

**THIS IS A VERY VERY VERY VERY VERY VERY VERY VERY
VERY VERY VERY VERY VERY VERY VERY LONG TITLE OF
THE THESIS**

by

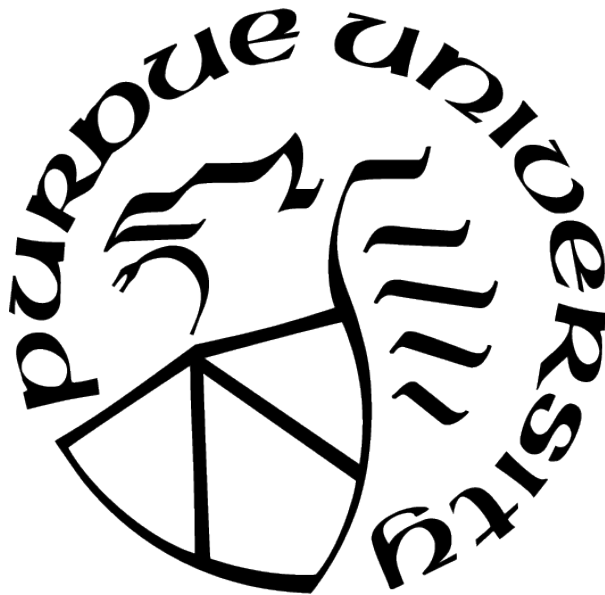
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PREFACE

This is the preface.

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LIST OF SYMBOLS

m mass

v velocity

ABBREVIATIONS

abbr	abbreviation
bcf	billion cubic feet
BMOC	big man on campus

NOMENCLATURE

Alanine 2-Aminopropanoic acid

Valine 2-Amino-3-methylbutanoic acid

GLOSSARY

- philtrum the groove between the nose and upper lip on most primates
septem the cartilage in the nose that separates the nostrils

ABSTRACT

PurdueThesis is a L^AT_EX document class used for master's bypass reports, master's theses, PhD dissertations, and PhD preliminary reports. This template demonstrates how to use PurdueThesis.

1. INTRODUCTION

Draizelle Sexon [1] recommends using these chapter names:

Problem and Its Background

Review of Related Literature and Studies

Methodology of the Study

Presentation, Analysis and Interpretation of Data

Summary, Conclusions, and Recommendations

Mantian Xue's [2] thesis contained these chapters:

Introduction

Device Technology

Graphene-based Biosensors

Graphene-based Ion Sensing

MoS₂-based Sensors

Conclusion and Future Work

I suggest thinking carefully about the structure of your thesis and using appropriate chapter names.

1.1 English-related information

1.1.1 Typographic Conventions

The following typographic conventions are used in this document. These conventions were influenced by [3]–[5].

Emphasis, First Use, and Title

Emphasis: You *must* do this.

First Use: The first use of an unusual term is *emphasized*. It is defined soon after it is emphasized. The sensor was installed in an *ekayak*. An *ekayak* is an electric kayak, we used a Duke Energy model 10-7 for this research.

Title: He read *The Grapes of Wrath* and watched *Citizen Kane*.

Keyboard Keys

`Control` + `A` means press the Control key and A key at the same time. `A` `B`
means press key A and then press key B.

Literal Elements

Literal elements include checkboxes, code, environment variables, file names, function names, \LaTeX input, output, variable names, and verbatim input (except for commands typed on the command line).

`Menu` `Items`

To make sure smooth scrolling is on go to `Open menu` `Preferences` and make sure the `Use smooth scrolling` checkbox is checked.

Placeholders

Placeholders need to be replaced with real input.

shell commands

Commands typed on the command line by the user.

1.1.2 Logical punctuation

I use logical punctuation [6]:

The sign said “Buses Only”.

instead of

The sign said “Buses Only.”

so quoted material, and only quoted material, is inside quotes. This is new and not many people use it. Your major professor may not like this style. Check with them before you decide to use this.

1.1.3 Serial comma

I use the serial comma:

apple, berry, and cherry

instead of

apple, berry and cherry

because I find it easier to see the list items when they are separated by commas.

I like to start all chapter names with `ch-`. Chapter names are everything from the beginning of the thesis through the last chapter. Chapters include all front matter in addition to all chapters.

Appendices start with `ap-` and are everything after the last chapter including any bibliography, colophon, indices, and vita.

Graphics files start with `gr-`.

\LaTeX package files start with `pa-`.

1.2 \LaTeX -related information

1.2.1 Input reading rules

\LaTeX uses the following rules when reading input:

- the end of a line is equivalent to a space
- spaces at the beginning of a line are ignored

The `itemize` environment takes lots of space—sometimes I like to compress the layout as shown below.

