Useful LaTeX

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Contents

1 Setting Up Your Document

1.1 Document Classes

The first information LaTeX needs to know when processing an input file is the type of document the author wants to create. Most of the time, the very first line of your document will be `\documentclass{article}`.

However, if you want to get fancy, the full command is the `\documentclass`[*options*]{*class*} command. Here *class* specifies the type of document to be created. For a list of document classes, see Table 1.1. The *options* parameter customizes the behaviour of the document class. The options have to be separated by commas. For a list of the most common options for the standard document classes, see Table 1.2.

For example, the following command instructs LaTeX to typeset the document as an *article* with a base font size of *eleven points*, and to produce a layout suitable for *double sided* printing on *A4 paper*:

```
\documentclass[11pt,twoside,a4paper]{article}
```

1.2 The Preamble and the Main Document Body

There are two sections to your document after specifying your document class: the preamble and the main document body. The preamble is everything in between `\documentclass` and `\begin{document}`, and is used to load packages (which give you access to more commands or characters depending on your needs) and change the page layout. The main document body (almost everything you will write) is set off by `\begin{document}` and `\end{document}`. `\end{document}` comes at the very end of your document. So the basic "skeleton" of your document most likely will look something like this:

```
\documentclass{article}

%This begins the preamble.
\usepackage{amsmath}
\usepackage{amsthm}
%This ends the preamble.

\begin{document}
%All the rest of your text will go here.
\end{document}
```

1.3 Making a Title

You can make a fancy title for your document by issuing a `\maketitle` command. The contents of the title have to be defined by the commands `\title{...}`, `\author{...}` and optionally `\date{...}` before calling `\maketitle`. Example:

```
\author{Amelia Lin, adapted from H. Partl}
\title{Useful \LaTeX}
\maketitle
```

Otherwise, you can just center some text to make a title.

1.4 Chapters and Sections

The following sectioning commands are available for the article class, so if you used `\documentclass{article}` then you can also use these commands:

```
\section{...}
\subsection{...}
\subsubsection{...}
\paragraph{...}
\subparagraph{...}
```
If you want to split your document in parts without influencing the section or chapter numbering you can use
```
\part{...}
```
When you work with the report or book class, an additional top-level sectioning command becomes available:
```
\chapter{...}
```

Placing one of these commands before a section of text will automatically format the text as a section, subsection, etc. in the context of the entire document. For example, this section, titled Chapters and Sections, begins as follows:

```
\subsection{Chapters and Sections}

The following sectioning commands are available for the article class ...
```

1.5 Table of Contents

The command `\tableofcontents` expands to a table of contents at the place it is issued. A new document has to be compiled (LaTeX-ed) twice to get a correct table of contents.

1.6 Adjusting Margins

LaTeX has default settings for margins, but you can adjust them yourself if you like. Several parameters control the margin dimensions of your document. Adding the command `\addtolength`{*parameter*}{*length*} to your preamble adds a length to any of the parameters, letting you work relative to the existing settings. To see a diagram and list of the parameters, see Figure 6.2. To add one centimeter to the overall text width, you could put the following commands into the document preamble:

```
\addtolength{\hoffset}{-0.5cm}
\addtolength{\textwidth}{1cm}
```

2 Beginning Basics

2.1 Comments

When LaTeX encounters a % character while processing an input file, it ignores the rest of the present line, the line break, and all whitespace at the beginning of the next line.

This is an example: Supercalifragilisticexpialidocious

```
This is an % stupid
% Better: instructive <----
example: Supercal%
ifragilist%
icexpialidocious
```

Comments are useful for writing in information that you don't actually want executed in the final document.

2.2 Line Breaks

\\ or \newline starts a new line *without* indenting. \\ additionally prohibits a page break after the forced line break. \newpage starts a new page, as does \pagebreak.

Usually, LaTeX ignores spaces in your code. However, if you skip a line between chunks of code, LaTeX will start a new line *and* indent it to start a new paragraph instead of actually skipping a line. To leave an empty line between two paragraphs without an indent, you can type \newline\newline or \\ \newline. If you don't want LaTeX to read the skipped line in your code, simply fill it in with a % to comment out the blank line.

2.3 Getting the Final Document

Ctrl+Shift+F5 is a shortcut in TeXnicCenter that will output the final form of your document, usually PDF. In TeXnicCenter, you have the option of selecting what format you want your LaTeX converted to. To output a PDF, use the drop-down menu in the toolbar at the top of the screen to select LaTeX => PDF or use the shortcut Ctrl+Shift+F5, called "Build and view current file", to view the PDF. This shortcut is extremely useful for checking for errors as you write up your LaTeX.

3 Formatting Text

3.1 Fonts and Font Sizes

LaTeX has a default font and font size, but you can change it if you like. For fonts, you will enclose the text in curly brackets, like \texttt{typewriter}. For font sizes, there are no brackets; simply use \normalsize to return to normal font size.

LaTeX has lots of fonts to choose from, including typewriter, sans serif, and Small Caps. You can make these any size from small to big , or even very small to very big .

```
\LaTeX~has lots of fonts to choose from, including
\texttt{typewriter}, \textsf{sans serif},
and \textsc{Small Caps}. You can make these any size from
\small small \normalsize to \Large big \normalsize,
or even \scriptsize very small \normalsize to \Huge very big
\normalsize.
```

See Table 6.1 for a more extensive list of text fonts and their commands and Table 6.2 for a list of font size commands. For total control over font size, see Table 6.3 for a list of absolute point sizes and their commands.

3.2 Bolding and Italicizing Text

The \textbf and \textit commands bold and italicize text. For bolding math, you will want to use the \boldmath, \mathbf, or \bold commands, covered in Bolding Math and Symbols in section 5.14 on page 18.

3.3 Accents for Text

Common accents are:

- \' to put an upward accent over a character

- `\‘` to put a downward accent over a character
- `\"` to put a double dot (umlaut) over a character
- `\~` to put a tilde over a character
- `\c` to put a French cedilla under a character
- `\^` to put a circumflex (like a hat) over a character

3.4 Cross-References

Use the following commands for cross referencing:
`\label{`*marker*`}` (for the thing to be referenced), `\ref{`*marker*`}` (section), and `\pageref{`*marker*`}` (page)
where *marker* is an identifier chosen by the user. LaTeX replaces `\ref` by the number of the section, subsection, figure, table, or theorem after which the corresponding `\label` command was issued. `\pageref` prints the page number of the page where the `\label` command occurred. As with the section titles, the numbers from the previous run are used.

