+02945	⤝	⤝	⤝	⤝						⤝		⤝	⤝	⤝	⤝	⤝	\rightarrowplus
u+02946	⤞	⤞	⤞	⤞						⤞		⤞	⤞	⤞	⤞	⤞	\leftarrowplus
u+02947	⤟	⤟	⤟	⤟						⤟		⤟	⤟	⤟	⤟	⤟	\rightarrowwx
u+02948	⤠	⤠	⤠	⤠						⤠		⤠	⤠	⤠	⤠	⤠	\leftrightarrowcircle
u+02949	⤡	⤡	⤡	⤡						⤡		⤡	⤡	⤡	⤡	⤡	\twoheaduparrowcircle
u+0294a	⤢	⤢	⤢	⤢						⤢		⤢	⤢	⤢	⤢	⤢	\leftrightharpoonupdown
u+0294b	⤣	⤣	⤣	⤣						⤣		⤣	⤣	⤣	⤣	⤣	\leftrightharpoonupdownup
u+0294c	⤤	⤤	⤤	⤤						⤤		⤤	⤤	⤤	⤤	⤤	\updownharpoonrightleft
u+0294d	⤥	⤥	⤥	⤥						⤥		⤥	⤥	⤥	⤥	⤥	\updownharpoonleftright
u+0294e	⤦	⤦	⤦	⤦						⤦		⤦	⤦	⤦	⤦	⤦	\leftrightharpoonupup
u+0294f	⤧	⤧	⤧	⤧						⤧		⤧	⤧	⤧	⤧	⤧	\updownharpoonrightright
u+02950	⤨	⤨	⤨	⤨						⤨		⤨	⤨	⤨	⤨	⤨	\leftrightharpoondowndown

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+02951		↖ ↗ ↖								↖		↖	↖ ↗ ↖	↖ ↗ ↖	↖ ↗ ↖	↖ ↗ ↖	\updownharpoonleftleft
u+02952		↑ ↑ ↑								↑		↑	↑ ↑ ↑	↑ ↑ ↑	↑ ↑ ↑	↑ ↑ ↑	\barleftharpoonup
u+02953		↓ ↓ ↓								↓		↓	↓ ↓ ↓	↓ ↓ ↓	↓ ↓ ↓	↓ ↓ ↓	\rightharpoonupbar
u+02954		↑ ↑ ↑								↑		↑	↑ ↑ ↑	↑ ↑ ↑	↑ ↑ ↑	↑ ↑ ↑	\barupharpoonright
u+02955		↓ ↓ ↓								↓		↓	↓ ↓ ↓	↓ ↓ ↓	↓ ↓ ↓	↓ ↓ ↓	\downharpoonrightbar
u+02956		↑ ↑ ↑								↑		↑	↑ ↑ ↑	↑ ↑ ↑	↑ ↑ ↑	↑ ↑ ↑	\barleftharpoondown
u+02957		→ → →								→		→	→ → →	→ → →	→ → →	→ → →	\rightharpoonondownbar
u+02958		↑ ↑ ↑								↑		↑	↑ ↑ ↑	↑ ↑ ↑	↑ ↑ ↑	↑ ↑ ↑	\barupharpoonleft
u+02959		↓ ↓ ↓								↓		↓	↓ ↓ ↓	↓ ↓ ↓	↓ ↓ ↓	↓ ↓ ↓	\downharpoonleftbar
u+0295a		↑ ↑ ↑								↑		↑	↑ ↑ ↑	↑ ↑ ↑	↑ ↑ ↑	↑ ↑ ↑	\leftharpoonupbar
u+0295b		↑ ↑ ↑								↑		↑	↑ ↑ ↑	↑ ↑ ↑	↑ ↑ ↑	↑ ↑ ↑	\barrightharpoonup
u+0295c		↓ ↓ ↓								↓		↓	↓ ↓ ↓	↓ ↓ ↓	↓ ↓ ↓	↓ ↓ ↓	\upharpoonrightbar
u+0295d		↓ ↓ ↓								↓		↓	↓ ↓ ↓	↓ ↓ ↓	↓ ↓ ↓	↓ ↓ ↓	\ardownharpoonright
u+0295e		↑ ↑ ↑								↑		↑	↑ ↑ ↑	↑ ↑ ↑	↑ ↑ ↑	↑ ↑ ↑	\leftharpoonondownbar
u+0295f		↑ ↑ ↑								↑		↑	↑ ↑ ↑	↑ ↑ ↑	↑ ↑ ↑	↑ ↑ ↑	\barrightharpoondown
u+02960		↑ ↑ ↑								↑		↑	↑ ↑ ↑	↑ ↑ ↑	↑ ↑ ↑	↑ ↑ ↑	\upharpoonleftbar
u+02961		↓ ↓ ↓								↓		↓	↓ ↓ ↓	↓ ↓ ↓	↓ ↓ ↓	↓ ↓ ↓	\ardownharpoonleft
u+02962		↔ ↔ ↔								↔		↔	↔ ↔ ↔	↔ ↔ ↔	↔ ↔ ↔	↔ ↔ ↔	\leftharpoononsupdown
u+02963		↔ ↔ ↔								↔		↔	↔ ↔ ↔	↔ ↔ ↔	↔ ↔ ↔	↔ ↔ ↔	\upharpoonleftsletright
u+02964		↔ ↔ ↔								↔		↔	↔ ↔ ↔	↔ ↔ ↔	↔ ↔ ↔	↔ ↔ ↔	\rightharpoononsupdown
u+02965		↓↓↓								↓		↓	↓↓↓	↓↓↓	↓↓↓	↓↓↓	\downharpoonleftsletright
u+02966		↔↔↔								↔		↔	↔↔↔	↔↔↔	↔↔↔	↔↔↔	\leftrightharpoonsup

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+02967		॥		॥						॥		॥				॥	\leftrightharpoonsdown
u+02968		॥		॥						॥		॥				॥	\rightleftharpoonsup
u+02969		॥	॥	॥	॥					॥		॥				॥	\rightleftharpoonsdown
u+0296a		॥	॥	॥	॥					॥		॥				॥	\leftharpoonupdash
u+0296b		॥	॥	॥	॥					॥		॥				॥	\dashleftharpoondown
u+0296c		॥	॥	॥	॥					॥		॥				॥	\rightharpoonupdash
u+0296d		॥	॥	॥	॥					॥		॥				॥	\dashrightharpoondown
u+0296e	॥	॥	॥	॥						॥		॥	॥	॥	॥	॥	\updownharpoonsleftright
u+0296f	॥	॥	॥	॥						॥		॥	॥	॥	॥	॥	\downupharpoonsleftright
u+02970	॥	॥	॥	॥						॥		॥	॥	॥	॥	॥	\rightimply
u+02971	॥	॥	॥	॥						॥		॥	॥	॥	॥	॥	\equalrightarrow
u+02972	॥	॥	॥	॥						॥		॥	॥	॥	॥	॥	\similarrightarrow
u+02973	॥	॥	॥	॥						॥		॥	॥	॥	॥	॥	\leftarrowsimilar
u+02974	॥	॥	॥	॥						॥		॥	॥	॥	॥	॥	\rightarrowsimilar
u+02975	॥	॥	॥	॥						॥		॥	॥	॥	॥	॥	\rightarrowapprox
u+02976																	\larr
u+02977																	\leftarrowless
u+02978																	\gtrarr
u+02979																	\subrarr
u+0297a																	\leftarrowsubset
u+0297b																	\suplarr
u+0297c																	\leftfishetail
u+0297d																	\rightfishetail
u+0297e																	\upfishetail
u+0297f																	\downfishetail
u+02982																	\typecolon
u+029ce																	\rtriltri
u+029cf																	\ltrivb
u+029d0																	\vbrtrii

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+029d1	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\lfbowtie
u+029d2	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\rbbowtie
u+029d3	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\fbbowtie
u+029d4	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\lftimes
u+029d5	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\rftimes
u+029df	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\dualmap
u+029e1	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\ltriangleeq
u+029e3	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\eparsl
u+029e4	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\smeparsl
u+029e5	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\eqvparsl
u+029e6	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\gleichstark
u+029f4	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\ruledelayed
u+02a59	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\veeonwedge
u+02a66	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\eqdot
u+02a67	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\dotequiv
u+02a68	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\equivVert
u+02a69	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\equivVvert
u+02a6a	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\dotsim
u+02a6b	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\simrdots
u+02a6c	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\simminussim
u+02a6d	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\congdot
u+02a6e	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\asteq
u+02a6f	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\hatapprox
u+02a70	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\approxeqq
u+02a73	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\eqqsim
u+02a74	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\Coloneq
u+02a75	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\eqeq
u+02a76	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\eqeqeq
u+02a77	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\ddotseq
u+02a78	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\equivDD
u+02a79	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\ltcir
u+02a7a	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\gtcir
u+02a7b	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\ltquest
u+02a7c	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\gtquest
u+02a7d	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\leqlslant <sup>(a)</sup>
u+02a7e	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\geqlslant <sup>(a)</sup>
u+02a7f	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\lesdot
u+02a80	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\gesdot
u+02a81	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\lesdoto
u+02a82	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	▀▀	\gesdoto

Fortsetzung ...

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+02aa7	Y A															\gtcc	
u+02aa8																\lescc	
u+02aa9																\gescc	
u+02aaa																\smt	
u+02aab																\lat	
u+02aac																\smte	
u+02aad																\late	
u+02aae																\bumpeqq	
u+02aaf																\preceq <sup>(p)</sup>	
u+02ab0																\succeq <sup>(p)</sup>	
u+02ab1																\precneq	
u+02ab2																\succneq	
u+02ab3																\preceqq	
u+02ab4																\succceqq	
u+02ab5																\precneqq	
u+02ab6																\succcneqq	
u+02ab7																\precapprox <sup>(a)</sup>	
u+02ab8																\succapprox <sup>(a)</sup>	
u+02ab9																\precnapprox <sup>(a)</sup>	
u+02aba																\succcnapprox <sup>(a)</sup>	
u+02abb																\Prec	
u+02abc																\Succ	
u+02abd																\subsetsetdot	
u+02abe																\supsetdot	
u+02abf																\subsetsetplus	
u+02ac0																\supsetplus	
u+02ac1																\submult	
u+02ac2																\supmult	
u+02ac3																\subedot	
u+02ac4																\supedot	
u+02ac5																\subsetseteqq <sup>(a)</sup>	
u+02ac6																\supseteqq <sup>(a)</sup>	
u+02ac7																\subsim	
u+02ac8																\supsim	
u+02ac9																\subsetsetapprox	
u+02aca																\supsetapprox	
u+02acb																\subsetsetneqq <sup>(a)</sup>	
u+02acc																\supsetneqq <sup>(a)</sup>	
u+02acd																\lsqhook	

Fortsetzung ...

Fortsetzung ...

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+02b4a	↔	↔	↔							↔	↔	↔	↔	↔		↔	\leftarrowwapprox
u+02b4b	↑	↑	↑							↑	↑	↑	↑	↑	↑	↑	\leftarrowwsimilar
u+02b4c	↓	↓	↓							↓	↓	↓	↓	↓	↓	↓	\rightarrowwbsimilar

## \mathop (big operators)

Die Anordnung der "Limits" ist davon abhängig ob das Makro \limits eingesetzt wird.

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Terms	Stix2	Hellenic	Lucida	Fira	Minion	Macro
u+02140	$\prod_0^1$	$\sum_0^1$														
u+0220f	$\coprod_0^1$	$\prod_0^1$														
u+02210	$\int_0^1$															
u+02211	$\int\!\!\!\int_0^1$															
u+0222b	$\int\!\!\!\int\!\!\!\int_0^1$															
u+0222c	$\int\!\!\!\int\!\!\!\int\!\!\!\int_0^1$															
u+0222d	$\int\!\!\!\int\!\!\!\int\!\!\!\int\!\!\!\int_0^1$															

Fortsetzung...

USV	LM	Xits	Cambria	Asana	Pagella	DejVu	Euler	Bonum	Schola	Terminus	Stix2	Hellenic	Libertinus	Lucida	Fira	Minion	Macro	
u+0222e	$\oint_0^1$	$\oint^{(p)}$																
u+0222f	$\oint\oint_0^1$	$\oint\oint^{(p)}$	$\oint\oint^{(p)}$															
u+02230	$\int\int_0^1$	$\int\int^{(p)}$	$\int\int^{(p)}$															
u+02231	$\int\int\int_0^1$	$\int\int\int^{(p)}$	$\int\int\int^{(p)}$															
u+02232	$\oint_0^1$	$\oint^{(p)}$	$\oint^{(p)}$															
u+02233	$\oint_0^1$	$\oint\oint^{(p)}$	$\oint\oint^{(p)}$															
u+022c0	$\bigwedge_0^1$	$\bigwedge_0^1$																
u+022c1	$\bigvee_0^1$	$\bigvee_0^1$																

Fortsetzung...



USV	Macro	Fortsetzung...														
		Minion	Fira	Lucida	Hellenic	Libertinus	Sixx2	Termes	Schola	Bonum	Euler	DejaVu	Pagella	Asana	Cambria	Xits
u+029f9	\xbsol	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	u+02a00	\bigodot <sup>(p)</sup>	\bigoplus <sup>(p)</sup>	\bigotimes <sup>(p)</sup>	\bigcup <sup>(p)</sup>	\bigcap <sup>(p)</sup>	\bigdotcup <sup>(p)</sup>	\bigcupdot <sup>(p)</sup>	\bigplus <sup>(p)</sup>	\bigcapdot <sup>(p)</sup>	\bigcupplus <sup>(p)</sup>	\bigcapplus <sup>(p)</sup>	\bigsqcupcap <sup>(p)</sup>	\bigsqcupcup <sup>(p)</sup>	\bigsqcupdot <sup>(p)</sup>	—
	u+02a01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	u+02a02	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	u+02a03	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	u+02a04	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	u+02a05	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	u+02a06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

USV	LM	XITS	Cambria	Asmara	PageFilla	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro	
u+02a07																		\con- jquant
u+02a08																		\dis- jquant
u+02a09																		\big- times
u+02a0a																		\modt- wosum
u+02a0b																		\sum- int
u+02a0c																		\iiint
u+02a0d																		\inbar
u+02a0e																		\intBar
u+02a0f																		\fint

Fortsetzung ...

