

# MathWrite

A brief excursion

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# Inspirational

- ▶ Writing mathematical texts is fun.
- ▶ A well-written text is a pleasure to read.
- ▶ Proper writing will focus the mind.
- ▶ Good writing and good teaching go hand in hand.
- ▶ Writing skills improve reading skills.
- ▶ Use every opportunity to practise writing skills.

# Topics

- ▶ Planning the text.
  - The catchy things.
  - Sections.
  - References.
- ▶ Recursion.
- ▶ Style.
  - Theorems, lemmas, etcetera.
  - $\LaTeX$ .
  - Language.
- ▶ Reading.

## Planning the text

- ▶ What is the theme of this text?

“Take away that pudding — it has no theme.”  
— Winston Churchill

If there is no theme, there should not be a text.

- ▶ Who is it intended for?

- The world of learning and scholarship.
- People in a specific field.
- A funding agency.
- Those in charge of my promotion.
- My supervisor.

- ▶ If it is a paper, which journal?

- What are the journal's requirements?
- Does the journal provide a  $\text{\LaTeX}$  Class (cls) file?

## The flow and rhythm of text

- ▶ The title should invite the reader to explore the theme.
- ▶ The abstract should offer a further enticement.
- ▶ The introductory section should review the basis of the work and describe the work as un-technical as possible.
- ▶ The order in which text is presented is towards the punchline.
- ▶ Coherence of order is important.

# Title

- ▶ Should show some imagination.
- ▶ Must never contain mathematical symbols.

## Example

Nonlinear acoustics: Life near the constraint.

## Another example

Behaviour of the solutions of the symmetric hyperbolic system of equations of nonlinear acoustics when  $\lim_{x \rightarrow \infty} [1 + p_0(x)] = 0$ .

## Abstract

- ▶ The abstract must, shortly and sweetly, zoom into the theme.
- ▶ It should hint at what is new, a new method or approach.
- ▶ It must never contain mathematical symbols or references.

### Example

We study in more detail than before, the situation when a gas is initially at rest and the initial pressure challenges the constraint far off. The approach is to replace the method of characteristics by the notion that the point of emanation of a characteristic is sufficient. It is shown that the initial pressure is contained and decays while the velocity becomes vigorous and spreads in a physically expected way.

**Keywords** are often part of the abstract. They are important for abstracting journals and the reader.

## Introductory section

- ▶ This section serves the purpose of an overview by providing
  - a proper, even historical, background for the work presented,
  - a human-readable, though technical, synopsis of the flow and the main results.
- ▶ An introduction should not be overbearingly long.
- ▶ The commonly used title “Introduction” is not mandatory.

### 1. What this is all about

It was in 1857 when Earnshaw [3, 4] argued that the notion of sound speed was improper. His ideas were followed up by Riemann [11], Rayleigh [7] and others . . .

In this work we follow the recently introduced approach of using material coordinates to study the problem. Section 2 presents the underlying ideas. In Section 3 we . . .



## Sections

- ▶ Sections are like tributaries of a river. They flow towards the theme.
- ▶ Every section should represent a coherent unit with a definite purpose.
- ▶ Sections should follow each other in a logical way.
- ▶ Sections should transparently merge into major results.
- ▶ The flow of sections should be well-described in Section 1.
- ▶ Irrelevant material and comments should ruthlessly be avoided.

## References

- ▶ **Ethical principle:** Only refer to a publication you have seen and read.
- ▶ References should be painfully accurate and relevant. You owe it to your readers.
- ▶ Consistently follow an accepted mode of referencing.
- ▶ The word “Dereferences is preferred to “Bibliography’s.

### Example (article reference):

[4] A. Human, The parallel postulate is independent. *J. Euclid. Geom.*, **107**(2013), 171–188.

### Example (book reference):

[5] A. Primatus, *A treatise on analytic geometry*, Second Edition. The Ancient Publishing Company, Alexandria, 1789.

## References, continued

- ▶ Note the style of referencing: Author; Title; Journal title (in italics); Volume number, year, pages.
- ▶ Journal titles have standard abbreviations (obtain from MAS).
- ▶ Books are cited differently. The publication name is always in italics. A book title would be in italics. The edition you cite, should be the one you consulted.
- ▶ Referencing styles should be consistent.
- ▶ References are usually listed alphabetically by the surname of the author.
- ▶ The Exhibit package, used with  $\text{\LaTeX}$ , provides an easy way of getting it right.