A reference to this subsection looks like this: see section 3.4 on page 6.

```
A reference to this subsection
\label{sec:this} looks like this:
see section~\ref{sec:this} on
page~\pageref{sec:this}.
```

You can also reference earlier equations, using `\eqref`, within certain environments.

$$f(x) = (a+b)(a-b) \tag{1}$$

This is a reference to (1).

```
\begin{align}
f(x) &= (a+b)(a-b) \label{1}
\end{align}
\qquad \qquad This is a reference to \eqref{1}.
```

3.5 Footnotes

Use the command `\footnote`. Example:

Here is a footnote[1].

```
Here is a footnote\protect\footnote{This is
a footnote.}.
```

[1] This is a footnote.

3.6 Lists

There are several different environments for lists. Use `enumerate` for a numbered list, `itemize` for a bulleted list, and `description` for a word-definition style list. Within a list, use `\item`[*bullet*] for each item. For *bullet*, you can enter a bullet style (-, *) or a word.

1. You can mix the list environments to your taste:
   - But it might start to look silly.
   - With a dash.
2. Therefore remember:

   Stupid things will not become smart because they are in a list.

   Smart things, though, can be presented beautifully in a list.

```
\flushleft
\begin{enumerate}
\item You can mix the list
environments to your taste:
\begin{itemize}
\item But it might start to
look silly.
\item[-] With a dash.
\end{itemize}
\item Therefore remember:
\begin{description}
\item[Stupid] things will not
become smart because they are
in a list.
\item[Smart] things, though,
can be presented beautifully
in a list.
\end{description}
\end{enumerate}
```

3.7 Boxing Text

The `\framebox`[*width*][*pos*]{*text*} command (or, for shorthand, `\fbox`) draws a box around text. *width* defines the width of the resulting box. You can also use the commands `\width, \height, \depth,` and `\totalheight` in the *width* parameter. The *pos* parameter defines the alignment of the text within the box and takes a one letter value: center (c), flushleft (l), flushright (r), or spread (s) the text to fill the box. The command `\makebox` (shorthand `\mbox`) works exactly the same as `\framebox`, but it does not draw a box around the text. Example:

This text is in a box.

```
\fbox{This text is in a box.}
```

You can also pack a paragraph of your choice into a box (no frame) with either the `\parbox`[*pos*]{*width*}{*text*} command or the `\begin{minipage}`[*pos*]{*width*} *text* `\end{minipage}` command.

3.8 Adjusting Paragraph Indents

`\indent` will add an indent to a paragraph and `\noindent` will suppress an indent. You can also control the indentation depth for the entire document by adding a command to the preamble like this:

```
\setlength{\parindent}{0.0in}
```

4 Formatting Mathematical Formulae

4.1 Text vs. Display Style for Equations

There are two ways to typeset mathematical formulae, in-line or display. In-line is less obtrusive; display sets off equations nicely. Examples:

Within a paragraph (in-line):
Add a squared and b squared to get c squared. Or, using a more mathematical approach: $a^2 + b^2 = c^2$
$\lim_{n\to\infty} \sum_{k=1}^{n} \frac{1}{k^2} = \frac{\pi^2}{6}$.

```
Add $a$ squared and $b$ squared
to get $c$ squared. Or, using
a more mathematical\\
 approach:
$a^2 + b^2 = c^2$\newline \newline

$\lim_{n \to \infty}
\sum_{k=1}^n \frac{1}{k^2}
= \frac{\pi^2}{6}$.
```

Breaking the paragraph to typeset it separately: (display style):
Add a squared and b squared to get c squared. Or, using a more mathematical approach:

$$a^2 + b^2 = c^2$$

$$\lim_{n\to\infty} \sum_{k=1}^{n} \frac{1}{k^2} = \frac{\pi^2}{6} \tag{2}$$

```
Add $a$ squared and $b$ squared
to get $c$ squared. Or, using
a more mathematical approach:
\[ a^2 + b^2 = c^2 \]
\begin{equation}
\lim_{n \to \infty}
\sum_{k=1}^n \frac{1}{k^2}
= \frac{\pi^2}{6}
\end{equation}
```

Using `\[` and `\]` will not number the equations. Using `equation` will number your equations, like this:

$$a^2 + b^2 = c^2 \tag{3}$$

```
\begin{equation}
a^2 + b^2 = c^2
\end{equation}
```

Additionally, the environment `equation*` is equivalent to using `\[` and `\]`. It too will not number your equations.

4.2 Tables

To begin a table, use the `tabular`{*alignment*} environment. You can use *alignment* to assign the text alignment for each column to be either left (l), right (r), or center (c). Use `&` to separate entries, and the `\\` command to begin a new line. You can also assign dividers between the columns: `|` inserts a vertical line, and `@{.}` inserts a period. `\hline` creates a horizontal line across the entire width of the table, and `\cline`{*column#-column#*} draws a partial horizontal line.

7C0	hexadecimal
3700	octal
11111000000	binary
1984	decimal

```
\begin{tabular}{|r|l|}
\hline
7C0 & hexadecimal \\
3700 & octal \\ \cline{2-2}
11111000000 & binary \\
\hline \hline
1984 & decimal \\
\hline
\end{tabular}
```

You can use `\multicolumn`{*column#*}{*alignment*}{*label*} to split a single column into multiple columns after a certain point. *column#* defines which column is to be split, *alignment* can either be assigned to be `l, r, or c`, and *label* assigns the label of the single column.

Pi expression	Value
π	3.1416
π^π	36.46
$(\pi^\pi)^\pi$	80662.7

```
\begin{tabular}{c r @{.} l}
Pi expression &
\multicolumn{2}{c}{Value} \\
\hline
$\pi$ & 3&1416 \\
$\pi^{\pi}$ & 36&46 \\
$(\pi^{\pi})^{\pi}$ & 80662&7 \\
\end{tabular}
```

Tables can be also used to write out doing addition/subtraction "by hand."

	33.0
+	3.21
=	36.21

```
\begin{tabular}{c r @{.} l}
&33&0 \\
+&3&21 \\
\hline
=&36&21 \\
\end{tabular}
```

4.3 Arrays, Matrices, and Delimiters

To typeset arrays, use the array environment. It works somewhat similarly to the tabular environment. Again, `&` is used to separate entries, and the `\\` command is used to break the lines.

$$|x| = \begin{cases} -x & \text{if } x < 0 \\ 0 & \text{if } x = 0 \\ x & \text{if } x > 0 \end{cases}$$

```
\begin{equation*}
|x| = \left\{
\begin{array}{rl}
-x & \text{if } x < 0\\
0 & \text{if } x = 0\\
x & \text{if } x > 0
\end{array} \right.
\end{equation*}
```

For matrices, there are 6 different `matrix` environments, with different delimiters:
`{matrix} (none), pmatrix (, bmatrix [, Bmatrix {, vmatrix |` and `Vmatrix} ||`.