UV	LM	XITS	Cambria	Aspara	Pagella	DejaVu	Euler	Schola	Terminus	Sixx2	Libertoinus	Hellenic	Lucida	Fira	Minion	Macro
U+02a10		$\int_0^1 f$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$\text{\circfrint}$						
U+02a11		$\int_0^1 f$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$\text{\awint}$						
U+02a12		$\int_0^1 f$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$\text{\wp-polint}$						
U+02a13		$\int_0^1 f$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$\text{\scpolint}$						
U+02a14		$\int_0^1 f$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$\text{\mpoint}$						
U+02a15		$\int_0^1 f$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$\text{\pointint}$						
U+02a16		$\int_0^1 f$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$\text{\sqint}$						
U+02a17		$\int_0^1 f$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$\text{\int-larhk}$						
U+02a18		$\int_0^1 f$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$f_0^1$	$\text{\intx}$						

Fortsetzung...

	Macro	Minion	Fira	Lucida	Hellenic	Libertinus	Sfz2	Terminus	Schola	Bonum	Euler	DejaVu	PageElla	Asana	Cambria	Xits	LM	JSV
\+02a19	\intcap	$\oint_0^1$	$\oint_0^1$	$\int_0^1$	$\oint_0^1$	$\int_0^1$	$\int_0^1$	$\bigtriangleup$	$\oint_0^1$	$\int_0^1$	$\otimes$	$\bigtriangleup$	$\bigtriangleup$	$\oint_0^1$	$\bigtriangleup$	$\bigtriangleup$	$\bigtriangleup$	$\bigtriangleup$
\+02a1a	\intcup	$\oint_0^1$	$\oint_0^1$	$\int_0^1$	$\oint_0^1$	$\int_0^1$	$\int_0^1$	$\bigtriangledown$	$\oint_0^1$	$\int_0^1$	$\otimes$	$\bigtriangleup$	$\bigtriangleup$	$\oint_0^1$	$\bigtriangleup$	$\bigtriangleup$	$\bigtriangleup$	$\bigtriangleup$
\+02a1b	\upint	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\bigtriangledown$	$\int_0^1$	$\int_0^1$	$\otimes$	$\bigtriangleup$	$\bigtriangleup$	$\oint_0^1$	$\bigtriangleup$	$\bigtriangleup$	$\bigtriangleup$	$\bigtriangleup$
\+02a1c	\lowint	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\bigtriangledown$	$\int_0^1$	$\int_0^1$	$\otimes$	$\bigtriangleup$	$\bigtriangleup$	$\oint_0^1$	$\bigtriangleup$	$\bigtriangleup$	$\bigtriangleup$	$\bigtriangleup$
\+02a1d	\Join	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\bigtriangledown$	$\int_0^1$	$\int_0^1$	$\otimes$	$\bigtriangleup$	$\bigtriangleup$	$\oint_0^1$	$\bigtriangleup$	$\bigtriangleup$	$\bigtriangleup$	$\bigtriangleup$
\+02a1e	\bigtriangleleft	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\bigtriangledown$	$\int_0^1$	$\int_0^1$	$\otimes$	$\bigtriangleup$	$\bigtriangleup$	$\oint_0^1$	$\bigtriangleup$	$\bigtriangleup$	$\bigtriangleup$	$\bigtriangleup$
\+02a1f	\zcmp	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\bigtriangledown$	$\int_0^1$	$\int_0^1$	$\otimes$	$\bigtriangleup$	$\bigtriangleup$	$\oint_0^1$	$\bigtriangleup$	$\bigtriangleup$	$\bigtriangleup$	$\bigtriangleup$
\+02a20	\zpipe	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\bigtriangledown$	$\int_0^1$	$\int_0^1$	$\otimes$	$\bigtriangleup$	$\bigtriangleup$	$\oint_0^1$	$\bigtriangleup$	$\bigtriangleup$	$\bigtriangleup$	$\bigtriangleup$
\+02a21	\zproj	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\int_0^1$	$\bigtriangledown$	$\int_0^1$	$\int_0^1$	$\otimes$	$\bigtriangleup$	$\bigtriangleup$	$\oint_0^1$	$\bigtriangleup$	$\bigtriangleup$	$\bigtriangleup$	$\bigtriangleup$

USV	LM	XITS	Cambria	Asana	PageElla	DejVu	Euler	Bonum	Schola	Terminus	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+02afc		1 ≡≡≡	0 ≡≡≡	1 ≡≡≡	0 ≡≡≡	1 ≡≡≡	0 ≡≡≡	1 ≡≡≡	0 ≡≡≡	1 ≡≡≡	1 ≡≡≡	1 ≡≡≡	0 ≡≡≡	1 ≡≡≡	0 ≡≡≡	1 ≡≡≡	\begin{array}{c} \backslash \text{begin-} \\ \text{terleave} \end{array}
u+02aff		0 ≡≡≡	1 ≡≡≡	0 ≡≡≡	0 ≡≡≡	1 ≡≡≡	0 ≡≡≡	1 ≡≡≡	0 ≡≡≡	1 ≡≡≡	0 ≡≡≡	1 ≡≡≡	0 ≡≡≡	1 ≡≡≡	0 ≡≡≡	1 ≡≡≡	\begin{array}{c} \backslash \text{bigtal-} \\ \text{lohang} \end{array}
u+1ef0		1 ≡≡≡	0 ≡≡≡	1 ≡≡≡	0 ≡≡≡	1 ≡≡≡	0 ≡≡≡	1 ≡≡≡	\begin{array}{c} \backslash \text{arabic-} \\ \text{maj} \end{array}								
u+1ef1		1 ≡≡≡	0 ≡≡≡	1 ≡≡≡	0 ≡≡≡	1 ≡≡≡	0 ≡≡≡	1 ≡≡≡	\begin{array}{c} \backslash \text{ara-} \\ \text{bichad} \end{array}								

## \mathshover

Fortsetzung ...

\mathbf{thunder}

## \mathalpha

Zeichentyp	Seite	Zeichentyp	Seite
Upright Greek, uppercase	198	Upright Greek, lowercase	198
Italic, Latin, uppercase	200	Italic, Latin, lowercase	200
Italic Greek, uppercase	201	Italic Greek, lowercase	203
Script, Latin, uppercase	204	Script, Latin, lowercase	204
Fraktur, Latin, uppercase	205	Fraktur, Latin, lowercase	205
Blackboard, Latin, uppercase	206	Blackboard, Latin, lowercase	207
Sans serif, Latin, uppercase	208	Sans serif, Latin, lowercase	208
Italic sans serif, Latin, uppercase	209	Italic sans serif, Latin, lowercase	210
Typewriter, Latin, uppercase	211	Typewriter, Latin, lowercase	212
Bold, Latin, uppercase	213	Bold, Latin, lowercase	213
Bold Greek, uppercase	214	Bold Greek, lowercase	215
Bold italic, Latin, uppercase	217	Bold italic, Latin, lowercase	218
Bold italic Greek, uppercase	219	Bold italic Greek, lowercase	222
Bold script, Latin, uppercase	224	Bold script, Latin, lowercase	225
Bold fraktur, Latin, uppercase	226	Bold fraktur, Latin, lowercase	227
Bold sans serif, Latin, uppercase	228	Bold sans serif, Latin, lowercase	229
Bold italic sans serif, Latin, uppercase	230	Bold italic sans serif, Latin, lowercase	231
Bold sans serif Greek, uppercase	232	Bold sans serif Greek, lowercase	233
Bold italic sans serif Greek, uppercase	235	Bold italic sans serif Greek, lowercase	236

Ein großer Teil der Zeichen, die unter der Kategorie \mathalpha aufgeführt werden, befinden sich auch im normalen Textsatz und sind über die Befehle \math<Typ> zugänglich. Nur für den Fall, dass der Text=Zeichensatz einen zugehörigen mathematischen Zeichensatz besitzt, kann man davon ausgehen, dass es keine Unterschiede gibt (wie bei der Libertinus im folgenden Beispiel). Die beiden Beispiele zeigen jeweils eine Gegenüberstellung von \math<Typ> und \sym<Typ>.

Zeichensatz Libertinus (Text und Mathe):

```
$\mathrm{A}\mathit{A}\mathsf{A}\mathbf{A}\mathit{\mathbf{A}} \Leftrightarrow
\symup{A}\symit{A}\symsf{A}\symbf{A}\symbfit{A}$
```

**AAAAA ↔ AAAAA**

Zeichensätze Pagella (Text) und Cambria Math:

```
$\mathrm{A}\mathit{A}\mathsf{A}\mathbf{A}\mathit{\mathbf{A}} \Leftrightarrow
\symup{A}\symit{A}\symsf{A}\symbf{A}\symbfit{A}$
```

**AAAAA ↔ AAAAA**

## Upright Greek, uppercase

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+00391	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	\mupAlpha
u+00392	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	\mupBeta
u+00393	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	\mupGamma
u+00394	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	\mupDelta
u+00395	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	\mupEpsilon
u+00396	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	\mupZeta
u+00397	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	\mupEta
u+00398	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	\mupTheta
u+00399	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	\mupIota
u+0039a	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	\mupKappa
u+0039b	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	\mupLambda
u+0039c	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	\mupMu
u+0039d	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	\mupNu
u+0039e	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	\mupXi
u+0039f	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	\mupOmicron
u+003a0	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	\mupPi
u+003a1	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	\mupRho
u+003a3	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	\mupSigma
u+003a4	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	\mupTau
u+003a5	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	\mupUpsilon
u+003a6	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	\mupPhi
u+003a7	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	\mupChi
u+003a8	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	\mupPsi
u+003a9	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	\mupOmega

## Upright Greek, lowercase

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+003b1	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	\mupalpha
u+003b2	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	\mupbeta
u+003b3	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	\mupgamma
u+003b4	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	\mupdelta
u+003b5	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	\mupvarepsilon
u+003b6	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	\mupzeta
u+003b7	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	\mupeta
u+003b8	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	\muptheta
u+003b9	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	\mupiota
u+003ba	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	\mupkappa
u+003bb	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	\muplambda
u+003bc	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	\mupmu
u+003bd	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	\mupnu
u+003be	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	\mupxi
u+003bf	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	\mupomicron
u+003c0	π	π	π	π	π	π	π	π	π	π	π	π	π	π	π	π	\muppi
u+003c1	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	\muprho
u+003c2	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	\mupvarsigma
u+003c3	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	\mupsigma
u+003c4	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	\muptau
u+003c5	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	\mupupsilon
u+003c6	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	\mupvarphi
u+003c7	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	\mupchi
u+003c8	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	\muppsi
u+003c9	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	\mupomega
u+003d1	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	\mupvartheta
u+003d5	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	\mupphi
u+003d6	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	\mupvarpi
u+003dc	F	F	F												F	\up-Digamma	
u+003dd	F	f	F												F	\up-digamma	
u+003f0	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	\mupvarkappa

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+003f1	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mupvarrho
u+003f4	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	\mupvarTheta
u+003f5	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	\mupepsilon

**Italic, Latin, uppercase**

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d434	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	\mitA
u+1d435	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	\mitB
u+1d436	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	\mitC
u+1d437	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	\mitD
u+1d438	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	\mitE
u+1d439	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	\mitF
u+1d43a	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	\mitG
u+1d43b	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	\mitH
u+1d43c	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	\mitI
u+1d43d	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	\mitJ
u+1d43e	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	\mitK
u+1d43f	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	\mitL
u+1d440	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	\mitM
u+1d441	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	\mitN
u+1d442	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	\mitO
u+1d443	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	\mitP
u+1d444	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	\mitQ
u+1d445	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	\mitR
u+1d446	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	\mitS
u+1d447	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	\mitT
u+1d448	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	\mitU
u+1d449	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	\mitV
u+1d44a	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	\mitW
u+1d44b	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	\mitX
u+1d44c	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	\mitY
u+1d44d	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	\mitZ

**Italic, Latin, lowercase**

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d44e	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	\mita
u+1d44f	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	\mitb
u+1d450	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	\mitc
u+1d451	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	\mitd
u+1d452	e	e	e	e	e	e	e	e	e	e	e	e	e	e	e	e	\mite
u+1d453	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	\mitf
u+1d454	g	g	g	g	g	g	g	g	g	g	g	g	g	g	g	g	\mitg
u+1d456	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	\miti
u+1d457	j	j	j	j	j	j	j	j	j	j	j	j	j	j	j	j	\mitj
u+1d458	k	k	k	k	k	k	k	k	k	k	k	k	k	k	k	k	\mitk
u+1d459	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	\mitl
u+1d45a	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	\mitm
u+1d45b	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	\mitn
u+1d45c	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	\mito
u+1d45d	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	\mitp
u+1d45e	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	\mitq
u+1d45f	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	\mitr
u+1d460	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	\mits
u+1d461	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t	\mitt
u+1d462	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	\mitu
u+1d463	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	\mitv
u+1d464	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	\mitw
u+1d465	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	\mitx
u+1d466	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	\mity
u+1d467	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	\mitz

### Italic Greek, uppercase

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d6e2	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	\mitAlpha
u+1d6e3	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	\mitBeta
u+1d6e4	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	\mitGamma
u+1d6e5	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	\mitDelta

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d6e6	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	\mitEpsilon
u+1d6e7	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	\mitZeta
u+1d6e8	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	\mitEta
u+1d6e9	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	\mitTheta
u+1d6ea	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	\mitIota
u+1d6eb	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	\mitKappa
u+1d6ec	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	\mitLambda
u+1d6ed	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	\mitMu
u+1d6ee	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	\mitNu
u+1d6ef	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	\mitXi
u+1d6f0	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	\mitOmicron
u+1d6f1	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	\mitPi
u+1d6f2	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	\mitRho
u+1d6f3	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	\mitVarTheta
u+1d6f4	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	\mitSigma
u+1d6f5	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	\mitTau
u+1d6f6	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	\mitUpsilon
u+1d6f7	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	\mitPhi
u+1d6f8	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	\mitChi
u+1d6f9	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	\mitPsi
u+1d6fa	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	\mitOmega

## Italic Greek, lowercase

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Times	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d6fc	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	\mitalpha
u+1d6fd	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	\mitbeta
u+1d6fe	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	\mitgamma
u+1d6ff	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	\mitdelta
u+1d700	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	\mitvarepsilonilon
u+1d701	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	\mitzeta
u+1d702	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	\miteta
u+1d703	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	\mittheta
u+1d704	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	\mitiota
u+1d705	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	\mitkappa
u+1d706	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	\mitlambda
u+1d707	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	\mitmu
u+1d708	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	\mitnu
u+1d709	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	\mitxi
u+1d70a	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	\mitomicron
u+1d70b	π	π	π	π	π	π	π	π	π	π	π	π	π	π	π	π	\mitpi
u+1d70c	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	\mitrho
u+1d70d	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	\mitvarsigma
u+1d70e	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	\mitsigma
u+1d70f	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	\mittau
u+1d710	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	\mitupsilon
u+1d711	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	\mitvarphi
u+1d712	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	\mitchi
u+1d713	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	\mitpsi
u+1d714	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	\mitomega
u+1d715	∂	∂	∂	∂	∂	∂	∂	∂	∂	∂	∂	∂	∂	∂	∂	∂	\mitpartial
u+1d716	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	\mitepsilon
u+1d717	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	\mitvartheta
u+1d718	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	\mitvarkappa
u+1d719	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	\mitphi
u+1d71a	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	\mitvarrho
u+1d71b	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	\mitvarpi