# The recursion

When the text is completed it is time to go back to the beginning and ask some questions:

- ▶ Is the title still appropriate?
- ▶ Can the abstract be improved?
- ▶ Should I revise the introduction? You probably would.
- ▶ Can I express some of the ideas better and more elegantly?
- ▶ Are references honest and correct?

This will most certainly lead to some revisions.

Fortunately, the recursion is never infinite!

# The major thing — Style

“All styles are good except the boring kind.” — Voltaire

## The things we number (or like to number)

Numbers are used as labels for cross-referencing.

### ▶ Theorems

- Theorems are the major statements of your work.
- Theorem statements should be extremely clear and precise.
- Theorem statements never include definitions or corollaries.
- Theorem statements are printed in italics. Latex does this automatically.

### ▶ Corollaries, Lemmas and Propositions

- Lemmas are results in aid of major statements. They may have a wider impact than the statement intended.
- Propositions have the same role as lemmas, but with a narrower focus.
- Corollaries usually are direct consequences of theorems with almost no proof needed.
- These are also printed in italics.

## more on numbering

### ▶ Figures and Tables

- Should be done with taste. Figures can be quite tasteless.
- Should be properly annotated.
- Should have appropriate captions.
- Should be labelled and referred to.

### ▶ Displayed mathematical expressions

- An almost general rule: Only displayed expressions are numbered.
- An exception: Expressions too complex to use online, can be displayed, but should not have numbers.
- Numbered expressions must be referred to.

## even more on numbering

### ▶ Sections

- Sections should be numbered. It makes cross-referencing much easier.  $\text{\LaTeX}$  will do that for you (in some way).
- Try to avoid subsections. It could easily become an example of boring pedantry. In the humanities this different.



## Some relevant L<sup>A</sup>T<sub>E</sub>X

### Theorems, Lemmas, etc.

```
\begin{theorem}\label{divergence}
If the boundary is smooth, then
\end{theorem}
```

### Displayed mathematical expressions, numbered

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

### Displayed mathematical expressions, not numbered

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

## Some more L<sup>A</sup>T<sub>E</sub>X

### Graphics (figures)

```
\begin{figure}[h!]  
  \centering  
  \includegraphics[width=0.6\textwidth]{Portrait_full_x.pdf}  
  \caption{Phase portrait with envelopes}  
  \label{Portrait_plus}  
\end{figure}
```

This will produce

(with loss of label number)

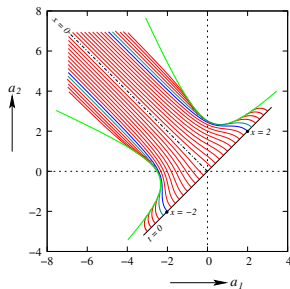


Figure : Phase portrait with envelopes

## Even more L<sup>A</sup>T<sub>E</sub>X (tables)

```
\begin{table}[h!]  
  \begin{center}  
    \begin{tabular}{|l r |}  
      \hline  
      $n$ & $11^n$ \\ \hline  
      1 & 11 \\ \hline  
      2 & 121 \\ \hline  
      3 & 12321 \\ \hline  
      4 & 1234321 \\ \hline  
    \end{tabular}  
  \end{center}  
  \caption{Pascal's triangle (on Eleven)}  
  \label{pascal_11}  
\end{table}
```

## The result

Annotation in column headings

$n$	$11^n$
0	1
1	11
2	121
3	12321
4	1234321

Table : Pascal's triangle (on Eleven)

## L<sup>A</sup>T<sub>E</sub>X: on the examples

Please take note that:

- ▶ In the examples “label’s is the reference tag.
- ▶ In Figures and Tables the label is placed right at the end.
- ▶ Captions are provided in Figures and Tables. We owe it to the reader.
- ▶ Labels are invoked in the following ways (for example)

```
\eqref{pythagoras} %%for equations
```

```
\thmref{divergence} %%or
```

```
Theorem \ref{divergence}
```

```
Figure \ref{Portrait_plus}
```

```
Table \ref{pascal_11}
```

## More on L<sup>A</sup>T<sub>E</sub>X examples

For citations note that:

- ▶ Citations contain a mandatory key (label) and an optional directive. They are invoked in the following ways:

```
\cite{Human_postulate} %% A single reference
\cite{Human_postulate, Human axioms}
                               %% Multiple reference
\cite[pp. 23--42]{Primatus_geometry} %% Book pages
\cite[Chap. 4]{Primatus_geometry} %% Book chapter
```

- ▶ The item in braces is the citation key in the Exhibit list.
- ▶ The item in brackets is for directives in books. Be considerate and include directives. Books normally have many pages and chapters.