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

```
\[\begin{bmatrix}
 1 & 2 & 3 \\
 4 & 5 & 6 \\
 7 & 8 & 9
\end{bmatrix}\]
```

You can nest matrices, like when you want to write magnitude of a vector:

$$\left| \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} \right|$$

```
\begin{vmatrix}
\begin{pmatrix}
1 \\
2 \\
3
\end{pmatrix}
\end{vmatrix}
```

If you want to adjust the size of your delimiters manually, refer to **Vertical Braces and Other Delimiters** in section 5.11 on page 17.

4.4 Vertically Aligning Multiple Equations

For formulae running over several lines or for equation systems, you can use the environments `align` and `align*` instead of `equation` and `equation*`. With `align` each line gets an equation number. The `align*` does not number anything.

The `align` environments center the single equation around the & sign. The `\\` command breaks the lines. If you only want to enumerate some of the equations, use `nonumber` to remove the number. You can also replace the enumeration with a word label, using `\tag`. It has to be placed before `\\`.

$$\begin{aligned} f(x) &= (a+b)(a-b) && (4)\\ &= a^2 - ab + ba - b^2 && (5)\\ &= a^2 + b^2 && \text{(wrong)} \end{aligned}$$

```
\begin{align}
f(x) &= (a+b)(a-b)\\
&= a^2-ab+ba-b^2 \\
&= a^2+b^2 \tag{wrong}
\end{align}
```

Long equations will not be automatically divided into neat bits. The author has to specify where to break them and correct the indent. Here, `\qquad` is used to insert space:

$$\begin{aligned} f(x) &= 3x^5 + x^4 + 2x^3\\ &\qquad + 9x^2 + 12x + 23 && (6)\\ &= g(x) - h(x) && (7) \end{aligned}$$

```
\begin{align}
f(x) &= 3x^5 + x^4 + 2x^3
\nonumber \\
&\qquad + 9x^2 + 12x + 23 \\
&= g(x) - h(x)
\end{align}
```

4.5 Writing Verbatim

Text that is enclosed between `\begin{verbatim}` and `\end{verbatim}` will be directly printed, as if typed on a typewriter, with all line breaks and spaces, without any LaTeX command being executed. Within a paragraph, similar behavior can be accessed with `\verb`, if the text is set off by a ∼ on either end. Other symbols, like +, can also be used. Example:

The `\ldots` command ...

```
The \verb~\ldots~ command \ldots
```

In the above example, the first `\ldots` is quoted verbatim, while the second is executed as an ellipsis.

4.6 Defining New Commands

Use `\newcommand{`*name*`}[`*num*`]{`*definition*`}` to assign new commands. Basically, the command requires two arguments: the *name* of the command you want to create, and the *definition* of the command. The *num* argument in square brackets is optional and specifies the number of arguments the new command takes (up to 9 are possible). If missing it defaults to 0, i.e. no argument allowed. Example:

This is Useful LaTeX ... Useful LaTeX

```
\newcommand{\useful}{Useful \LaTeX}
This is \useful \ldots{}
\useful
```

The next example illustrates how to define a new command that takes one argument. The #1 tag gets replaced by the argument you specify. If you wanted to use more than one argument, use #2 and so on.

- This is *useful* LaTeX
- This is *very useful* LaTeX

```
\newcommand{\usefulness}[1]
{This is \emph{#1} \LaTeX}
% in the document body:
\begin{itemize}
\item \usefulness{useful}
\item \usefulness{very useful}
\end{itemize}
```

4.7 Fractions

A built-up fraction is typeset with the `\frac{...}{...}` command. If you have single characters in either the numerator or denominator, you can optionally drop the brackets.

$$\frac{1}{2} \quad \frac{1}{2} \quad \frac{1}{x} \quad \frac{x^2}{2} \quad \frac{1}{1+x}$$

```
\[ \frac{1}{2} \qquad \frac12 \qquad
\frac1x \qquad \frac{x^2}2 \qquad \frac1{1+x} \]
```

If you want to get fancy, you can manually format your fractions. In in-line equations, the fraction is shrunk to fit the line. This style is obtainable in display style with `\tfrac`. The reverse, i.e. display style fraction in text, is made with `\dfrac`.

A normal style fraction and display style fraction, both in in-line style: $1\frac{1}{2}$ hours $1\dfrac{1}{2}$ hours

```
$1\frac{1}{2}$~hours \qquad
$1\dfrac{1}{2}$~hours
```

An unformatted style fraction, normal style fraction, and text style fraction, all within display style:

$$3/8 \quad \frac{3}{8} \quad \tfrac{3}{8}$$

```
\[3/8 \qquad \frac{3}{8}
\qquad \tfrac{3}{8} \]
```

4.8 Inserting Normal Text Within Mathematical Expressions

If you want to typeset normal text within a formula (normal upright font and normal spacing) then you have to enter the text using the `\text{...}` command.

$$x^2 \geq 0 \qquad \text{for all } x \in \mathbf{R}$$

```
\[x^{2} \geq 0\qquad
\text{for all }x\in\mathbf{R}\]
```

4.9 Proofs

Use the `proof` environment to format proofs.

Proof. Trivial, use

$$E = mc^2$$

□

```
\begin{proof}
Trivial, use
\[E=mc^2\]
\end{proof}
```

4.10 Boxing Math

To draw a box around mathmatical formulae, use the `\boxed{...}` command. If you want to box multiple lines, you will need to, within the `\boxed{...}` command, go into the `gathered` environment and break your lines using `\\`. Furthermore, if you'd like to center your box, you will need to do that manually.

$$\boxed{\begin{gathered} x_1 = 3 \\ x_2 = 5 \end{gathered}}$$

```
\begin{center}
\boxed{
\begin{gathered}
x_1 = 3 \\
x_2 = 5
\end{gathered}
}
\end{center}
```

4.11 Phantom Text

The `\phantom` command will insert an "invisible" character that shows up as blank space.

$$ {}^{14}_{6}\text{C} \qquad \text{versus} \qquad {}^{14}_{6}\text{C} $$

```
\begin{equation*}
{}^{14}_{6}\text{C}
\qquad \text{versus} \qquad
{}^{14}_{\phantom{1}6}\text{C}
\end{equation*}
```

4.12 Adjusting Spacing in Math Mode

Spacing between characters in math mode can be tricky, because LaTeX usually adjusts it automatically. Two useful commands are `\,`, which adds a very small amount of space, and `\qquad`, which adds a larger amount of space.

$$\int_1^2 \ln x\mathrm{d}x \qquad \int_1^2 \ln x\,\mathrm{d}x$$

```
\[\int_1^2 \ln x \mathrm{d}x \qquad
\int_1^2 \ln x \,\mathrm{d}x\]
```

4.13 The Smash Command

Use `\smash` to stop LaTeX from adjusting the line spacing to accomodate mathematical expressions. This keeps the line spacing even.