## Script, Latin, uppercase

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d49c	𝒜	𝒜	𝒜	𝒜	𝒜	𝒜	𝒜	𝒜	𝒜	𝒜	𝒜	𝒜	𝒜	𝒜	𝒜	𝒜	\mscrA
u+1d49e	𝒽	𝒽	𝒽	𝒽	𝒽	𝒽	𝒽	𝒽	𝒽	𝒽	𝒽	𝒽	𝒽	𝒽	𝒽	𝒽	\mscrC
u+1d49f	𝒟	𝒟	𝒟	𝒟	𝒟	𝒟	𝒟	𝒟	𝒟	𝒟	𝒟	𝒟	𝒟	𝒟	𝒟	𝒟	\mscrD
u+1d4a2	𝒢	𝒢	𝒢	𝒢	𝒢	𝒢	𝒢	𝒢	𝒢	𝒢	𝒢	𝒢	𝒢	𝒢	𝒢	𝒢	\mscrG
u+1d4a5	𝒤	𝒤	𝒤	𝒤	𝒤	𝒤	𝒤	𝒤	𝒤	𝒤	𝒤	𝒤	𝒤	𝒤	𝒤	𝒤	\mscrJ
u+1d4a6	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	\mscrK
u+1d4a9	𝒪	𝒪	𝒪	𝒪	𝒪	𝒪	𝒪	𝒪	𝒪	𝒪	𝒪	𝒪	𝒪	𝒪	𝒪	𝒪	\mscrN
u+1d4aa	𝒬	𝒬	𝒬	𝒬	𝒬	𝒬	𝒬	𝒬	𝒬	𝒬	𝒬	𝒬	𝒬	𝒬	𝒬	𝒬	\mscrO
u+1d4ab	𝒫	𝒫	𝒫	𝒫	𝒫	𝒫	𝒫	𝒫	𝒫	𝒫	𝒫	𝒫	𝒫	𝒫	𝒫	𝒫	\mscrP
u+1d4ac	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	\mscrQ
u+1d4ae	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	𝒮	\mscrS
u+1d4af	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	𝒯	\mscrT
u+1d4b0	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	\mscrU
u+1d4b1	𝑽	𝑽	𝑽	𝑽	𝑽	𝑽	𝑽	𝑽	𝑽	𝑽	𝑽	𝑽	𝑽	𝑽	𝑽	𝑽	\mscrV
u+1d4b2	𝒨	𝒨	𝒨	𝒨	𝒨	𝒨	𝒨	𝒨	𝒨	𝒨	𝒨	𝒨	𝒨	𝒨	𝒨	𝒨	\mscrW
u+1d4b3	𝒳	𝒳	𝒳	𝒳	𝒳	𝒳	𝒳	𝒳	𝒳	𝒳	𝒳	𝒳	𝒳	𝒳	𝒳	𝒳	\mscrX
u+1d4b4	𝒺	𝒺	𝒺	𝒺	𝒺	𝒺	𝒺	𝒺	𝒺	𝒺	𝒺	𝒺	𝒺	𝒺	𝒺	𝒺	\mscrY
u+1d4b5	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	𝒰	\mscrZ

## Script, Latin, lowercase

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d4b6	𝒶	𝒶	𝒶	𝒶	𝒶	𝒶	𝒶	𝒶	𝒶	𝒶	𝒶	𝒶	𝒶	𝒶	𝒶	𝒶	\mscrra
u+1d4b7	𝒷	𝒷	𝒷	𝒷	𝒷	𝒷	𝒷	𝒷	𝒷	𝒷	𝒷	𝒷	𝒷	𝒷	𝒷	𝒷	\mscrb
u+1d4b8	𝒸	𝒸	𝒸	𝒸	𝒸	𝒸	𝒸	𝒸	𝒸	𝒸	𝒸	𝒸	𝒸	𝒸	𝒸	𝒸	\mscrcc
u+1d4b9	𝒹	𝒹	𝒹	𝒹	𝒹	𝒹	𝒹	𝒹	𝒹	𝒹	𝒹	𝒹	𝒹	𝒹	𝒹	𝒹	\mscrd
u+1d4bb	𝒻	𝒻	𝒻	𝒻	𝒻	𝒻	𝒻	𝒻	𝒻	𝒻	𝒻	𝒻	𝒻	𝒻	𝒻	𝒻	\mscrf
u+1d4bd	𝒉	𝒉	𝒉	𝒉	𝒉	𝒉	𝒉	𝒉	𝒉	𝒉	𝒉	𝒉	𝒉	𝒉	𝒉	𝒉	\mscrh
u+1d4be	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	\mscri
u+1d4bf	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	\mscrj
u+1d4c0	𝓀	𝓀	𝓀	𝓀	𝓀	𝓀	𝓀	𝓀	𝓀	𝓀	𝓀	𝓀	𝓀	𝓀	𝓀	𝓀	\mscrk
u+1d4c1	𝓁	𝓁	𝓁	𝓁	𝓁	𝓁	𝓁	𝓁	𝓁	𝓁	𝓁	𝓁	𝓁	𝓁	𝓁	𝓁	\mscrl
u+1d4c2	𝓂	𝓂	𝓂	𝓂	𝓂	𝓂	𝓂	𝓂	𝓂	𝓂	𝓂	𝓂	𝓂	𝓂	𝓂	𝓂	\mscrm
u+1d4c3	𝓃	𝓃	𝓃	𝓃	𝓃	𝓃	𝓃	𝓃	𝓃	𝓃	𝓃	𝓃	𝓃	𝓃	𝓃	𝓃	\mscrn
u+1d4c5	𝓅	𝓅	𝓅	𝓅	𝓅	𝓅	𝓅	𝓅	𝓅	𝓅	𝓅	𝓅	𝓅	𝓅	𝓅	𝓅	\mscrp

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d4c6	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	\mscrq
u+1d4c7	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	\mscrr
u+1d4c8	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	\mscrs
u+1d4c9	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t	\mscrt
u+1d4ca	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	\mscru
u+1d4cb	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	\mscrv
u+1d4cc	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	\mscrw
u+1d4cd	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	\mscrx
u+1d4ce	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	\mscry
u+1d4cf	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	\mscrz

## Fraktur, Latin, uppercase

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d504	À	À	À	À	À	À	À	À	À	À	À	À	À	À	À	À	\mfrakA
u+1d505	Ò	Ò	Ò	Ò	Ò	Ò	Ò	Ò	Ò	Ò	Ò	Ò	Ò	Ò	Ò	Ò	\mfrakB
u+1d507	Ó	Ó	Ó	Ó	Ó	Ó	Ó	Ó	Ó	Ó	Ó	Ó	Ó	Ó	Ó	Ó	\mfrakD
u+1d508	Ѐ	Ѐ	Ѐ	Ѐ	Ѐ	Ѐ	Ѐ	Ѐ	Ѐ	Ѐ	Ѐ	Ѐ	Ѐ	Ѐ	Ѐ	Ѐ	\mfrakE
u+1d509	Ӄ	Ӄ	Ӄ	Ӄ	Ӄ	Ӄ	Ӄ	Ӄ	Ӄ	Ӄ	Ӄ	Ӄ	Ӄ	Ӄ	Ӄ	Ӄ	\mfrakF
u+1d50a	ӄ	ӄ	ӄ	ӄ	ӄ	ӄ	ӄ	ӄ	ӄ	ӄ	ӄ	ӄ	ӄ	ӄ	ӄ	ӄ	\mfrakG
u+1d50d	ӂ	ӂ	ӂ	ӂ	ӂ	ӂ	ӂ	ӂ	ӂ	ӂ	ӂ	ӂ	ӂ	ӂ	ӂ	ӂ	\mfrakJ
u+1d50e	Ӂ	Ӂ	Ӂ	Ӂ	Ӂ	Ӂ	Ӂ	Ӂ	Ӂ	Ӂ	Ӂ	Ӂ	Ӂ	Ӂ	Ӂ	Ӂ	\mfrakK
u+1d50f	Ӆ	ӆ	ӆ	ӆ	ӆ	ӆ	ӆ	ӆ	ӆ	ӆ	ӆ	ӆ	ӆ	ӆ	ӆ	ӆ	\mfrakL
u+1d510	Ӈ	Ӈ	Ӈ	Ӈ	Ӈ	Ӈ	Ӈ	Ӈ	Ӈ	Ӈ	Ӈ	Ӈ	Ӈ	Ӈ	Ӈ	Ӈ	\mfrakM
u+1d511	ӈ	ӈ	ӈ	ӈ	ӈ	ӈ	ӈ	ӈ	ӈ	ӈ	ӈ	ӈ	ӈ	ӈ	ӈ	ӈ	\mfrakN
u+1d512	Ӊ	Ӊ	Ӊ	Ӊ	Ӊ	Ӊ	Ӊ	Ӊ	Ӊ	Ӊ	Ӊ	Ӊ	Ӊ	Ӊ	Ӊ	Ӊ	\mfrakO
u+1d513	ӊ	ӊ	ӊ	ӊ	ӊ	ӊ	ӊ	ӊ	ӊ	ӊ	ӊ	ӊ	ӊ	ӊ	ӊ	ӊ	\mfrakP
u+1d514	Ӌ	Ӌ	Ӌ	Ӌ	Ӌ	Ӌ	Ӌ	Ӌ	Ӌ	Ӌ	Ӌ	Ӌ	Ӌ	Ӌ	Ӌ	Ӌ	\mfrakQ
u+1d516	ӌ	ӌ	ӌ	ӌ	ӌ	ӌ	ӌ	ӌ	ӌ	ӌ	ӌ	ӌ	ӌ	ӌ	ӌ	ӌ	\mfrakS
u+1d517	Ӎ	Ӎ	Ӎ	Ӎ	Ӎ	Ӎ	Ӎ	Ӎ	Ӎ	Ӎ	Ӎ	Ӎ	Ӎ	Ӎ	Ӎ	Ӎ	\mfrakT
u+1d518	ӎ	ӎ	ӎ	ӎ	ӎ	ӎ	ӎ	ӎ	ӎ	ӎ	ӎ	ӎ	ӎ	ӎ	ӎ	ӎ	\mfrakU
u+1d519	ӏ	ӏ	ӏ	ӏ	ӏ	ӏ	ӏ	ӏ	ӏ	ӏ	ӏ	ӏ	ӏ	ӏ	ӏ	ӏ	\mfrakV
u+1d51a	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	Ӑ	\mfrakW
u+1d51b	ӑ	ӑ	ӑ	ӑ	ӑ	ӑ	ӑ	ӑ	ӑ	ӑ	ӑ	ӑ	ӑ	ӑ	ӑ	ӑ	\mfrakX
u+1d51c	Ӓ	Ӓ	Ӓ	Ӓ	Ӓ	Ӓ	Ӓ	Ӓ	Ӓ	Ӓ	Ӓ	Ӓ	Ӓ	Ӓ	Ӓ	Ӓ	\mfrakY

## Fraktur, Latin, lowercase

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d51e	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfraka
u+1d51f	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrakb
u+1d520	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrakc
u+1d521	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrakd
u+1d522	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrake
u+1d523	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrakf
u+1d524	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrakg
u+1d525	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrakh
u+1d526	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfraki
u+1d527	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrakj
u+1d528	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrakk
u+1d529	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrakl
u+1d52a	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrakm
u+1d52b	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrakn
u+1d52c	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrako
u+1d52d	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrakp
u+1d52e	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrakq
u+1d52f	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrakr
u+1d530	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfraks
u+1d531	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrakt
u+1d532	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfraku
u+1d533	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrakv
u+1d534	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrakw
u+1d535	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrakx
u+1d536	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfraky
u+1d537	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\mfrakz

## Blackboard, Latin, uppercase

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d538	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\BbbA
u+1d539	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\BbbB
u+1d53b	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\BbbD
u+1d53c	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\BbbE
u+1d53d	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\BbbF
u+1d53e	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\BbbG
u+1d540	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	¤	\BbbI

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d541	؂	؂	؂	؂	؂	؂	؂	؂	؂	؂	؂	؂	؂	؂	؂	؂	\BbbJ
u+1d542	؃	؃	؃	؃	؃	؃	؃	؃	؃	؃	؃	؃	؃	؃	؃	؃	\BbbK
u+1d543	؄	؄	؄	؄	؄	؄	؄	؄	؄	؄	؄	؄	؄	؄	؄	؄	\BbbL
u+1d544	؅	؅	؅	؅	؅	؅	؅	؅	؅	؅	؅	؅	؅	؅	؅	؅	\BbbM
u+1d546	؇	؇	؇	؇	؇	؇	؇	؇	؇	؇	؇	؇	؇	؇	؇	؇	\BbbO
u+1d54a	؈	؈	؈	؈	؈	؈	؈	؈	؈	؈	؈	؈	؈	؈	؈	؈	\BbbS
u+1d54b	؉	؉	؉	؉	؉	؉	؉	؉	؉	؉	؉	؉	؉	؉	؉	؉	\BbbT
u+1d54c	؊	؊	؊	؊	؊	؊	؊	؊	؊	؊	؊	؊	؊	؊	؊	؊	\BbbU
u+1d54d	؋	؋	؋	؋	؋	؋	؋	؋	؋	؋	؋	؋	؋	؋	؋	؋	\BbbV
u+1d54e	،	،	،	،	،	،	،	،	،	،	،	،	،	،	،	،	\BbbW
u+1d54f	؍	؍	؍	؍	؍	؍	؍	؍	؍	؍	؍	؍	؍	؍	؍	؍	\BbbX
u+1d550	؏	؏	؏	؏	؏	؏	؏	؏	؏	؏	؏	؏	؏	؏	؏	؏	\BbbY