## Mathematics and language

It is often claimed that mathematics is a language. Let us see what it looks like:

The function  $f$  is *continuous* at  $x$  if

$$(\forall \varepsilon) : \varepsilon > 0. \Rightarrow : (\exists \delta) : \delta > 0 : (\forall y) : |y-x| < \delta. \Rightarrow .|f(y)-f(x)| < \varepsilon.$$

Doesn't that make you sick?

Let us add more natural language to it:

The function  $f$  is *continuous* at  $x$  if for each positive  $\varepsilon$  there is a positive  $\delta$  such that whenever  $|y - x| < \delta$  we have  $|f(y) - f(x)| < \varepsilon$ .

**Examples both taken from** Rosser, J.B. *Logic for Mathematicians*, McGraw-Hill Book Company, Inc., New York-Toronto-London, 1953.



## The elementary principles of style

“I agree that no style is good that is not fit to be spoken or read aloud with effect.” — William Hazlitt.

- ▶ Express your thoughts in simple, direct language.
- ▶ A sentence containing mathematical symbols should be amenable to the spoken word. Usually mathematical expressions have the elements of a sentence and should be viewed so.
- ▶ Mathematical symbols should be well-chosen with the reader in mind. The freedom of choice could be dangerous and disastrous.
- ▶ Be consistent in the use of symbols.

## more elementary principles

- ▶ Do not overload your sentences with mathematical notation.
- ▶ Do not bore your reader (and yourself) by using the same phrase over and over.
- ▶ Be kind to the reader by using more than a mere equation number in the text when appropriate. For example: ... **from the inequality (6.4) we see that ...**
- ▶ Do not over-punctuate — the Americans will do it for you.
- ▶ If a mathematical expression occurs at the end of a sentence, everyone is looking for a period (full stop).
- ▶ Use of American English is acceptable, but do it consistently.

## even more

- ▶ Begin new sections in a lively manner. This clearly will link what is already recorded with what is to come.
- ▶ Use of “we” (first person plural) is preferred in mathematical texts. It suggests a dialogue between the author/s and the reader.
- ▶ When you have difficulties with words, phrases, spelling or grammar, ask a friend you can trust.
- ▶ Do not attempt to impress. The word “pompous” is known to many people.
- ▶ Keep the mystical out of acknowledgements. The gods may not like your work.

## Some phrases and possible alternatives

- ▶ Implies — *follows from; consequence of; so that; then; ...*
- ▶ Get — *obtain, arrive at.*
- ▶ Prove — *show, demonstrate.*
- ▶ In order to — use *To* instead.
- ▶ Exists — *there is, can be found.*
- ▶ Iff — write *If and only if* instead.

### Avoid

- ▶ Can (easily) be shown that — can do it yourself?
- ▶ Trivial — It may transfer a complex to the reader.
- ▶ Elementary — try not to use.
- ▶ Multiplying, substituting — likely to be misunderstood.
- ▶ In other words — you did not say it properly in the first place.

## About reading

To write, you must read extensively, both inside and outside your chosen genre and to the point of “overflow”. — Terry Pratchett

- ▶ Take note of an author’s style and ways of expressing things differently.
- ▶ Do not read mathematical texts only. Most of them will do little to sharpen the edge.
- ▶ When you consult a dictionary, look for other uses of the word and the etymology of the word. Browse a little; there may be some interesting words around. The internet is not likely to do this for you. The friend you can trust is the dictionary.

## Books to have by your side

- ▶ *The Concise Oxford Dictionary*, Oxford University Press, Latest Edition.
- ▶ *Roget's Thesaurus of English Words and Phrases*. Can be downloaded via the internet.
- ▶ N. J. Higham. *Handbook of Writing for the Mathematical Sciences*, Second Edition, SIAM, 1998.
- ▶ F. Vivaldi. *Mathematical Writing*, Springer Verlag, London, 2014.
- ▶ G-C. Rota. *Indiscrete Thoughts*, Birkhäuser, Boston, 1997.
- ▶ *The LaTeX manual*,  
<http://en.wikibooks.org/wiki/LaTeX>.  
Can be downloaded as a PDF.

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