An unsmashed $d_{e_{e_p}}$ mathematical expression
followed by an unsmashed $h^{i^{g^h}}$ expression.

Versus a smashed $d_{e_{e_p}}$ expression
followed by a $h^{i^{g^h}}$ expression.

```
An unsmashed $d_{e_{e_p}}$ mathematical
expression}\\
followed by an unsmashed
$h^{i^{g^h}}$ expression.}\newline

Versus a smashed
\smash{$d_{e_{e_p}}$} expression\\
followed by a
\smash{$h^{i^{g^h}}$} expression.
```

4.14 Math Fonts

See Table 6.4 for a list of math fonts and Table 3.14 for a list of various math alphabets and their commands. They are used similarly to the commands for text fonts, in **Fonts and Font Sizes** in section 3.1 on page 5.

5 Some Useful Mathematical Symbols

5.1 Integrals, Sums, Products, and Infinity

The integral operator is generated with `\int`, the sum operator with `\sum`, and the product operator with `\prod`. The upper and lower limits are specified with ^ and _ like subscripts and superscripts. The symbol for infinity is obtained using `\infty`.

$$\sum_{i=1}^{\infty} \qquad \int_0^{\frac{\pi}{2}} \qquad \prod_{\epsilon}$$

```
\sum_{i=1}^\infty \qquad
\int_0^{\frac{\pi}{2}} \qquad
\prod_\epsilon
```

If you want to use the "evaluated at" sign in an integral, which looks like a vertical bar, you can do this using `\bigg`, which adjusts most delimiters like parentheses and brackets as well.

$$-\int_0^\infty \frac{1}{x^2}dx = \frac{1}{x}\bigg|_0^\infty$$

```
\[-\int_0^\infty\frac{1}{x^2}dx=\frac{1}{x}\bigg|_0^\infty\]
```

5.2 Partial Derivatives

Use the `\partial` command to insert the partial derivative symbol:

$$\sqrt{\frac{x^2}{k+1}} \qquad x^{\frac{2}{k+1}} \qquad \frac{\partial^2 f}{\partial x^2}$$

```
\[\sqrt{\frac{x^2}{k+1}}\qquad
x^\frac{2}{k+1}\qquad
\frac{\partial^2f}
{\partial x^2} \]
```

5.3 Limits

To write a limit, use `\lim` and use subscripts accordingly, as you did for integrals.

$$\lim a \rightarrow \infty \qquad \lim_{a \rightarrow \infty}$$

```
\[\lim a \rightarrow \infty \qquad
\lim_{a \rightarrow \infty}\]
```

5.4 Vectors, Hats, Bars, and Primes

Vectors are specified by adding small arrow symbols on top of a variable. This is done with the `\vec` command. The two commands `\overrightarrow` and `\overleftarrow` can be used to denote the vector from A to B:

$$\vec{a} \qquad \vec{AB} \qquad \overrightarrow{AB} \qquad \overleftarrow{AB}$$

```
\[\vec{a} \qquad
\vec{AB} \qquad
\overrightarrow{AB} \qquad
\overleftarrow{AB}\]
```

Wide hats and tildes covering several characters are generated with `\widetilde` and `\widehat`. Notice the difference between `\hat` and `\widehat` and the placement of `\bar` for a variable with subscript.

$$\hat{XY} \quad \widehat{XY} \quad \bar{x_0} \quad \bar{x}_0$$

```
\[\hat{XY} \quad \widehat{XY}
\quad \bar{x_0} \quad \bar{x}_0\]
```

An apostrophe ' or `\prime` gives a prime:

$$f(x) = x^2 \qquad f'(x) = 2x \qquad f''(x) = 2$$

```
\[f(x) = x^2 \qquad f^{\prime}(x)
= 2x \qquad f''(x) = 2\]
```

5.5 Square Roots

The square root is entered as `\sqrt`; the nth root is generated with `\sqrt[n]`. The size of the root sign is determined automatically by LaTeX.

$$\sqrt{36} = 6 \qquad \sqrt[3]{27} = 3$$

```
\[\sqrt{36} = 6
\qquad \sqrt[3]{27} = 3\]
```

5.6 Absolute Value

Normally, you can use `\vert` or | (in math mode) on your keyboard for the absolute value symbol. However, if you need to adjust the size you can prefix it with the commands `\big`, `Big`, `\bigg`, or `\Bigg`. This also works with most other delimiters, as explained in **Vertical Braces and Other Delimiters** in section 5.11 on page 17.

$$\big\vert \Big\vert \bigg\vert \Bigg\vert$$

```
\[\big\vert \Big\vert \bigg\vert \Bigg\vert\]
```

5.7 Dots

`\cdot` typesets a single dot centered.
`\cdots` is three centered dots.
`\ldots` sets three dots on the baseline, like an ellipsis.
`\vdots` gives three vertical dots.
`\ddots` gives three diagonal dots.

$$\Psi = v_1 \cdot v_2 \cdot \ldots$$

```
\[\Psi = v_1 \cdot v_2 \cdot \ldots\]
```

5.8 Div and Curl

For the upside-down triangle that is used for div and curl, use `\nabla`.

$$\nabla \times \mathcal{E}$$

```
\[ \nabla \times \mathcal{E} \]
```

5.9 Underlining and Overlining

The commands `\overline` and `\underline` create horizontal lines directly over or under an expression:

$$0.\overline{3} = \underline{\underline{1/3}}$$

```
\[0.\overline{3} =
\underline{\underline{1/3}}\]
```

5.10 Horizontal Braces

The commands `\overbrace` and `\underbrace` create long horizontal braces over or under an expression:

$$\underbrace{\overbrace{a+b+c}^{6}\cdot\overbrace{d+e+f}^{9}}_{\text{meaning of life}} = 42$$

```
\[\underbrace{\overbrace{a+b+c}^6
\cdot \overbrace{d+e+f}^9}
_\text{meaning of life} = 42\]
```