## Blackboard, Latin, lowercase

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d552	؂	؂	؂	؂	؂	؂	؂	؂	؂	؂	؂	؂	؂	؂	؂	؂	\Bbba
u+1d553	؃	؃	؃	؃	؃	؃	؃	؃	؃	؃	؃	؃	؃	؃	؃	؃	\Bbbb
u+1d554	؄	؄	؄	؄	؄	؄	؄	؄	؄	؄	؄	؄	؄	؄	؄	؄	\Bbbc
u+1d555	؅	؅	؅	؅	؅	؅	؅	؅	؅	؅	؅	؅	؅	؅	؅	؅	\Bbbd
u+1d556	؆	؆	؆	؆	؆	؆	؆	؆	؆	؆	؆	؆	؆	؆	؆	؆	\Bbbe
u+1d557	؇	؇	؇	؇	؇	؇	؇	؇	؇	؇	؇	؇	؇	؇	؇	؇	\Bbbf
u+1d558	؈	؈	؈	؈	؈	؈	؈	؈	؈	؈	؈	؈	؈	؈	؈	؈	\Bbbg
u+1d559	؉	؉	؉	؉	؉	؉	؉	؉	؉	؉	؉	؉	؉	؉	؉	؉	\Bbbh
u+1d55a	؊	؊	؊	؊	؊	؊	؊	؊	؊	؊	؊	؊	؊	؊	؊	؊	\Bbbi
u+1d55b	؋	؋	؋	؋	؋	؋	؋	؋	؋	؋	؋	؋	؋	؋	؋	؋	\Bbbj
u+1d55c	،	،	،	،	،	،	،	،	،	،	،	،	،	،	،	،	\Bbbk <sup>(a)</sup>
u+1d55d	؍	؍	؍	؍	؍	؍	؍	؍	؍	؍	؍	؍	؍	؍	؍	؍	\Bbbl
u+1d55e	؎	؎	؎	؎	؎	؎	؎	؎	؎	؎	؎	؎	؎	؎	؎	؎	\Bbbm
u+1d55f	؏	؏	؏	؏	؏	؏	؏	؏	؏	؏	؏	؏	؏	؏	؏	؏	\Bbbn
u+1d560	ؐ	ؐ	ؐ	ؐ	ؐ	ؐ	ؐ	ؐ	ؐ	ؐ	ؐ	ؐ	ؐ	ؐ	ؐ	ؐ	\Bbbo
u+1d561	ؑ	ؑ	ؑ	ؑ	ؑ	ؑ	ؑ	ؑ	ؑ	ؑ	ؑ	ؑ	ؑ	ؑ	ؑ	ؑ	\Bbbp
u+1d562	ؒ	ؒ	ؒ	ؒ	ؒ	ؒ	ؒ	ؒ	ؒ	ؒ	ؒ	ؒ	ؒ	ؒ	ؒ	ؒ	\Bbbq
u+1d563	ؓ	ؓ	ؓ	ؓ	ؓ	ؓ	ؓ	ؓ	ؓ	ؓ	ؓ	ؓ	ؓ	ؓ	ؓ	ؓ	\Bbbr
u+1d564	ؔ	ؔ	ؔ	ؔ	ؔ	ؔ	ؔ	ؔ	ؔ	ؔ	ؔ	ؔ	ؔ	ؔ	ؔ	ؔ	\Bbbss
u+1d565	ؕ	ؕ	ؕ	ؕ	ؕ	ؕ	ؕ	ؕ	ؕ	ؕ	ؕ	ؕ	ؕ	ؕ	ؕ	ؕ	\Bbbt
u+1d566	ؖ	ؖ	ؖ	ؖ	ؖ	ؖ	ؖ	ؖ	ؖ	ؖ	ؖ	ؖ	ؖ	ؖ	ؖ	ؖ	\Bbbu

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d567	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	\Bbbv
u+1d568	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	\Bbbw
u+1d569	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	\Bbbx
u+1d56a	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	\Bbbby
u+1d56b	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	\Bbbz

### Sans serif, Latin, uppercase

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d5a0	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	\msansA
u+1d5a1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	\msansB
u+1d5a2	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	\msansC
u+1d5a3	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	\msansD
u+1d5a4	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	\msansE
u+1d5a5	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	\msansF
u+1d5a6	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	\msansG
u+1d5a7	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	\msansH
u+1d5a8	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	\msansI
u+1d5a9	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	\msansJ
u+1d5aa	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	\msansK
u+1d5ab	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	\msansL
u+1d5ac	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	\msansM
u+1d5ad	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	\msansN
u+1d5ae	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	\msansO
u+1d5af	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	\msansP
u+1d5b0	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	\msansQ
u+1d5b1	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	\msansR
u+1d5b2	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	\msansS
u+1d5b3	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	\msansT
u+1d5b4	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	\msansU
u+1d5b5	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	\msansV
u+1d5b6	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	\msansW
u+1d5b7	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	\msansX
u+1d5b8	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	\msansY
u+1d5b9	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	\msansZ

### Sans serif, Latin, lowercase

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d5ba	a	a	a	a	a	a	a	a	a	a	a	a	a	a	\msansa		
u+1d5bb	b	b	b	b	b	b	b	b	b	b	b	b	b	b	\msansb		
u+1d5bc	c	c	c	c	c	c	c	c	c	c	c	c	c	c	\msansc		
u+1d5bd	d	d	d	d	d	d	d	d	d	d	d	d	d	d	\msansd		
u+1d5be	e	e	e	e	e	e	e	e	e	e	e	e	e	e	\msanse		
u+1d5bf	f	f	f	f	f	f	f	f	f	f	f	f	f	f	\msansf		
u+1d5c0	g	g	g	g	g	g	g	g	g	g	g	g	g	g	\msansg		
u+1d5c1	h	h	h	h	h	h	h	h	h	h	h	h	h	h	\msansh		
u+1d5c2	i	i	i	i	i	i	i	i	i	i	i	i	i	i	\msansi		
u+1d5c3	j	j	j	j	j	j	j	j	j	j	j	j	j	j	\msansj		
u+1d5c4	k	k	k	k	k	k	k	k	k	k	k	k	k	k	\msansk		
u+1d5c5	l	l	l	l	l	l	l	l	l	l	l	l	l	l	\msansl		
u+1d5c6	m	m	m	m	m	m	m	m	m	m	m	m	m	m	\msansm		
u+1d5c7	n	n	n	n	n	n	n	n	n	n	n	n	n	n	\msansn		
u+1d5c8	o	o	o	o	o	o	o	o	o	o	o	o	o	o	\msanso		
u+1d5c9	p	p	p	p	p	p	p	p	p	p	p	p	p	p	\msansp		
u+1d5ca	q	q	q	q	q	q	q	q	q	q	q	q	q	q	\msansq		
u+1d5cb	r	r	r	r	r	r	r	r	r	r	r	r	r	r	\msansr		
u+1d5cc	s	s	s	s	s	s	s	s	s	s	s	s	s	s	\msanss		
u+1d5cd	t	t	t	t	t	t	t	t	t	t	t	t	t	t	\msanst		
u+1d5ce	u	u	u	u	u	u	u	u	u	u	u	u	u	u	\msansu		
u+1d5cf	v	v	v	v	v	v	v	v	v	v	v	v	v	v	\msansv		
u+1d5d0	w	w	w	w	w	w	w	w	w	w	w	w	w	w	\msansw		
u+1d5d1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	\msansx		
u+1d5d2	y	y	y	y	y	y	y	y	y	y	y	y	y	y	\msansy		
u+1d5d3	z	z	z	z	z	z	z	z	z	z	z	z	z	z	\msansz		

**Italic sans serif, Latin, uppercase**

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d608	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	\mitsansA	
u+1d609	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	\mitsansB	
u+1d60a	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	\mitsansC	
u+1d60b	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	\mitsansD	

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d60c	<i>E</i>	<i>E</i>	<i>E</i>	<i>E</i>	<i>E</i>	\mitsansE											
u+1d60d	<i>F</i>	<i>F</i>	<i>F</i>	<i>F</i>	<i>F</i>	\mitsansF											
u+1d60e	<i>G</i>	<i>G</i>	<i>G</i>	<i>G</i>	<i>G</i>	\mitsansG											
u+1d60f	<i>H</i>	<i>H</i>	<i>H</i>	<i>H</i>	<i>H</i>	\mitsansH											
u+1d610	<i>I</i>	<i>I</i>	<i>I</i>	<i>I</i>	<i>I</i>	\mitsansI											
u+1d611	<i>J</i>	<i>J</i>	<i>J</i>	<i>J</i>	<i>J</i>	\mitsansJ											
u+1d612	<i>K</i>	<i>K</i>	<i>K</i>	<i>K</i>	<i>K</i>	\mitsansK											
u+1d613	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>	<i>L</i>	\mitsansL											
u+1d614	<i>M</i>	<i>M</i>	<i>M</i>	<i>M</i>	<i>M</i>	\mitsansM											
u+1d615	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	\mitsansN											
u+1d616	<i>O</i>	<i>O</i>	<i>O</i>	<i>O</i>	<i>O</i>	\mitsansO											
u+1d617	<i>P</i>	<i>P</i>	<i>P</i>	<i>P</i>	<i>P</i>	\mitsansP											
u+1d618	<i>Q</i>	<i>Q</i>	<i>Q</i>	<i>Q</i>	<i>Q</i>	\mitsansQ											
u+1d619	<i>R</i>	<i>R</i>	<i>R</i>	<i>R</i>	<i>R</i>	\mitsansR											
u+1d61a	<i>S</i>	<i>S</i>	<i>S</i>	<i>S</i>	<i>S</i>	\mitsansS											
u+1d61b	<i>T</i>	<i>T</i>	<i>T</i>	<i>T</i>	<i>T</i>	\mitsansT											
u+1d61c	<i>U</i>	<i>U</i>	<i>U</i>	<i>U</i>	<i>U</i>	\mitsansU											
u+1d61d	<i>V</i>	<i>V</i>	<i>V</i>	<i>V</i>	<i>V</i>	\mitsansV											
u+1d61e	<i>W</i>	<i>W</i>	<i>W</i>	<i>W</i>	<i>W</i>	\mitsansW											
u+1d61f	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	<i>X</i>	\mitsansX											
u+1d620	<i>Y</i>	<i>Y</i>	<i>Y</i>	<i>Y</i>	<i>Y</i>	\mitsansY											
u+1d621	<i>Z</i>	<i>Z</i>	<i>Z</i>	<i>Z</i>	<i>Z</i>	\mitsansZ											

**Italic sans serif, Latin, lowercase**

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d622	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	\mitsansa											
u+1d623	<i>b</i>	<i>b</i>	<i>b</i>	<i>b</i>	<i>b</i>	\mitsansb											
u+1d624	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>	\mitsansc											
u+1d625	<i>d</i>	<i>d</i>	<i>d</i>	<i>d</i>	<i>d</i>	\mitsansd											
u+1d626	<i>e</i>	<i>e</i>	<i>e</i>	<i>e</i>	<i>e</i>	\mitsanse											
u+1d627	<i>f</i>	<i>f</i>	<i>f</i>	<i>f</i>	<i>f</i>	\mitsansf											
u+1d628	<i>g</i>	<i>g</i>	<i>g</i>	<i>g</i>	<i>g</i>	\mitsansg											
u+1d629	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	\mitsansh											
u+1d62a	<i>i</i>	<i>i</i>	<i>i</i>	<i>i</i>	<i>i</i>	\mitsansi											
u+1d62b	<i>j</i>	<i>j</i>	<i>j</i>	<i>j</i>	<i>j</i>	\mitsansj											
u+1d62c	<i>k</i>	<i>k</i>	<i>k</i>	<i>k</i>	<i>k</i>	\mitsansk											

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d62d	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	\mitsansl
u+1d62e	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	\mitsansm
u+1d62f	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	\mitsansn
u+1d630	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	\mitsanso
u+1d631	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	\mitsansp
u+1d632	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	\mitsansq
u+1d633	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	\mitsansr
u+1d634	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	\mitsanss
u+1d635	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t	\mitsanst
u+1d636	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	\mitsansu
u+1d637	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	\mitsansv
u+1d638	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	\mitsansw
u+1d639	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	\mitsansx
u+1d63a	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	\mitsansy
u+1d63b	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	\mitsansz

## Typewriter, Latin, uppercase

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d670	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	\mttA
u+1d671	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	\mttB
u+1d672	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	\mttC
u+1d673	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	\mttD
u+1d674	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	\mttE
u+1d675	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	\mttF
u+1d676	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	\mttG
u+1d677	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	\mttH
u+1d678	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	\mttI
u+1d679	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	\mttJ
u+1d67a	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	\mttK
u+1d67b	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	\mttL
u+1d67c	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	\mttM
u+1d67d	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	\mttN
u+1d67e	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	\mttO
u+1d67f	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	\mttP
u+1d680	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	\mttQ
u+1d681	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	\mttR

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d682	S	S	S	S	S	S	S	S	S	S	S	S	S	S	\mttS		
u+1d683	T	T	T	T	T	T	T	T	T	T	T	T	T	T	\mttT		
u+1d684	U	U	U	U	U	U	U	U	U	U	U	U	U	U	\mttU		
u+1d685	V	V	V	V	V	V	V	V	V	V	V	V	V	V	\mttV		
u+1d686	W	W	W	W	W	W	W	W	W	W	W	W	W	W	\mttW		
u+1d687	X	X	X	X	X	X	X	X	X	X	X	X	X	X	\mttX		
u+1d688	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	\mttY		
u+1d689	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	\mttZ		

## Typewriter, Latin, lowercase

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d68a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	\mtta		
u+1d68b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	\mttb		
u+1d68c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	\mttc		
u+1d68d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	\mttd		
u+1d68e	e	e	e	e	e	e	e	e	e	e	e	e	e	e	\mtte		
u+1d68f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	\mttf		
u+1d690	g	g	g	g	g	g	g	g	g	g	g	g	g	g	\mttg		
u+1d691	h	h	h	h	h	h	h	h	h	h	h	h	h	h	\mtth		
u+1d692	i	i	i	i	i	i	i	i	i	i	i	i	i	i	\mtti		
u+1d693	j	j	j	j	j	j	j	j	j	j	j	j	j	j	\mttj		
u+1d694	k	k	k	k	k	k	k	k	k	k	k	k	k	k	\mttk		
u+1d695	l	l	l	l	l	l	l	l	l	l	l	l	l	l	\mttl		
u+1d696	m	m	m	m	m	m	m	m	m	m	m	m	m	m	\mttm		
u+1d697	n	n	n	n	n	n	n	n	n	n	n	n	n	n	\mttn		
u+1d698	o	o	o	o	o	o	o	o	o	o	o	o	o	o	\mtto		
u+1d699	p	p	p	p	p	p	p	p	p	p	p	p	p	p	\mttp		
u+1d69a	q	q	q	q	q	q	q	q	q	q	q	q	q	q	\mttq		
u+1d69b	r	r	r	r	r	r	r	r	r	r	r	r	r	r	\mttr		
u+1d69c	s	s	s	s	s	s	s	s	s	s	s	s	s	s	\mtts		
u+1d69d	t	t	t	t	t	t	t	t	t	t	t	t	t	t	\mttt		
u+1d69e	u	u	u	u	u	u	u	u	u	u	u	u	u	u	\mttu		
u+1d69f	v	v	v	v	v	v	v	v	v	v	v	v	v	v	\mttv		
u+1d6a0	w	w	w	w	w	w	w	w	w	w	w	w	w	w	\mttw		
u+1d6a1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	\mttx		
u+1d6a2	y	y	y	y	y	y	y	y	y	y	y	y	y	y	\mtty		