5.11 Vertical Braces and Other Delimiters

Round and square braces can be entered with the corresponding keys, and curly braces with `\{`.

$$a, b, c \neq \{a, b, c\}$$

```
\begin{equation*}
{a,b,c} \neq \{a,b,c\}
\end{equation*}
```

If you put `\left` in front of an opening delimiter and `\right` in front of a closing delimiter, LaTeX will automatically determine the correct size of the delimiter. Note that you must close every `\left` with a corresponding `\right`. If you dont want anything on the right, use the invisible "`\right.`"

$$1 + \left(\frac{1}{1-x^2}\right)^3 \qquad \left.\ddagger\frac{~}{~}\right)$$

```
\begin{equation*}
1 + \left(\frac{1}{1-x^{2}}
\right)^3 \qquad
\left. \ddagger \frac{~}{~}\right)
\end{equation*}
```

If you ever want to adjust the size of delimiters manually, you can do so using `\big`, `Big`, `\bigg`, and `\Bigg` as prefixes to most delimiters:

$$\big(\Big(\bigg(\Bigg(\quad \big\} \Big\} \bigg\} \Bigg\} \quad \big\| \Big\| \bigg\| \Bigg\| \quad \big\Downarrow \Big\Downarrow \bigg\Downarrow \Bigg\Downarrow$$

```
\[\big( \Big( \bigg( \Bigg( \quad
\big\} \Big\} \bigg\} \Bigg\} \quad
\big\| \Big\| \bigg\| \Bigg\| \quad
\big\Downarrow \Big\Downarrow
\bigg\Downarrow \Bigg\Downarrow\]
```

5.12 Accents in Math

Common math accents are:

- `\tilde` to put a tilde over a character
- `\dot` to put a single dot over a character
- `\ddot` to put a double dot over a character

5.13 Stacking Symbols

For binary relations it may be useful to stack symbols over each other. `stackrel{#1}{#2}` puts the symbol given in #1 in superscript-like size over #2 which is set in its usual position.

$$f_n(x) \stackrel{*}{\approx} 1$$

```
f_n(x) \stackrel{*}{\approx} 1
```

5.14 Bolding Math and Symbols

Within math mode, you can use the `\mathbf` and `\bold` commands to bold math or symbols. There is also a `\boldmath` command, but (ironically) this can only be used outside math mode.

μ, M $\mu, \mathbf{M}$ $\boldsymbol{\mu, M}$

```
$\mu, M \qquad
\mathbf{\mu}, \mathbf{M}$
\qquad \boldmath{$\mu, M$}
```

If you use the amsbsy package, it includes a `\boldsymbol` command:

$$\boldsymbol{\mu, M} \qquad \boldsymbol{\mu, M}$$

```
\[\mu, M \qquad
\boldsymbol{\mu}, \boldsymbol{M}\]
```

For bolding and italicizing text as opposed to math, see **Bolding and Italicizing Text** in section 3.2 on page 5.

5.15 Tables and Other Reference

For more...

Greek letters see Table 3.2

Binary relations $(>, <, \approx, \subset)$ see Tables 3.3 and 3.16

Binary operators $(\div)$ see Tables 3.4 and 3.15

Big operators $(\sum, \int)$ see Table 3.5

Centered arrows see Table 3.6, 3.17

Over and under arrows see Table 3.7

Negated binary relations and arrows see Table 3.18

Delimiters ([, {) see Table 2.8

Large delimiters see Table 3.9

Dots and misc. see Table 3.10

Misc. see Tables 3.11, 3.12, 3.19

Useful LaTeX – Tables and Diagrams

Table 1.1: Document Classes.

`article`	for articles in scientific journals, presentations, short reports, program documentation, invitations, ...
`proc`	a class for proceedings based on the article class.
`minimal`	is as small as it can get. It only sets a page size and a base font. It is mainly used for debugging purposes.
`report`	for longer reports containing several chapters, small books, PhD theses, ...
`book`	for real books
`slides`	for slides. The class uses big sans serif letters. You might want to consider using FoilTEX[a] instead.

Table 1.2: Document Class Options.

`10pt`, `11pt`, `12pt`	Sets the size of the main font in the document. If no option is specified, `10pt` is assumed.
`a4paper`, `letterpaper`, ...	Defines the paper size. The default size is `letterpaper`. Besides that, `a5paper`, `b5paper`, `executivepaper`, and `legalpaper` can be specified.
`fleqn`	Typesets displayed formulae left-aligned instead of centred.
`leqno`	Places the numbering of formulae on the left hand side instead of the right.
`titlepage`, `notitlepage`	Specifies whether a new page should be started after the document title or not. The `article` class does not start a new page by default, while `report` and `book` do.
`onecolumn`, `twocolumn`	Instructs LaTeX to typeset the document in one column or two columns.
`twoside`, `oneside`	Specifies whether double or single sided output should be generated. The classes `article` and `report` are single sided and the book class is double sided by default. Note that this option concerns the style of the document only. The option `twoside` does *not* tell the printer you use that it should actually make a two-sided printout.
`landscape`	Changes the layout of the document to print in landscape mode.
`openright`, `openany`	Makes chapters begin either only on right hand pages or on the next page available. This does not work with the `article` class, as it does not know about chapters. The `report` class by default starts chapters on the next page available and the `book` class starts them on right hand pages.

Table 3.2: Greek Letters.

There is no uppercase of some of the letters like `\Alpha`, `\Beta` and so on, because they look the same as normal roman letters: A, B...

α	`\alpha`	θ	`\theta`	o	`o`	υ	`\upsilon`
β	`\beta`	ϑ	`\vartheta`	π	`\pi`	ϕ	`\phi`
γ	`\gamma`	ι	`\iota`	ϖ	`\varpi`	φ	`\varphi`
δ	`\delta`	κ	`\kappa`	ρ	`\rho`	χ	`\chi`
ϵ	`\epsilon`	λ	`\lambda`	ϱ	`\varrho`	ψ	`\psi`
ε	`\varepsilon`	μ	`\mu`	σ	`\sigma`	ω	`\omega`
ζ	`\zeta`	ν	`\nu`	ς	`\varsigma`		
η	`\eta`	ξ	`\xi`	τ	`\tau`		
Γ	`\Gamma`	Λ	`\Lambda`	Σ	`\Sigma`	Ψ	`\Psi`
Δ	`\Delta`	Ξ	`\Xi`	Υ	`\Upsilon`	Ω	`\Omega`
Θ	`\Theta`	Π	`\Pi`	Φ	`\Phi`		

Table 3.3: Binary Relations.