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d6a3	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	\mttz	

**Bold, Latin, uppercase**

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d400	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	\mbfA
u+1d401	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	\mbfB
u+1d402	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	\mbfC
u+1d403	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	\mbfD
u+1d404	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	\mbfE
u+1d405	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	\mbfF
u+1d406	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	\mbfG
u+1d407	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	\mbfH
u+1d408	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	\mbfI
u+1d409	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	\mbfJ
u+1d40a	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	\mbfK
u+1d40b	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	\mbfL
u+1d40c	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	\mbfM
u+1d40d	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	\mbfN
u+1d40e	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	\mbfO
u+1d40f	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	\mbfP
u+1d410	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	\mbfQ
u+1d411	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	\mbfR
u+1d412	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	\mbfS
u+1d413	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	\mbfT
u+1d414	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	\mbfU
u+1d415	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	\mbfV
u+1d416	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	\mbfW
u+1d417	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	\mbfX
u+1d418	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	\mbfY
u+1d419	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	\mbfZ

**Bold, Latin, lowercase**

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d41a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	\mbf{a}
u+1d41b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	\mbf{b}
u+1d41c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	\mbf{c}
u+1d41d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	\mbf{d}
u+1d41e	e	e	e	e	e	e	e	e	e	e	e	e	e	e	e	e	\mbf{e}
u+1d41f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	f	\mbf{f}
u+1d420	g	g	g	g	g	g	g	g	g	g	g	g	g	g	g	g	\mbf{g}
u+1d421	h	h	h	h	h	h	h	h	h	h	h	h	h	h	h	h	\mbf{h}
u+1d422	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	i	\mbf{i}
u+1d423	j	j	j	j	j	j	j	j	j	j	j	j	j	j	j	j	\mbf{j}
u+1d424	k	k	k	k	k	k	k	k	k	k	k	k	k	k	k	k	\mbf{k}
u+1d425	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	l	\mbf{l}
u+1d426	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	\mbf{m}
u+1d427	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	\mbf{n}
u+1d428	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	\mbf{o}
u+1d429	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	\mbf{p}
u+1d42a	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	q	\mbf{q}
u+1d42b	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	r	\mbf{r}
u+1d42c	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	\mbf{s}
u+1d42d	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t	\mbf{t}
u+1d42e	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	\mbf{u}
u+1d42f	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	v	\mbf{v}
u+1d430	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	\mbf{w}
u+1d431	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	\mbf{x}
u+1d432	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	\mbf{y}
u+1d433	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	z	\mbf{z}

**Bold Greek, uppercase**

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d6a8	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	\mbf{A}
u+1d6a9	Β	Β	Β	Β	Β	Β	Β	Β	Β	Β	Β	Β	Β	Β	Β	Β	\mbf{B}
u+1d6aa	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	\mbf{Gamma}
u+1d6ab	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	\mbf{Delta}

Fortsetzung ...

USV	LM	XITS	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d6ac	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	\mbfEpsilon
u+1d6ad	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	\mbfZeta
u+1d6ae	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	\mbfEta
u+1d6af	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	\mbfTheta
u+1d6b0	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	\mbfIota
u+1d6b1	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	\mbfKappa
u+1d6b2	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	\mbfLambda
u+1d6b3	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	\mbfMu
u+1d6b4	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	\mbfNu
u+1d6b5	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	\mbfXi
u+1d6b6	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	\mbfOmicron
u+1d6b7	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	\mbfPi
u+1d6b8	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	\mbfRho
u+1d6b9	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	\mbfVarTheta
u+1d6ba	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	\mbfSigma
u+1d6bb	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	\mbfTau
u+1d6bc	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	\mbfUpsilon
u+1d6bd	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	\mbfPhi
u+1d6be	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	\mbfChi
u+1d6bf	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	\mbfPsi
u+1d6c0	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	\mbfOmega

**Bold Greek, lowercase**

USV	LM	XITS	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d6c2	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	\mbfalpha
u+1d6c3	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	\mbfbeta
u+1d6c4	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	\mbfgamma
u+1d6c5	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	\mbfdelta
u+1d6c6	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	\mbfvarepsilon
u+1d6c7	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	\mbfzeta
u+1d6c8	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	\mbfeta
u+1d6c9	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	\mbftheta
u+1d6ca	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	\mbfiota
u+1d6cb	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	\mbfkappa
u+1d6cc	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	\mbflambda
u+1d6cd	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	\mbfmu
u+1d6ce	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	\mbfnu
u+1d6cf	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	\mbfxi
u+1d6d0	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	\mbfomicron
u+1d6d1	π	π	π	π	π	π	π	π	π	π	π	π	π	π	π	π	\mbfpi
u+1d6d2	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	\mbfrho
u+1d6d3	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	\mbfvarsigma
u+1d6d4	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	\mbfsigma
u+1d6d5	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	\mbftau
u+1d6d6	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	\mbfupsilon
u+1d6d7	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	\mbfvarphi
u+1d6d8	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	\mbfchi
u+1d6d9	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	\mbfpsi
u+1d6da	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	\mbfomega
u+1d6db	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	\mbfpartial
u+1d6dc	€	€	€	€	€	€	€	€	€	€	€	€	€	€	€	€	\mbfepsi

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d6dd	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	\mbf-vartheta
u+1d6de	ϰ	ϰ	ϰ	ϰ	ϰ	ϰ	ϰ	ϰ	ϰ	ϰ	ϰ	ϰ	ϰ	ϰ	ϰ	ϰ	\mbf-varkappa
u+1d6df	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	\mbf-phi
u+1d6e0	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	\mbf-varrho
u+1d6e1	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	\mbf-varpi

**Bold italic, Latin, uppercase**

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d468	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	\mbf-fitA
u+1d469	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	\mbf-fitB
u+1d46a	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	\mbf-fitC
u+1d46b	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	\mbf-fitD
u+1d46c	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	\mbf-fitE
u+1d46d	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	\mbf-fitF
u+1d46e	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	\mbf-fitG
u+1d46f	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	\mbf-fitH
u+1d470	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	\mbf-fitI
u+1d471	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	\mbf-fitJ
u+1d472	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	\mbf-fitK
u+1d473	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	\mbf-fitL
u+1d474	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	\mbf-fitM

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d475	<b>N</b>	<b>N</b>	<b>N</b>	<b>N</b>	<b>N</b>	\mbfitN											
u+1d476	<b>O</b>	<b>O</b>	<b>O</b>	<b>O</b>	<b>O</b>	\mbfitO											
u+1d477	<b>P</b>	<b>P</b>	<b>P</b>	<b>P</b>	<b>P</b>	\mbfitP											
u+1d478	<b>Q</b>	<b>Q</b>	<b>Q</b>	<b>Q</b>	<b>Q</b>	\mbfitQ											
u+1d479	<b>R</b>	<b>R</b>	<b>R</b>	<b>R</b>	<b>R</b>	\mbfitR											
u+1d47a	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	\mbfitS											
u+1d47b	<b>T</b>	<b>T</b>	<b>T</b>	<b>T</b>	<b>T</b>	\mbfitT											
u+1d47c	<b>U</b>	<b>U</b>	<b>U</b>	<b>U</b>	<b>U</b>	\mbfitU											
u+1d47d	<b>V</b>	<b>V</b>	<b>V</b>	<b>V</b>	<b>V</b>	\mbfitV											
u+1d47e	<b>W</b>	<b>W</b>	<b>W</b>	<b>W</b>	<b>W</b>	\mbfitW											
u+1d47f	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	\mbfitX											
u+1d480	<b>Y</b>	<b>Y</b>	<b>Y</b>	<b>Y</b>	<b>Y</b>	\mbfitY											
u+1d481	<b>Z</b>	<b>Z</b>	<b>Z</b>	<b>Z</b>	<b>Z</b>	\mbfitZ											

**Bold italic, Latin, lowercase**

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d482	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	\mbfita											
u+1d483	<i>b</i>	<i>b</i>	<i>b</i>	<i>b</i>	<i>b</i>	\mbfitb											
u+1d484	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>	<i>c</i>	\mbfitc											
u+1d485	<i>d</i>	<i>d</i>	<i>d</i>	<i>d</i>	<i>d</i>	\mbfitd											
u+1d486	<i>e</i>	<i>e</i>	<i>e</i>	<i>e</i>	<i>e</i>	\mbfite											
u+1d487	<i>f</i>	<i>f</i>	<i>f</i>	<i>f</i>	<i>f</i>	\mbfitf											
u+1d488	<i>g</i>	<i>g</i>	<i>g</i>	<i>g</i>	<i>g</i>	\mbfitg											
u+1d489	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	<i>h</i>	\mbfith											
u+1d48a	<i>i</i>	<i>i</i>	<i>i</i>	<i>i</i>	<i>i</i>	\mbfiti											
u+1d48b	<i>j</i>	<i>j</i>	<i>j</i>	<i>j</i>	<i>j</i>	\mbfitj											

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d48c	<b>k</b>	<b>k</b>	<b>k</b>	<b>k</b>	<b>k</b>	\mbfitk											
u+1d48d	<b>l</b>	<b>l</b>	<b>l</b>	<b>l</b>	<b>l</b>	\mbfitl											
u+1d48e	<b>m</b>	<b>m</b>	<b>m</b>	<b>m</b>	<b>m</b>	\mbfitm											
u+1d48f	<b>n</b>	<b>n</b>	<b>n</b>	<b>n</b>	<b>n</b>	\mbfitn											
u+1d490	<b>o</b>	<b>o</b>	<b>o</b>	<b>o</b>	<b>o</b>	\mbfito											
u+1d491	<b>p</b>	<b>p</b>	<b>p</b>	<b>p</b>	<b>p</b>	\mbfitp											
u+1d492	<b>q</b>	<b>q</b>	<b>q</b>	<b>q</b>	<b>q</b>	\mbfitq											
u+1d493	<b>r</b>	<b>r</b>	<b>r</b>	<b>r</b>	<b>r</b>	\mbfitr											
u+1d494	<b>s</b>	<b>s</b>	<b>s</b>	<b>s</b>	<b>s</b>	\mbfits											
u+1d495	<b>t</b>	<b>t</b>	<b>t</b>	<b>t</b>	<b>t</b>	\mbfitt											
u+1d496	<b>u</b>	<b>u</b>	<b>u</b>	<b>u</b>	<b>u</b>	\mbfitu											
u+1d497	<b>v</b>	<b>v</b>	<b>v</b>	<b>v</b>	<b>v</b>	\mbfitv											
u+1d498	<b>w</b>	<b>w</b>	<b>w</b>	<b>w</b>	<b>w</b>	\mbfitw											
u+1d499	<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>	\mbfitx											
u+1d49a	<b>y</b>	<b>y</b>	<b>y</b>	<b>y</b>	<b>y</b>	\mbfity											
u+1d49b	<b>z</b>	<b>z</b>	<b>z</b>	<b>z</b>	<b>z</b>	\mbfitz											

**Bold italic Greek, uppercase**

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d71c	<b>A</b>	<b>A</b>	<b>A</b>	<b>A</b>	<b>A</b>	\mbfitAlpha											
u+1d71d	<b>B</b>	<b>B</b>	<b>B</b>	<b>B</b>	<b>B</b>	\mbfitBeta											
u+1d71e	<b>Γ</b>	<b>Γ</b>	<b>Γ</b>	<b>Γ</b>	<b>Γ</b>	\mbfitGamma											
u+1d71f	<b>Δ</b>	<b>Δ</b>	<b>Δ</b>	<b>Δ</b>	<b>Δ</b>	\mbfitDelta											
u+1d720	<b>E</b>	<b>E</b>	<b>E</b>	<b>E</b>	<b>E</b>	\mbfitEpsilon											
u+1d721	<b>Z</b>	<b>Z</b>	<b>Z</b>	<b>Z</b>	<b>Z</b>	\mbfitZeta											
u+1d722	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	\mbfitEta											

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d723	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	\mb-fit-Theta
u+1d724	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	\mb-fit-Iota
u+1d725	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	K	\mb-fitKappa
u+1d726	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	\mb-fit-Lambda
u+1d727	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	\mb-fitMu
u+1d728	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	\mb-fitNu
u+1d729	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	\mb-fitXi
u+1d72a	O	O	o	O	O	O	O	o	O	O	O	O	O	O	o	O	\mb-fit-Omicron
u+1d72b	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	\mb-fitPi
u+1d72c	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	\mb-fitRho
u+1d72d	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	\mb-fit-var-Theta
u+1d72e	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	\mb-fit-Sigma
u+1d72f	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	\mb-fit-Tau
u+1d730	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	ρ	τ	τ	τ	τ	τ	Υ	Υ	\mb-fit-Upsilon
u+1d731	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	\mb-fit-Phi
u+1d732	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	\mb-fitChi
u+1d733	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	\mb-fitPsi

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d734	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	\mb- fit- O- mega

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USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d736	$\alpha$	$\alpha$	$\alpha$	$\alpha$	$\alpha$	$\alpha$	$\alpha$	$\alpha$	$\alpha$	$\alpha$	$\alpha$	$\alpha$	$\alpha$	$\alpha$	$\alpha$	$\alpha$	$\alpha$ \mbfitalpha
u+1d737	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$ \mbfitbeta
u+1d738	$\gamma$	$\gamma$	$\gamma$	$\gamma$	$\gamma$	$\gamma$	$\gamma$	$\gamma$	$\gamma$	$\gamma$	$\gamma$	$\gamma$	$\gamma$	$\gamma$	$\gamma$	$\gamma$	$\gamma$ \mbfitgamma
u+1d739	$\delta$	$\delta$	$\delta$	$\delta$	$\delta$	$\delta$	$\delta$	$\delta$	$\delta$	$\delta$	$\delta$	$\delta$	$\delta$	$\delta$	$\delta$	$\delta$	$\delta$ \mbfitdelta
u+1d73a	$\epsilon$	$\epsilon$	$\epsilon$	$\epsilon$	$\epsilon$	$\epsilon$	$\epsilon$	$\epsilon$	$\epsilon$	$\epsilon$	$\epsilon$	$\epsilon$	$\epsilon$	$\epsilon$	$\epsilon$	$\epsilon$	$\epsilon$ \mbfitvarepsilon
u+1d73b	$\zeta$	$\zeta$	$\zeta$	$\zeta$	$\zeta$	$\zeta$	$\zeta$	$\zeta$	$\zeta$	$\zeta$	$\zeta$	$\zeta$	$\zeta$	$\zeta$	$\zeta$	$\zeta$	$\zeta$ \mbfitzeta
u+1d73c	$\eta$	$\eta$	$\eta$	$\eta$	$\eta$	$\eta$	$\eta$	$\eta$	$\eta$	$\eta$	$\eta$	$\eta$	$\eta$	$\eta$	$\eta$	$\eta$	$\eta$ \mbfiteta
u+1d73d	$\theta$	$\theta$	$\theta$	$\theta$	$\theta$	$\theta$	$\theta$	$\theta$	$\theta$	$\theta$	$\theta$	$\theta$	$\theta$	$\theta$	$\theta$	$\theta$	$\theta$ \mbfittheta
u+1d73e	$\iota$	$\iota$	$\iota$	$\iota$	$\iota$	$\iota$	$\iota$	$\iota$	$\iota$	$\iota$	$\iota$	$\iota$	$\iota$	$\iota$	$\iota$	$\iota$	$\iota$ \mbfitiota
u+1d73f	$\kappa$	$\kappa$	$\kappa$	$\kappa$	$\kappa$	$\kappa$	$\kappa$	$\kappa$	$\kappa$	$\kappa$	$\kappa$	$\kappa$	$\kappa$	$\kappa$	$\kappa$	$\kappa$	$\kappa$ \mbfitkappa
u+1d740	$\lambda$	$\lambda$	$\lambda$	$\lambda$	$\lambda$	$\lambda$	$\lambda$	$\lambda$	$\lambda$	$\lambda$	$\lambda$	$\lambda$	$\lambda$	$\lambda$	$\lambda$	$\lambda$	$\lambda$ \mbfitlambda
u+1d741	$\mu$	$\mu$	$\mu$	$\mu$	$\mu$	$\mu$	$\mu$	$\mu$	$\mu$	$\mu$	$\mu$	$\mu$	$\mu$	$\mu$	$\mu$	$\mu$	$\mu$ \mbfitmu
u+1d742	$\nu$	$\nu$	$\nu$	$\nu$	$\nu$	$\nu$	$\nu$	$\nu$	$\nu$	$\nu$	$\nu$	$\nu$	$\nu$	$\nu$	$\nu$	$\nu$	$\nu$ \mbfitnu
u+1d743	$\xi$	$\xi$	$\xi$	$\xi$	$\xi$	$\xi$	$\xi$	$\xi$	$\xi$	$\xi$	$\xi$	$\xi$	$\xi$	$\xi$	$\xi$	$\xi$	$\xi$ \mbfitxi
u+1d744	$\circ$	$\circ$	$\circ$	$\circ$	$\circ$	$\circ$	$\circ$	$\circ$	$\circ$	$\circ$	$\circ$	$\circ$	$\circ$	$\circ$	$\circ$	$\circ$	$\circ$ \mbfitmicron
u+1d745	$\pi$	$\pi$	$\pi$	$\pi$	$\pi$	$\pi$	$\pi$	$\pi$	$\pi$	$\pi$	$\pi$	$\pi$	$\pi$	$\pi$	$\pi$	$\pi$	$\pi$ \mbfitpi
u+1d746	$\rho$	$\rho$	$\rho$	$\rho$	$\rho$	$\rho$	$\rho$	$\rho$	$\rho$	$\rho$	$\rho$	$\rho$	$\rho$	$\rho$	$\rho$	$\rho$	$\rho$ \mbfitrho
u+1d747	$\varsigma$	$\varsigma$	$\varsigma$	$\varsigma$	$\varsigma$	$\varsigma$		$\varsigma$ \mbfitvarsigma									
u+1d748	$\sigma$	$\sigma$	$\sigma$	$\sigma$	$\sigma$	$\sigma$	$\sigma$	$\sigma$	$\sigma$	$\sigma$	$\sigma$	$\sigma$	$\sigma$	$\sigma$	$\sigma$	$\sigma$	$\sigma$ \mbfitsigma
u+1d749	$\tau$	$\tau$	$\tau$	$\tau$	$\tau$	$\tau$	$\tau$	$\tau$	$\tau$	$\tau$	$\tau$	$\tau$	$\tau$	$\tau$	$\tau$	$\tau$	$\tau$ \mbfittau
u+1d74a	$\upsilon$	$\upsilon$	$\upsilon$	$\upsilon$	$\upsilon$	$\upsilon$	$\upsilon$	$\upsilon$	$\upsilon$	$\upsilon$	$\upsilon$	$\upsilon$	$\upsilon$	$\upsilon$	$\upsilon$	$\upsilon$	$\upsilon$ \mbfitupsilon

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d74b	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	\mbfitvarphi
u+1d74c	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	\mbfitchi
u+1d74d	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	\mbfitpsi
u+1d74e	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	\mbfitomega
u+1d74f	∂	∂	∂	∂	∂	∂	∂	∂	∂	∂	∂	∂	∂	∂	∂	∂	\mbfitpartial
u+1d750	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	\mbfitepsilon
u+1d751	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	\mbfitvartheta
u+1d752	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	\mbfitvarkappa
u+1d753	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	\mbfitphi
u+1d754	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	ϱ	\mbfitvarrho
u+1d755	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	\mbfitvarpi

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USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d4d0	<b>A</b>	<b>À</b>	<b>À</b>	<b>À</b>	<b>À</b>	<b>À</b>	\mbf-scrA										
u+1d4d1	<b>B</b>	<b>฿</b>	<b>฿</b>	<b>฿</b>	<b>฿</b>	<b>฿</b>	\mbf-scrB										
u+1d4d2	<b>C</b>	<b>₵</b>	<b>₵</b>	<b>₵</b>	<b>₵</b>	<b>₵</b>	\mbf-scrC										
u+1d4d3	<b>D</b>	<b>₵</b>	<b>₵</b>	<b>₵</b>	<b>₵</b>	<b>₵</b>	\mbf-scrD										
u+1d4d4	<b>E</b>	<b>Ӭ</b>	<b>Ӭ</b>	<b>Ӭ</b>	<b>Ӭ</b>	<b>Ӭ</b>	\mbf-scrE										
u+1d4d5	<b>F</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	\mbf-scrF										
u+1d4d6	<b>G</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	\mbf-scrG										
u+1d4d7	<b>H</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	\mbf-scrH										
u+1d4d8	<b>I</b>	<b>Ӥ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	\mbf-scrI								
u+1d4d9	<b>J</b>	<b>Ӥ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	\mbf-scrJ						
u+1d4da	<b>K</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	\mbf-scrK										
u+1d4db	<b>L</b>	<b>Ӆ</b>	<b>Ӆ</b>	<b>Ӆ</b>	<b>Ӆ</b>	<b>Ӆ</b>	\mbf-scrL										
u+1d4dc	<b>M</b>	<b>Ӎ</b>	<b>Ӎ</b>	<b>Ӎ</b>	<b>Ӎ</b>	<b>Ӎ</b>	\mbf-scrM										
u+1d4dd	<b>N</b>	<b>Ӎ</b>	<b>Ӎ</b>	<b>Ӎ</b>	<b>Ӎ</b>	<b>Ӎ</b>	\mbf-scrN										
u+1d4de	<b>O</b>	<b>Ӫ</b>	<b>Ӫ</b>	<b>Ӫ</b>	<b>Ӫ</b>	<b>Ӫ</b>	\mbf-scrO										
u+1d4df	<b>P</b>	<b>Ӫ</b>	<b>Ӫ</b>	<b>Ӫ</b>	<b>Ӫ</b>	<b>Ӫ</b>	\mbf-scrP										
u+1d4e0	<b>Q</b>	<b>ӫ</b>	<b>ӫ</b>	<b>ӫ</b>	<b>ӫ</b>	<b>ӫ</b>	\mbf-scrQ										
u+1d4e1	<b>R</b>	<b>ӫ</b>	<b>ӫ</b>	<b>ӫ</b>	<b>ӫ</b>	<b>ӫ</b>	\mbf-scrR										
u+1d4e2	<b>S</b>	<b>ӫ</b>	<b>ӫ</b>	<b>ӫ</b>	<b>ӫ</b>	<b>ӫ</b>	\mbf-scrS										
u+1d4e3	<b>T</b>	<b>Ҭ</b>	<b>Ҭ</b>	<b>Ҭ</b>	<b>Ҭ</b>	<b>Ҭ</b>	\mbf-scrT										
u+1d4e4	<b>U</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	<b>Ӯ</b>	\mbf-scrU										

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d4e5	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	\mbfscrV
u+1d4e6	Ꝟ	Ꝟ	Ꝟ	Ꝟ	Ꝟ	Ꝟ	Ꝟ	Ꝟ	Ꝟ	Ꝟ	Ꝟ	Ꝟ	Ꝟ	Ꝟ	Ꝟ	Ꝟ	\mbfscrW
u+1d4e7	ꝣ	ꝣ	ꝣ	ꝣ	ꝣ	ꝣ	ꝣ	ꝣ	ꝣ	ꝣ	ꝣ	ꝣ	ꝣ	ꝣ	ꝣ	ꝣ	\mbfscrX
u+1d4e8	Ꝥ	Ꝥ	Ꝥ	Ꝥ	Ꝥ	Ꝥ	Ꝥ	Ꝥ	Ꝥ	Ꝥ	Ꝥ	Ꝥ	Ꝥ	Ꝥ	Ꝥ	Ꝥ	\mbfscrY
u+1d4e9	ꝥ	ꝥ	ꝥ	ꝥ	ꝥ	ꝥ	ꝥ	ꝥ	ꝥ	ꝥ	ꝥ	ꝥ	ꝥ	ꝥ	ꝥ	ꝥ	\mbfscrZ

### Bold script, Latin, lowercase

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d4ea	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mbfscra
u+1d4eb	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	\mbfscrb
u+1d4ec	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	\mbfscrc
u+1d4ed	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	\mbfscrd
u+1d4ee	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	\mbfscre
u+1d4ef	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	\mbfscrf
u+1d4f0	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	\mbfscrg
u+1d4f1	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	\mbfscrh
u+1d4f2	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	\mbfscri
u+1d4f3	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	\mbfscrj
u+1d4f4	ꝛ	ꝛ	ꝛ	ꝛ	ꝛ	ꝛ	ꝛ	ꝛ	ꝛ	ꝛ	ꝛ	ꝛ	ꝛ	ꝛ	ꝛ	ꝛ	\mbfscrk
u+1d4f5	Ꝝ	Ꝝ	Ꝝ	Ꝝ	Ꝝ	Ꝝ	Ꝝ	Ꝝ	Ꝝ	Ꝝ	Ꝝ	Ꝝ	Ꝝ	Ꝝ	Ꝝ	Ꝝ	\mbfscrl
u+1d4f6	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	ꝝ	\mbfscrm
u+1d4f7	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mbfscrn
u+1d4f8	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	\mbfscro
u+1d4f9	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	\mbfscrp
u+1d4fa	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	\mbfscrq
u+1d4fb	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	\mbfscrr
u+1d4fc	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	\mbfscrs
u+1d4fd	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	\mbfscrt
u+1d4fe	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	\mbfscru
u+1d4ff	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	\mbfscrv
u+1d500	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	Ꝛ	\mbfscrw

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d501	<b>x</b>					\mbfscrx											
u+1d502	<b>y</b>					\mbfscry											
u+1d503	<b>z</b>					\mbfscrz											

**Bold fraktur, Latin, uppercase**

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d56c	<b>A</b>					\mbf-frakA											
u+1d56d	<b>B</b>					\mbf-frakB											
u+1d56e	<b>C</b>					\mbf-frakC											
u+1d56f	<b>D</b>					\mbf-frakD											
u+1d570	<b>E</b>					\mbf-frakE											
u+1d571	<b>F</b>					\mbf-frakF											
u+1d572	<b>G</b>					\mbf-frakG											
u+1d573	<b>H</b>					\mbf-frakH											
u+1d574	<b>I</b>					\mbf-frakI											
u+1d575	<b>J</b>					\mbf-frakJ											
u+1d576	<b>K</b>					\mbf-frakK											
u+1d577	<b>L</b>					\mbf-frakL											
u+1d578	<b>M</b>					\mbf-frakM											
u+1d579	<b>N</b>					\mbf-frakN											
u+1d57a	<b>O</b>					\mbf-frakO											
u+1d57b	<b>P</b>					\mbf-frakP											
u+1d57c	<b>Q</b>					\mbf-frakQ											

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d57d	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mbf-frakR
u+1d57e	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	Ꝓ	\mbf-frakS
u+1d57f	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	ꝓ	\mbf-frakT
u+1d580	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	Ꝕ	\mbf-frakU
u+1d581	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	ꝕ	\mbf-frakV
u+1d582	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	Ꝗ	\mbf-frakW
u+1d583	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	ꝗ	\mbf-frakX
u+1d584	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	Ꝙ	\mbf-frakY
u+1d585	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	ꝙ	\mbf-frakZ

## Bold fraktur, Latin, lowercase

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d586	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mbffraka
u+1d587	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mbffrakb
u+1d588	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mbffrakc
u+1d589	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mbffrakd
u+1d58a	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mbffrake
u+1d58b	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mbffrakf
u+1d58c	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mbffrakg
u+1d58d	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mbffrakh
u+1d58e	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mbffraki
u+1d58f	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mbffrakj
u+1d590	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mbffrakk
u+1d591	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mbffrakl
u+1d592	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mbffrakm
u+1d593	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mbffrakn
u+1d594	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mbffrako

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d595	ƿ	ƿ	ƿ	ƿ	ƿ	ƿ	ƿ	ƿ	ƿ	ƿ	ƿ	ƿ	ƿ	ƿ	ƿ	ƿ	\mbffrakp
u+1d596	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	\mbffrakq
u+1d597	ᚱ	ᚱ	ᚱ	ᚱ	ᚱ	ᚱ	ᚱ	ᚱ	ᚱ	ᚱ	ᚱ	ᚱ	ᚱ	ᚱ	ᚱ	ᚱ	\mbffrkr
u+1d598	ſ	ſ	ſ	ſ	ſ	ſ	ſ	ſ	ſ	ſ	ſ	ſ	ſ	ſ	ſ	ſ	\mbffraks
u+1d599	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	ȝ	\mbffrakt
u+1d59a	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	\mbffraku
u+1d59b	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	\mbffrakv
u+1d59c	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	\mbffrakw
u+1d59d	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	\mbffrakx
u+1d59e	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	\mbffraky
u+1d59f	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	ុ	\mbffrakz