You can negate the following symbols by prefixing them with a `\not` command.

$<$	`<`	$>$	`>`	$=$	`=`
$\leq$	`\leq` or `\le`	$\geq$	`\geq` or `\ge`	$\equiv$	`\equiv`
$\ll$	`\ll`	$\gg$	`\gg`	$\doteq$	`\doteq`
$\prec$	`\prec`	$\succ$	`\succ`	$\sim$	`\sim`
$\preceq$	`\preceq`	$\succeq$	`\succeq`	$\simeq$	`\simeq`
$\subset$	`\subset`	$\supset$	`\supset`	$\approx$	`\approx`
$\subseteq$	`\subseteq`	$\supseteq$	`\supseteq`	$\cong$	`\cong`
$\sqsubset$ [a]	`\sqsubset` [a]	$\sqsupset$ [a]	`\sqsupset` [a]	$\bowtie$ [a]	`\Join` [a]
$\sqsubseteq$	`\sqsubseteq`	$\sqsupseteq$	`\sqsupseteq`	$\bowtie$	`\bowtie`
$\in$	`\in`	$\ni$	`\ni` , `\owns`	$\propto$	`\propto`
$\vdash$	`\vdash`	$\dashv$	`\dashv`	$\models$	`\models`
$\mid$	`\mid`	$\parallel$	`\parallel`	$\perp$	`\perp`
$\smile$	`\smile`	$\frown$	`\frown`	$\asymp$	`\asymp`
$:$	`:`	$\notin$	`\notin`	$\neq$	`\neq` or `\ne`

[a] Use the latexsym package to access this symbol

Table 3.4: Binary Operators.

$+$	+	$-$	-		
$\pm$	\pm	$\mp$	\mp	$\triangleleft$	\triangleleft
$\cdot$	\cdot	$\div$	\div	$\triangleright$	\triangleright
$\times$	\times	$\setminus$	\setminus	$\star$	\star
$\cup$	\cup	$\cap$	\cap	$*$	\ast
$\sqcup$	\sqcup	$\sqcap$	\sqcap	$\circ$	\circ
$\vee$	\vee , \lor	$\wedge$	\wedge , \land	$\bullet$	\bullet
$\oplus$	\oplus	$\ominus$	\ominus	$\diamond$	\diamond
$\odot$	\odot	$\oslash$	\oslash	$\uplus$	\uplus
$\otimes$	\otimes	$\bigcirc$	\bigcirc	$\amalg$	\amalg
$\triangle$	\bigtriangleup	$\bigtriangledown$	\bigtriangledown	$\dagger$	\dagger
$\lhd$	\lhd [a]	$\rhd$	\rhd [a]	$\ddagger$	\ddagger
$\unlhd$	\unlhd [a]	$\unrhd$	\unrhd [a]	$\wr$	\wr

Table 3.5: BIG Operators.

$\sum$	\sum	$\bigcup$	\bigcup	$\bigvee$	\bigvee
$\prod$	\prod	$\bigcap$	\bigcap	$\bigwedge$	\bigwedge
$\coprod$	\coprod	$\bigsqcup$	\bigsqcup	$\biguplus$	\biguplus
$\int$	\int	$\oint$	\oint	$\bigodot$	\bigodot
$\bigoplus$	\bigoplus	$\bigotimes$	\bigotimes		

Table 3.6: Arrows.

$\leftarrow$	\leftarrow or \gets	$\longleftarrow$	\longleftarrow
$\rightarrow$	\rightarrow or \to	$\longrightarrow$	\longrightarrow
$\leftrightarrow$	\leftrightarrow	$\longleftrightarrow$	\longleftrightarrow
$\Leftarrow$	\Leftarrow	$\Longleftarrow$	\Longleftarrow
$\Rightarrow$	\Rightarrow	$\Longrightarrow$	\Longrightarrow
$\Leftrightarrow$	\Leftrightarrow	$\Longleftrightarrow$	\Longleftrightarrow
$\mapsto$	\mapsto	$\longmapsto$	\longmapsto
$\hookleftarrow$	\hookleftarrow	$\hookrightarrow$	\hookrightarrow
$\leftharpoonup$	\leftharpoonup	$\rightharpoonup$	\rightharpoonup
$\leftharpoondown$	\leftharpoondown	$\rightharpoondown$	\rightharpoondown
$\rightleftharpoons$	\rightleftharpoons	$\iff$	\iff (bigger spaces)
$\uparrow$	\uparrow	$\downarrow$	\downarrow
$\updownarrow$	\updownarrow	$\Uparrow$	\Uparrow
$\Downarrow$	\Downarrow	$\Updownarrow$	\Updownarrow
$\nearrow$	\nearrow	$\searrow$	\searrow
$\swarrow$	\swarrow	$\nwarrow$	\nwarrow
$\leadsto$	\leadsto [a]		

[a]Use the latexsym package to access this symbol

Table 3.7: Arrows as Accents.

$\overrightarrow{AB}$	\overrightarrow{AB}	$\underrightarrow{AB}$	\underrightarrow{AB}
$\overleftarrow{AB}$	\overleftarrow{AB}	$\underleftarrow{AB}$	\underleftarrow{AB}
$\overleftrightarrow{AB}$	\overleftrightarrow{AB}	$\underleftrightarrow{AB}$	\underleftrightarrow{AB}

Table 3.8: Delimiters.

(	(	)	)	↑	\uparrow
[	[or \lbrack	]	] or \rbrack	↓	\downarrow
{	\{ or \lbrace	}	\} or \rbrace	↕	\updownarrow
⟨	\langle	⟩	\rangle	⇑	\Uparrow
|	| or \vert	‖	\\| or \Vert	⇓	\Downarrow
/	/	\	\backslash	⇕	\Updownarrow
⌊	\lfloor	⌋	\rfloor		
⌉	\rceil	⌈	\lceil		

Table 3.9: Large Delimiters.

⎛	\lgroup	⎞	\rgroup	⎰	\lmoustache
⏐	\arrowvert	⏐	\Arrowvert	⏐	\bracevert
⎝	\rmoustache				

Table 3.10: Miscellaneous Symbols.