**Bold sans serif, Latin, uppercase**

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d5d4	𝐀	𝐀	𝐀	𝐀	𝐀	𝐀	𝐀	𝐀	𝐀	𝐀	𝐀	𝐀	𝐀	𝐀	𝐀	𝐀	\mbf-sansA
u+1d5d5	𝐁	𝐁	𝐁	𝐁	𝐁	𝐁	𝐁	𝐁	𝐁	𝐁	𝐁	𝐁	𝐁	𝐁	𝐁	𝐁	\mbf-sansB
u+1d5d6	𝐂	𝐂	𝐂	𝐂	𝐂	𝐂	𝐂	𝐂	𝐂	𝐂	𝐂	𝐂	𝐂	𝐂	𝐂	𝐂	\mbf-sansC
u+1d5d7	𝐃	𝐃	𝐃	𝐃	𝐃	𝐃	𝐃	𝐃	𝐃	𝐃	𝐃	𝐃	𝐃	𝐃	𝐃	𝐃	\mbf-sansD
u+1d5d8	𝐄	𝐄	𝐄	𝐄	𝐄	𝐄	𝐄	𝐄	𝐄	𝐄	𝐄	𝐄	𝐄	𝐄	𝐄	𝐄	\mbf-sansE
u+1d5d9	𝐅	𝐅	𝐅	𝐅	𝐅	𝐅	𝐅	𝐅	𝐅	𝐅	𝐅	𝐅	𝐅	𝐅	𝐅	𝐅	\mbf-sansF
u+1d5da	𝐆	𝐆	𝐆	𝐆	𝐆	𝐆	𝐆	𝐆	𝐆	𝐆	𝐆	𝐆	𝐆	𝐆	𝐆	𝐆	\mbf-sansG
u+1d5db	𝐇	𝐇	𝐇	𝐇	𝐇	𝐇	𝐇	𝐇	𝐇	𝐇	𝐇	𝐇	𝐇	𝐇	𝐇	𝐇	\mbf-sansH
u+1d5dc	𝐈	𝐈	𝐈	𝐈	𝐈	𝐈	𝐈	𝐈	𝐈	𝐈	𝐈	𝐈	𝐈	𝐈	𝐈	𝐈	\mbf-sansI
u+1d5dd	𝐉	𝐉	𝐉	𝐉	𝐉	𝐉	𝐉	𝐉	𝐉	𝐉	𝐉	𝐉	𝐉	𝐉	𝐉	𝐉	\mbf-sansJ
u+1d5de	𝐊	𝐊	𝐊	𝐊	𝐊	𝐊	𝐊	𝐊	𝐊	𝐊	𝐊	𝐊	𝐊	𝐊	𝐊	𝐊	\mbf-sansK
u+1d5df	𝐋	𝐋	𝐋	𝐋	𝐋	𝐋	𝐋	𝐋	𝐋	𝐋	𝐋	𝐋	𝐋	𝐋	𝐋	𝐋	\mbf-sansL

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d5e0	<b>M</b>	<b>M</b>	<b>M</b>	<b>N</b>	<b>O</b>	\mbf-sansM											
u+1d5e1	<b>N</b>	<b>N</b>	<b>N</b>	<b>P</b>	<b>P</b>	\mbf-sansN											
u+1d5e2	<b>O</b>	<b>O</b>	<b>O</b>	<b>Q</b>	<b>Q</b>	\mbf-sansO											
u+1d5e3	<b>P</b>	<b>P</b>	<b>P</b>	<b>R</b>	<b>R</b>	\mbf-sansP											
u+1d5e4	<b>Q</b>	<b>Q</b>	<b>Q</b>	<b>R</b>	<b>R</b>	\mbf-sansQ											
u+1d5e5	<b>R</b>	<b>R</b>	<b>R</b>	<b>S</b>	<b>S</b>	\mbf-sansR											
u+1d5e6	<b>S</b>	<b>S</b>	<b>S</b>	<b>T</b>	<b>T</b>	\mbf-sansS											
u+1d5e7	<b>T</b>	<b>T</b>	<b>T</b>	<b>U</b>	<b>U</b>	\mbf-sansT											
u+1d5e8	<b>U</b>	<b>U</b>	<b>U</b>	<b>V</b>	<b>V</b>	\mbf-sansU											
u+1d5e9	<b>V</b>	<b>V</b>	<b>V</b>	<b>W</b>	<b>W</b>	\mbf-sansV											
u+1d5ea	<b>W</b>	<b>W</b>	<b>W</b>	<b>X</b>	<b>X</b>	\mbf-sansW											
u+1d5eb	<b>X</b>	<b>X</b>	<b>X</b>	<b>Y</b>	<b>Y</b>	\mbf-sansX											
u+1d5ec	<b>Y</b>	<b>Y</b>	<b>Y</b>	<b>Z</b>	<b>Z</b>	\mbf-sansY											
u+1d5ed	<b>Z</b>	<b>Z</b>	<b>Z</b>	<b>Z</b>	<b>Z</b>	\mbf-sansZ											

**Bold sans serif, Latin, lowercase**

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d5ee	<b>a</b>	<b>a</b>	<b>b</b>	<b>b</b>	<b>c</b>	\mbfsansa											
u+1d5ef	<b>b</b>	<b>b</b>	<b>b</b>	<b>d</b>	<b>d</b>	\mbfsansb											
u+1d5f0	<b>c</b>	<b>c</b>	<b>c</b>	<b>d</b>	<b>d</b>	\mbfsansc											
u+1d5f1	<b>d</b>	<b>d</b>	<b>d</b>	<b>e</b>	<b>e</b>	\mbfsansd											
u+1d5f2	<b>e</b>	<b>e</b>	<b>e</b>	<b>f</b>	<b>f</b>	\mbfsanse											
u+1d5f3	<b>f</b>	<b>f</b>	<b>f</b>	<b>f</b>	<b>f</b>	\mbfsansf											

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d5f4	<b>g</b>	<b>g</b>	<b>g</b>	<b>g</b>	<b>g</b>	\mbfsansg											
u+1d5f5	<b>h</b>	<b>h</b>	<b>h</b>	<b>h</b>	<b>h</b>	\mbfsansh											
u+1d5f6	<b>i</b>	<b>i</b>	<b>i</b>	<b>i</b>	<b>i</b>	\mbfsansi											
u+1d5f7	<b>j</b>	<b>j</b>	<b>j</b>	<b>j</b>	<b>j</b>	\mbfsansj											
u+1d5f8	<b>k</b>	<b>k</b>	<b>k</b>	<b>k</b>	<b>k</b>	\mbfsansk											
u+1d5f9	<b>l</b>	<b>l</b>	<b>l</b>	<b>l</b>	<b>l</b>	\mbfsansl											
u+1d5fa	<b>m</b>	<b>m</b>	<b>m</b>	<b>m</b>	<b>m</b>	\mbfsansm											
u+1d5fb	<b>n</b>	<b>n</b>	<b>n</b>	<b>n</b>	<b>n</b>	\mbfsansn											
u+1d5fc	<b>o</b>	<b>o</b>	<b>o</b>	<b>o</b>	<b>o</b>	\mbfsanso											
u+1d5fd	<b>p</b>	<b>p</b>	<b>p</b>	<b>p</b>	<b>p</b>	\mbfsansp											
u+1d5fe	<b>q</b>	<b>q</b>	<b>q</b>	<b>q</b>	<b>q</b>	\mbfsansq											
u+1d5ff	<b>r</b>	<b>r</b>	<b>r</b>	<b>r</b>	<b>r</b>	\mbfsansr											
u+1d600	<b>s</b>	<b>s</b>	<b>s</b>	<b>s</b>	<b>s</b>	\mbfsanss											
u+1d601	<b>t</b>	<b>t</b>	<b>t</b>	<b>t</b>	<b>t</b>	\mbfsanst											
u+1d602	<b>u</b>	<b>u</b>	<b>u</b>	<b>u</b>	<b>u</b>	\mbfsansu											
u+1d603	<b>v</b>	<b>v</b>	<b>v</b>	<b>v</b>	<b>v</b>	\mbfsansv											
u+1d604	<b>w</b>	<b>w</b>	<b>w</b>	<b>w</b>	<b>w</b>	\mbfsansw											
u+1d605	<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>	\mbfsansx											
u+1d606	<b>y</b>	<b>y</b>	<b>y</b>	<b>y</b>	<b>y</b>	\mbfsansy											
u+1d607	<b>z</b>	<b>z</b>	<b>z</b>	<b>z</b>	<b>z</b>	\mbfsansz											

**Bold italic sans serif, Latin, uppercase**

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d63c	<b>A</b>	<b>A</b>	<b>A</b>	<b>A</b>	<b>A</b>	\mbfit-sansA											
u+1d63d	<b>B</b>	<b>B</b>	<b>B</b>	<b>B</b>	<b>B</b>	\mbfit-sansB											
u+1d63e	<b>C</b>	<b>C</b>	<b>C</b>	<b>C</b>	<b>C</b>	\mbfit-sansC											
u+1d63f	<b>D</b>	<b>D</b>	<b>D</b>	<b>D</b>	<b>D</b>	\mbfit-sansD											
u+1d640	<b>E</b>	<b>E</b>	<b>E</b>	<b>E</b>	<b>E</b>	\mbfit-sansE											
u+1d641	<b>F</b>	<b>F</b>	<b>F</b>	<b>F</b>	<b>F</b>	\mbfit-sansF											
u+1d642	<b>G</b>	<b>G</b>	<b>G</b>	<b>G</b>	<b>G</b>	\mbfit-sansG											

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d643	<b>H</b>	<b>H</b>	<b>H</b>	<b>I</b>	\mbfit-sansH												
u+1d644	<b>I</b>	<b>I</b>	<b>I</b>	<b>J</b>	\mbfit-sansI												
u+1d645	<b>J</b>	<b>J</b>	<b>J</b>	<b>K</b>	\mbfit-sansJ												
u+1d646	<b>K</b>	<b>K</b>	<b>K</b>	<b>L</b>	\mbfit-sansK												
u+1d647	<b>L</b>	<b>L</b>	<b>L</b>	<b>M</b>	\mbfit-sansL												
u+1d648	<b>M</b>	<b>M</b>	<b>M</b>	<b>N</b>	\mbfit-sansM												
u+1d649	<b>N</b>	<b>N</b>	<b>N</b>	<b>O</b>	\mbfit-sansN												
u+1d64a	<b>O</b>	<b>O</b>	<b>O</b>	<b>P</b>	\mbfit-sansO												
u+1d64b	<b>P</b>	<b>P</b>	<b>P</b>	<b>Q</b>	\mbfit-sansP												
u+1d64c	<b>Q</b>	<b>Q</b>	<b>Q</b>	<b>R</b>	\mbfit-sansQ												
u+1d64d	<b>R</b>	<b>R</b>	<b>R</b>	<b>S</b>	\mbfit-sansR												
u+1d64e	<b>S</b>	<b>S</b>	<b>S</b>	<b>T</b>	\mbfit-sansS												
u+1d64f	<b>T</b>	<b>T</b>	<b>T</b>	<b>U</b>	\mbfit-sansT												
u+1d650	<b>U</b>	<b>U</b>	<b>U</b>	<b>V</b>	\mbfit-sansU												
u+1d651	<b>V</b>	<b>V</b>	<b>V</b>	<b>W</b>	\mbfit-sansV												
u+1d652	<b>W</b>	<b>W</b>	<b>W</b>	<b>X</b>	\mbfit-sansW												
u+1d653	<b>X</b>	<b>X</b>	<b>X</b>	<b>Y</b>	\mbfit-sansX												
u+1d654	<b>Y</b>	<b>Y</b>	<b>Y</b>	<b>Z</b>	\mbfit-sansY												
u+1d655	<b>Z</b>	<b>Z</b>	<b>Z</b>	<b>Z</b>	\mbfit-sansZ												

**Bold italic sans serif, Latin, lowercase**

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d656	<b>a</b>	<b>a</b>	<b>a</b>	<b>a</b>	<b>a</b>	\mbfitsansa											
u+1d657	<b>b</b>	<b>b</b>	<b>b</b>	<b>b</b>	<b>b</b>	\mbfitsansb											
u+1d658	<b>c</b>	<b>c</b>	<b>c</b>	<b>c</b>	<b>c</b>	\mbfitsanc											
u+1d659	<b>d</b>	<b>d</b>	<b>d</b>	<b>d</b>	<b>d</b>	\mbfitsansd											
u+1d65a	<b>e</b>	<b>e</b>	<b>e</b>	<b>e</b>	<b>e</b>	\mbfitsanse											
u+1d65b	<b>f</b>	<b>f</b>	<b>f</b>	<b>f</b>	<b>f</b>	\mbfitsansf											
u+1d65c	<b>g</b>	<b>g</b>	<b>g</b>	<b>g</b>	<b>g</b>	\mbfitsansg											
u+1d65d	<b>h</b>	<b>h</b>	<b>h</b>	<b>h</b>	<b>h</b>	\mbfitsansh											
u+1d65e	<b>i</b>	<b>i</b>	<b>i</b>	<b>i</b>	<b>i</b>	\mbfitsansi											
u+1d65f	<b>j</b>	<b>j</b>	<b>j</b>	<b>j</b>	<b>j</b>	\mbfitsansj											
u+1d660	<b>k</b>	<b>k</b>	<b>k</b>	<b>k</b>	<b>k</b>	\mbfitsansk											
u+1d661	<b>l</b>	<b>l</b>	<b>l</b>	<b>l</b>	<b>l</b>	\mbfitsansl											
u+1d662	<b>m</b>	<b>m</b>	<b>m</b>	<b>m</b>	<b>m</b>	\mbfitsansm											
u+1d663	<b>n</b>	<b>n</b>	<b>n</b>	<b>n</b>	<b>n</b>	\mbfitsansn											
u+1d664	<b>o</b>	<b>o</b>	<b>o</b>	<b>o</b>	<b>o</b>	\mbfitsanso											
u+1d665	<b>p</b>	<b>p</b>	<b>p</b>	<b>p</b>	<b>p</b>	\mbfitsansp											
u+1d666	<b>q</b>	<b>q</b>	<b>q</b>	<b>q</b>	<b>q</b>	\mbfitsansq											
u+1d667	<b>r</b>	<b>r</b>	<b>r</b>	<b>r</b>	<b>r</b>	\mbfitsansr											
u+1d668	<b>s</b>	<b>s</b>	<b>s</b>	<b>s</b>	<b>s</b>	\mbfitsanss											
u+1d669	<b>t</b>	<b>t</b>	<b>t</b>	<b>t</b>	<b>t</b>	\mbfitsanst											
u+1d66a	<b>u</b>	<b>u</b>	<b>u</b>	<b>u</b>	<b>u</b>	\mbfitsansu											
u+1d66b	<b>v</b>	<b>v</b>	<b>v</b>	<b>v</b>	<b>v</b>	\mbfitsansv											
u+1d66c	<b>w</b>	<b>w</b>	<b>w</b>	<b>w</b>	<b>w</b>	\mbfitsansw											
u+1d66d	<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>	\mbfitsansx											
u+1d66e	<b>y</b>	<b>y</b>	<b>y</b>	<b>y</b>	<b>y</b>	\mbfitsansy											
u+1d66f	<b>z</b>	<b>z</b>	<b>z</b>	<b>z</b>	<b>z</b>	\mbfitsansz											