…	\dots	⋯	\cdots	⋮	\vdots	⋱	\ddots
ℏ	\hbar	ı	\imath	ȷ	\jmath	ℓ	\ell
ℜ	\Re	ℑ	\Im	ℵ	\aleph	℘	\wp
∀	\forall	∃	\exists	℧	\mho [a]	∂	\partial
′	'	′	\prime	∅	\emptyset	∞	\infty
∇	\nabla	△	\triangle	□	\Box [a]	◇	\Diamond [a]
⊥	\bot	⊤	\top	∠	\angle	√	\surd
♢	\diamondsuit	♡	\heartsuit	♣	\clubsuit	♠	\spadesuit
¬	\neg or \lnot	♭	\flat	♮	\natural	♯	\sharp

[a] Use the latexsym package to access this symbol

Table 3.11: Non-Mathematical Symbols.

These symbols can also be used in text mode.

†	\dag	§	\S	©	\copyright	®	\textregistered
‡	\ddag	¶	\P	£	\pounds	%	\%

Table 3.12: $\mathcal{AMS}$ Delimiters.

⌜	\ulcorner	⌝	\urcorner	⌞	\llcorner	⌟	\lrcorner
|	\lvert	|	\rvert	‖	\lVert	‖	\rVert

Table 3.14: Math Alphabets.

See Table 6.4 on 113 for other math fonts.

Example	Command	Required package
ABCDEabcde1234	`\mathrm{ABCDE abcde 1234}`	
ABCDEabcde1234	`\mathit{ABCDE abcde 1234}`	
*ABCDEabcde*1234	`\mathnormal{ABCDE abcde 1234}`	
$\mathcal{ABCDE}$	`\mathcal{ABCDE abcde 1234}`	
$\mathscr{ABCDE}$	`\mathscr{ABCDE abcde 1234}`	mathrsfs
𝔄𝔅ℭ𝔇𝔈𝔞𝔟𝔠𝔡𝔢1234	`\mathfrak{ABCDE abcde 1234}`	amsfonts or amssymb
𝔸𝔹ℂ𝔻𝔼𝕒𝕓𝕔𝕕𝕖1234	`\mathbb{ABCDE abcde 1234}`	amsfonts or amssymb

Table 3.15: $\mathcal{AMS}$ Binary Operators.

∔	`\dotplus`	∙	`\centerdot`		
⋉	`\ltimes`	⋊	`\rtimes`	⋇	`\divideontimes`
⋓	`\doublecup`	⋒	`\doublecap`	⧵	`\smallsetminus`
⊻	`\veebar`	⊼	`\barwedge`	⩞	`\doublebarwedge`
⊞	`\boxplus`	⊟	`\boxminus`	⊝	`\circleddash`
⊠	`\boxtimes`	⊡	`\boxdot`	⊚	`\circledcirc`
⊺	`\intercal`	⊛	`\circledast`	⋌	`\rightthreetimes`
⋎	`\curlyvee`	⋏	`\curlywedge`	⋋	`\leftthreetimes`

Table 3.16: $\mathcal{AMS}$ Binary Relations.

⩿	`\lessdot`	⩾	`\gtrdot`	≒	`\doteqdot`
⪽	`\leqslant`	⩾	`\geqslant`	≓	`\risingdotseq`
⪕	`\eqslantless`	⪖	`\eqslantgtr`	≒	`\fallingdotseq`
≦	`\leqq`	≧	`\geqq`	≗	`\eqcirc`
⋘	`\lll` or `\llless`	⋙	`\ggg`	≗	`\circeq`
≲	`\lesssim`	≳	`\gtrsim`	≜	`\triangleq`
⪅	`\lessapprox`	⪆	`\gtrapprox`	≏	`\bumpeq`
≶	`\lessgtr`	≷	`\gtrless`	≎	`\Bumpeq`
⋚	`\lesseqgtr`	⋛	`\gtreqless`	∼	`\thicksim`
⪋	`\lesseqqgtr`	⪌	`\gtreqqless`	≈	`\thickapprox`
≼	`\preccurlyeq`	≽	`\succcurlyeq`	≅	`\approxeq`
⋞	`\curlyeqprec`	⋟	`\curlyeqsucc`	∽	`\backsim`
≾	`\precsim`	≿	`\succsim`	⋍	`\backsimeq`
⪷	`\precapprox`	⪸	`\succapprox`	⊨	`\vDash`
⫅	`\subseteqq`	⫆	`\supseteqq`	⊩	`\Vdash`
∥	`\shortparallel`	⫈	`\Supset`	⊪	`\Vvdash`
◀	`\blacktriangleleft`	⊐	`\sqsupset`	϶	`\backepsilon`
▷	`\vartriangleright`	∵	`\because`	∝	`\varpropto`
▶	`\blacktriangleright`	⋐	`\Subset`	≬	`\between`
⊵	`\trianglerighteq`	⌢	`\smallfrown`	⋔	`\pitchfork`
◁	`\vartriangleleft`	∣	`\shortmid`	⌣	`\smallsmile`
⊴	`\trianglelefteq`	∴	`\therefore`	⊏	`\sqsubset`

Table 3.17: $\mathcal{AMS}$ Arrows.

⇠	\dashleftarrow	⇢	\dashrightarrow
⇇	\leftleftarrows	⇉	\rightrightarrows
⇆	\leftrightarrows	⇄	\rightleftarrows
⇚	\Lleftarrow	⇛	\Rrightarrow
↞	\twoheadleftarrow	↠	\twoheadrightarrow
↢	\leftarrowtail	↣	\rightarrowtail
⇋	\leftrightharpoons	⇌	\rightleftharpoons
↰	\Lsh	↱	\Rsh
↫	\looparrowleft	↬	\looparrowright
↶	\curvearrowleft	↷	\curvearrowright
↺	\circlearrowleft	↻	\circlearrowright
⊸	\multimap	⇈	\upuparrows
⇊	\downdownarrows	↿	\upharpoonleft
↾	\upharpoonright	⇂	\downharpoonright
⇝	\rightsquigarrow	↭	\leftrightsquigarrow

Table 3.18: $\mathcal{AMS}$ Negated Binary Relations and Arrows.