**Bold sans serif Greek, uppercase**

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d756	<b>A</b>	<b>A</b>	<b>A</b>	<b>A</b>	<b>A</b>	\mbf-sansAlpha											
u+1d757	<b>B</b>	<b>B</b>	<b>B</b>	<b>B</b>	<b>B</b>	\mbfsansBeta											
u+1d758	<b>Γ</b>	<b>Γ</b>	<b>Γ</b>	<b>Γ</b>	<b>Γ</b>	\mbfsansGamma											
u+1d759	<b>Δ</b>	<b>Δ</b>	<b>Δ</b>	<b>Δ</b>	<b>Δ</b>	\mbfsansDelta											

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d75a	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	\mbf-sansEpsilon
u+1d75b	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	\mbfsans-Zeta
u+1d75c	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	\mbf-sansEta
u+1d75d	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	\mbfsans-Theta
u+1d75e	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	\mbfsans-Iota
u+1d75f	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	\mbfsans-Kappa
u+1d760	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	\mbf-sansLambda
u+1d761	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	\mbf-sansMu
u+1d762	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	Ν	\mbf-sansNu
u+1d763	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	Ξ	\mbfsansXi
u+1d764	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	Ο	\mbfsans-Omicron
u+1d765	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	\mbfsansPi
u+1d766	Ρ	Ρ	Θ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	Ρ	\mbfsans-Rho
u+1d767	Θ	Θ	Ρ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	\mbf-sansvar-Theta
u+1d768	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	\mbf-sansSigma
u+1d769	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	Τ	\mbf-sansTau
u+1d76a	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ	\mbfsans-Upsilon
u+1d76b	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	Φ	\mbf-sansPhi
u+1d76c	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	Χ	\mbfsans-Chi
u+1d76d	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	\mbf-sansPsi
u+1d76e	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	Ω	\mbfsans-Omega

**Bold sans serif Greek, lowercase**

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d770	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	α	\mbfsansalpha
u+1d771	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	β	\mbfsansbeta
u+1d772	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	\mbfsansgamma
u+1d773	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	\mbfsansdelta
u+1d774	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	\mbfsansvarepsilon
u+1d775	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	\mbfsansszeta
u+1d776	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	\mbfsanseta
u+1d777	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	\mbfsanstheta
u+1d778	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	\mbfsansiota
u+1d779	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	\mbfsanskappa
u+1d77a	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	\mbfsanslambda
u+1d77b	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	\mbfsansmu
u+1d77c	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	\mbfsansnu
u+1d77d	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	\mbfsansxi
u+1d77e	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	\mbfsansomicron
u+1d77f	π	π	π	π	π	π	π	π	π	π	π	π	π	π	π	π	\mbfsanspi
u+1d780	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	\mbfsansrho
u+1d781	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	\mbfsansvarsigma
u+1d782	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	\mbfsanssigma
u+1d783	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	\mbfsanstau
u+1d784	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	\mbfsansupsilon
u+1d785	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	\mbfsansvarphi
u+1d786	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	\mbfsanschi
u+1d787	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	\mbfsanspsi
u+1d788	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	\mbfsansomega
u+1d789	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	\mbfsanspartial

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d78a	€	€	€	€	€	€	€	€	€	€	€	€	€	€	€	€	\mbfsanspsilon
u+1d78b	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	\mbfsansvartheta
u+1d78c	κ	χ	χ	κ	χ	χ	κ	κ	κ	κ	κ	κ	x	x	x	x	\mbf-sansvarkappa
u+1d78d	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	\mbfsansphi
u+1d78e	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	ϙ	\mbfsansvarrho
u+1d78f	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\mbf-sansvarpi

**Bold italic sans serif Greek, uppercase**

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d790	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	Α	\mbfit-sansAlpha
u+1d791	Β	Β	Β	Β	Β	Β	Β	Β	Β	Β	Β	Β	Β	Β	Β	Β	\mbfit-sansBeta
u+1d792	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	\mbfit-sansGamma
u+1d793	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	Δ	\mbfit-sansDelta
u+1d794	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	Ε	\mbfit-sansEpsilon
u+1d795	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	Ζ	\mbfitsansZeta
u+1d796	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	Η	\mbfit-sansEta
u+1d797	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	Θ	\mbfit-sansTheta
u+1d798	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	Ι	\mbfitsansIota
u+1d799	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	Κ	\mbfitsansKappa
u+1d79a	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	Λ	\mbfit-sansLambda
u+1d79b	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	Μ	\mbfit-sansMu

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d79c	<b>N</b>	<b>N</b>	<b>N</b>	<b>N</b>	<b>N</b>	\mbfit-sansNu											
u+1d79d	<b>Ξ</b>	<b>Ξ</b>	<b>Ξ</b>	<b>Ξ</b>	<b>Ξ</b>	\mbfitsansXi											
u+1d79e	<b>Ο</b>	<b>Ο</b>	<b>Ο</b>	<b>Ο</b>	<b>Ο</b>	\mbfitsansOmicron											
u+1d79f	<b>Π</b>	<b>Π</b>	<b>Π</b>	<b>Π</b>	<b>Π</b>	\mbfitsansPi											
u+1d7a0	<b>Ρ</b>	<b>Ρ</b>	<b>Θ</b>	<b>Ρ</b>	<b>Ρ</b>	<b>Ρ</b>	<b>Ρ</b>	<b>Ρ</b>	\mbfitsansRho								
u+1d7a1	<b>Θ</b>	<b>Θ</b>	<b>Ρ</b>	<b>Θ</b>	<b>Θ</b>	<b>Θ</b>	<b>Θ</b>	<b>Θ</b>	\mbfit-sansvar-Theta								
u+1d7a2	<b>Σ</b>	<b>Σ</b>	<b>Σ</b>	<b>Σ</b>	<b>Σ</b>	\mbfit-sansSigma											
u+1d7a3	<b>Τ</b>	<b>Τ</b>	<b>Τ</b>	<b>Τ</b>	<b>Τ</b>	\mbfit-sansTau											
u+1d7a4	<b>Υ</b>	<b>Υ</b>	<b>Υ</b>	<b>Υ</b>	<b>Υ</b>	\mbfitsansUpsilon											
u+1d7a5	<b>Φ</b>	<b>Φ</b>	<b>Φ</b>	<b>Φ</b>	<b>Φ</b>	\mbfit-sansPhi											
u+1d7a6	<b>Χ</b>	<b>Χ</b>	<b>Χ</b>	<b>Χ</b>	<b>Χ</b>	\mbfitsansChi											
u+1d7a7	<b>Ψ</b>	<b>Ψ</b>	<b>Ψ</b>	<b>Ψ</b>	<b>Ψ</b>	\mbfit-sansPsi											
u+1d7a8	<b>Ω</b>	<b>Ω</b>	<b>Ω</b>	<b>Ω</b>	<b>Ω</b>	\mbfitsansOmega											

**Bold italic sans serif Greek, lowercase**

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d7aa	<b>α</b>	<b>α</b>	<b>α</b>	<b>α</b>	<b>α</b>	\mbfit-sansalpha											
u+1d7ab	<b>β</b>	<b>β</b>	<b>β</b>	<b>β</b>	<b>β</b>	\mbfitsans-beta											
u+1d7ac	<b>γ</b>	<b>γ</b>	<b>γ</b>	<b>γ</b>	<b>γ</b>	\mbfitsans-gamma											
u+1d7ad	<b>δ</b>	<b>δ</b>	<b>δ</b>	<b>δ</b>	<b>δ</b>	\mbfitsans-delta											
u+1d7ae	<b>ε</b>	<b>ε</b>	<b>ε</b>	<b>ε</b>	<b>ε</b>	\mbfit-sansvarepsilonilon											

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d7af	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	ζ	\mbfitsanszeta
u+1d7b0	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	η	\mbfitsanseta
u+1d7b1	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	θ	\mbfitsanstheta
u+1d7b2	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	ι	\mbfitsansiota
u+1d7b3	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	\mbfitsanskappa
u+1d7b4	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	λ	\mbfitsanslambda
u+1d7b5	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	μ	\mbfitsansmu
u+1d7b6	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	ν	\mbfitsansnu
u+1d7b7	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	ξ	\mbfitsansxi
u+1d7b8	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	ο	\mbfitsansomicron
u+1d7b9	π	π	π	π	π	π	π	π	π	π	π	π	π	π	π	π	\mbfitsanspi
u+1d7ba	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ	\mbfitsansrho
u+1d7bb	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	ς	\mbfitsansvarsigma
u+1d7bc	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	σ	\mbfitsanssigma
u+1d7bd	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	τ	\mbfitsanstau
u+1d7be	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	υ	\mbfitsansupsilon
u+1d7bf	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ	\mbfitsansvarphi
u+1d7c0	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	χ	\mbfitsanschi
u+1d7c1	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	ψ	\mbfitsanspsi
u+1d7c2	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	ω	\mbfitsansomega
u+1d7c3	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	δ	\mbfitsanspartial
u+1d7c4	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	ε	\mbfitsansepsilon

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+1d7c5	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	ϑ	\mbfit-sansvartheta
u+1d7c6	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	κ	\mbfit-sansvarkappa
u+1d7c7	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	\mbfit-sansphi
u+1d7c8	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	϶	\mbfit-sansvarho
u+1d7c9	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	ϖ	\mbfit-sansvarpi

## Verschiedenes

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro
u+000f0	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	\matheth
u+02010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	\mathhyphen
u+02102	⌚	⌚	⌚	⌚	⌚	⌚	⌚	⌚	⌚	⌚	⌚	⌚	⌚	⌚	⌚	⌚	\BbbC
u+0210a	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mscrg
u+0210b	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mscrH
u+0210c	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\mfrakH
u+0210d	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	ꝑ	\BbbH
u+0210f	ᬁ	ᬁ	ᬁ	ᬁ	ᬁ	ᬁ	ᬁ	ᬁ	ᬁ	ᬁ	ᬁ	ᬁ	ᬁ	ᬁ	ᬁ	ᬁ	\hslash(a)
u+02110	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\mscrI
u+02111	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\Im(p)
u+02112	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\mscrL
u+02113	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\ell(p)
u+02115	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\BbbN
u+02118	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\wp(p)
u+02119	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\BbbP
u+0211a	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\BbbQ
u+0211b	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\mscrR
u+0211c	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\Re(p)
u+0211d	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\BbbR
u+02124	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\BbbZ
u+02128	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\mfrakZ
u+02129	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	ጀ	\turnediota

Fortsetzung ...

USV	LM	Xits	Cambria	Asana	Pagella	DejaVu	Euler	Bonum	Schola	Termes	Stix2	Libertinus	Hellenic	Lucida	Fira	Minion	Macro	
u+0212b	Å	Å	Å	Å	Å	Å	Å	Å	Å	Å	Å	Å	Å	Å	Å	Å	\Angstrom	
u+0212c	฿	฿	฿	฿	฿	฿	฿	฿	฿	฿	฿	฿	฿	฿	฿	฿	\mscrB	
u+0212d	€	€	€	€	€	€	€	€	€	€	€	€	€	€	€	€	\mfrakC	
u+0212f	€	€	€	€	€	€	€	€	€	€	€	€	€	€	€	€	\mscre	
u+02130	ℰ	ℰ	ℰ	ℰ	ℰ	ℰ	ℰ	ℰ	ℰ	ℰ	ℰ	ℰ	ℰ	ℰ	ℰ	ℰ	\mscrE	
u+02131	ℱ	ℱ	ℱ	ℱ	ℱ	ℱ	ℱ	ℱ	ℱ	ℱ	ℱ	ℱ	ℱ	ℱ	ℱ	ℱ	\mscrF	
u+02133	ℳ	ℳ	ℳ	ℳ	ℳ	ℳ	ℳ	ℳ	ℳ	ℳ	ℳ	ℳ	ℳ	ℳ	ℳ	ℳ	\mscrM	
u+02134	օ	օ	օ	օ	օ	օ	օ	օ	օ	օ	օ	օ	օ	օ	օ	օ	\mscro	
u+02135	ℵ	ℵ	ℵ	ℵ	ℵ	ℵ	ℵ	ℵ	ℵ	ℵ	ℵ	ℵ	ℵ	ℵ	ℵ	ℵ	ℵ	\aleph^{(p)}
u+02136	beth <sup>(a)</sup>																	
u+02137	ג	ג	ג	ג	ג	ג	ג	ג	ג	ג	ג	ג	ג	ג	ג	ג	ג	\gimel^{(a)}
u+02138	daleth <sup>(a)</sup>																	
u+0213d	฿	฿	฿	฿	฿	฿	฿	฿	฿	฿	฿	฿	฿	฿	฿	฿	฿	\Bbb- bgamma
u+0213e	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	Γ	\Bbb- bGamma
u+0213f	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	Π	\BbbPi
u+02202	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	ð	\partial
u+02207	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	\nabla
u+1d6a4	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	𝒾	\imath^{(p)}
u+1d6a5	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	𝒿	\jmath^{(p)}
u+1d6c1	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	\mbfnabla
u+1d6fb	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	\mitnabla
u+1d735	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	\mbfitnabla
u+1d76f	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	\mbfsansnabla
u+1d7a9	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	∇	\mbfit-sansnabla
u+1d7ca	F	F	F							F	F			F	F	F	F	\mbfdigamma
u+1d7cb	F	f	F							f	f			f	f	f	f	\mbfdigamma



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# Index of Commands and Concepts

To make it easier to use a command or concept, the entries are distinguished by their “type” and this is often indicated by one of the following “type words” at the beginning of an entry:

boolean, counter, document class, env., file, file extension, font, font encoding, key value, keyword, length, option, package, program, rigid length, or syntax.

The absence of an explicit “type word” means that the “type” is either a  $\text{\TeX}$  or  $\text{\LaTeX}$  “command” or simply a “concept”.

Use by, or in connection with, a particular package is indicated by adding the package name (in parentheses) to an entry.

An italic page number indicates that the command is demonstrated in a source code snippet or in an example on that page.

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