≮	\nless	≯	\ngtr	⫋	\varsubsetneqq
≨	\lneq	≩	\gneq	⫌	\varsupsetneqq
≰	\nleq	≱	\ngeq	⫅̸	\nsubseteqq
⩽̸	\nleqslant	⩾̸	\ngeqslant	⫆̸	\nsupseteqq
≨	\lneqq	≩	\gneqq	∤	\nmid
≨	\lvertneqq	≩	\gvertneqq	∦	\nparallel
≰	\nleqq	≱	\ngeqq	∤	\nshortmid
⋦	\lnsim	⋧	\gnsim	∦	\nshortparallel
⪉	\lnapprox	⪊	\gnapprox	≁	\nsim
⊀	\nprec	⊁	\nsucc	≇	\ncong
⪯̸	\npreceq	⪰̸	\nsucceq	⊬	\nvdash
⪵	\precneqq	⪶	\succneqq	⊭	\nvDash
⋨	\precnsim	⋩	\succnsim	⊮	\nVdash
⪹	\precnapprox	⪺	\succnapprox	⊯	\nVDash
⊄	\subsetneq	⊅	\supsetneq	⋪	\ntriangleleft
⫋	\varsubsetneq	⫌	\varsupsetneq	⋫	\ntriangleright
⫅̸	\nsubseteq	⫆̸	\nsupseteq	⋬	\ntrianglelefteq
⊈	\subsetneqq	⊉	\supsetneqq	⋭	\ntrianglerighteq
↚	\nleftarrow	↛	\nrightarrow	↮	\nleftrightarrow
⇍	\nLeftarrow	⇏	\nRightarrow	⇎	\nLeftrightarrow

Table 3.19: $\mathcal{AMS}$ Miscellaneous.

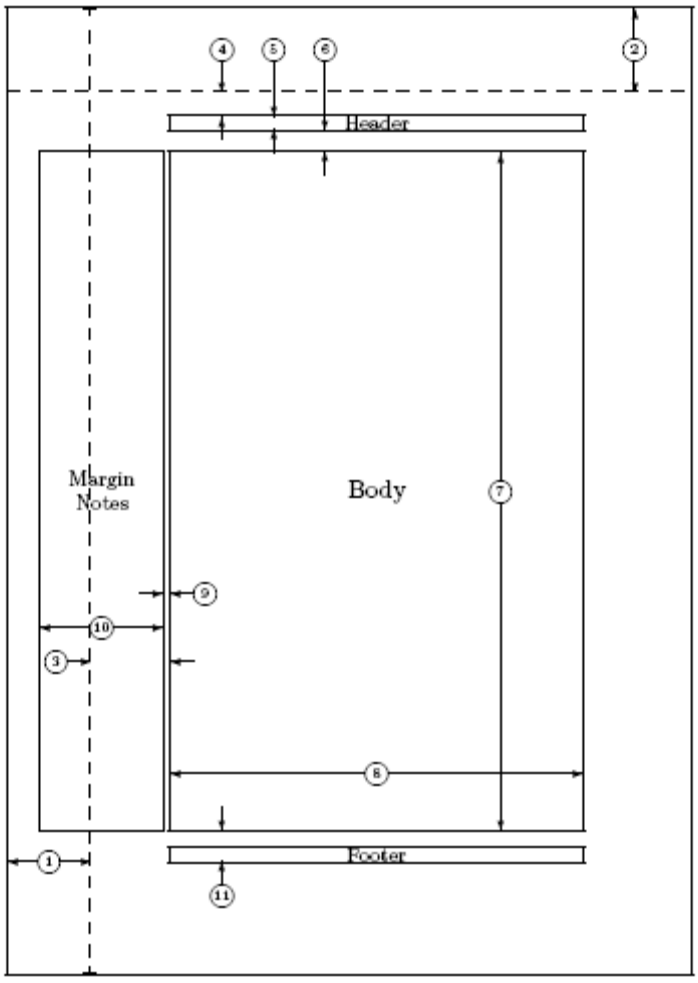
ℏ	\hbar	ℏ	\hslash	𝕜	\Bbbk
□	\square	■	\blacksquare	Ⓢ	\circledS
△	\vartriangle	▲	\blacktriangle	∁	\complement
▽	\triangledown	▼	\blacktriangledown	⅁	\Game
◊	\lozenge	⧫	\blacklozenge	★	\bigstar
∠	\angle	∡	\measuredangle		
⟋	\diagup	⟍	\diagdown	‵	\backprime
∄	\nexists	ⅎ	\Finv	∅	\varnothing
ð	\eth	⦟	\sphericalangle	℧	\mho

Table 6.1: Fonts.

`\textrm{...}`	roman	`\textsf{...}`	sans serif
`\texttt{...}`	typewriter		
`\textmd{...}`	medium	`\textbf{...}`	**bold face**
`\textup{...}`	upright	`\textit{...}`	*italic*
`\textsl{...}`	*slanted*	`\textsc{...}`	SMALL CAPS
`\emph{...}`	*emphasized*	`\textnormal{...}`	document font

Table 6.2: Font Sizes.

`\tiny`	tiny font	`\Large`	larger font
`\scriptsize`	very small font	`\LARGE`	very large font
`\footnotesize`	quite small font	`\huge`	huge
`\small`	small font	`\Huge`	largest
`\normalsize`	normal font		
`\large`	large font		



1	one inch + \hoffset	2	one inch + \voffset
3	\oddsidemargin = 22pt	4	\topmargin = 22pt
	or \evensidemargin		
5	\headheight = 12pt	6	\headsep = 19pt
7	\textheight = 595pt	8	\textwidth = 360pt
9	\marginparsep = 7pt	10	\marginparwidth = 106pt
11	\footskip = 27pt		\marginparpush = 5pt (not shown)
	\hoffset = 0pt		\voffset = 0pt
	\paperwidth = 597pt		\paperheight = 845pt

Figure 6.2: Page Layout Parameters.

Table 6.3: Absolute Point Sizes in Standard Classes.

size	10pt (default)	11pt option	12pt option
`\tiny`	5pt	6pt	6pt
`\scriptsize`	7pt	8pt	8pt
`\footnotesize`	8pt	9pt	10pt
`\small`	9pt	10pt	11pt
`\normalsize`	10pt	11pt	12pt
`\large`	12pt	12pt	14pt
`\Large`	14pt	14pt	17pt
`\LARGE`	17pt	17pt	20pt
`\huge`	20pt	20pt	25pt
`\Huge`	25pt	25pt	25pt

Table 6.4: Math Fonts.

`\mathrm{...}`	Roman Font
`\mathbf{...}`	**Boldface Font**
`\mathsf{...}`	Sans Serif Font
`\mathtt{...}`	`Typewriter Font`
`\mathit{...}`	*Italic Font*
`\mathcal{...}`	$\mathcal{CALLIGRAPHIC\ FONT}$
`\mathnormal{...}`	*Normal Font*