1.2.2 Input preparation conventions

I've used \LaTeX over 30 years and use these personal conventions to prepare input. Using these conventions leads to many short lines, but I find those easier to read and edit. Do whatever works best for you.

start input lines with

the first word of a sentence

(

and

but

or

to

end input lines with

sentence-ending periods

phrase-ending commas

phrase-ending colons

phrase-ending semicolons

)

`\[dimension]`

`\`

put these on a line of their own

`\begin{environment name}`

`\end{environment name}`

short parenthetical remark

2. SUMMARY

This is the summary chapter.

2.1 First Section

This is the first section of the summary chapter.

```
1 \chapter{SUMMARY}
2
3 This is the summary chapter.
4
5
6 \section{First Section}
7
8 This is the first section of the summary chapter.
```

3. RECOMMENDATIONS

Buy low. Sell high.

4. TEST CHAPTER—THIS IS A VERY, VERY, VERY, VERY, VERY, VERY, VERY, VERY, VERY, VERY, VERY, VERY, VERY LONG CHAPTER NAME

This is a footnote¹

Cite a reference with a very, very, very, ...long title [7].

¹↑This is a footnote.

REFERENCES

- [1] D. Sexon. (Sep. 18, 2012). The thesis, [Online]. Available: https://www.slideshare.net/draizelle_sexon/the-thesis-and-its-parts.
- [2] M. Xue, “Chemical and biomedical sensors using two dimensional materials,” Masters of Science in Electrical Engineering and Computer Science, Sep. 2019. [Online]. Available: <https://dspace.mit.edu/handle/1721.1/124282>.
- [3] R. Sharpe, E. Warnicke, and U. Lamping, *Wireshark users’s guide*, version 3.3.0. [Online]. Available: https://www.wireshark.org/docs/wsug_html_chunked/PrefaceTypographicContent.html.
- [4] L. E. van Dijk and C. L. Spiel. (Jun. 4, 2000). Scilab bag of tricks: The scilab-2.5 iaq (infrequently asked questions), [Online]. Available: <http://kiwi.emse.fr/SCILAB/sci-bot/sci-bot.pdf>.
- [5] T. Weh. (Aug. 8, 2016). Menukeys. version 1.5, [Online]. Available: <http://www.ctan.org/pkg/menukeys>.
- [6] B. Yagoda, “The rise of “logical punctuation”.”, *Slate*, May 12, 2011. [Online]. Available: <https://slate.com/human-interest/2011/05/logical-punctuation-should-we-start-placing-commas-outside-quotation-marks.html>.

- [14] J. D. Hobby and The MetaPost development team, *METAPOST - A User's Manual*, version 2.00, Jun. 1, 2019. [Online]. Available: <https://tug.org/docs/metapost/mpman.pdf>.
- [15] Y. Kim, *Please help me do diagram*. Oct. 16, 2009.
- [16] A. Hirzel, *Example: Glider, a hacker emblem*, Jul. 28, 2012. [Online]. Available: <http://www.texample.net/tikz/examples/glider>.
- [17] Wikipedia, *Bushel*, 2020. [Online]. Available: <https://en.wikipedia.org/wiki/Bushel>.
- [18] IEEE, "IEEE editorial style manual for authors," [Online]. Available: <https://journals.ieeeauthorcenter.ieee.org/your-role-in-article-production/ieee-editorial-style-manual/>.
- [19] IEEE, "IEEE editorial style manual for authors," Aug. 19, 2020. [Online]. Available: http://journals.ieeeauthorcenter.ieee.org/wp-content/uploads/sites/7/IEEE-Editorial-Style-Manual_081920.pdf.
- [20] IEEE, "Editing mathematics," Nov. 12, 2018. [Online]. Available: <http://journals.ieeeauthorcenter.ieee.org/wp-content/uploads/sites/7/Editing-Mathematics.pdf>.
- [21] IEEE, "IEEE reference guide," Aug. 19, 2020. [Online]. Available: http://journals.ieeeauthorcenter.ieee.org/wp-content/uploads/sites/7/IEEE-Reference-Guide_081920.pdf.
- [22] Meriam-Webster, *Irregardless*. [Online]. Available: <https://www.merriam-webster.com/dictionary/irregardless>.
- [23] Meriam-Webster, *out of date / out-of-date*. [Online]. Available: <https://www.merriam-webster.com/dictionary/out-of-date>.
- [24] TheWriter, *To hyphenate or not to hyphenate?* [Online]. Available: <http://www.thewriter.com/what-we-think/style-guide/to-hyphenate-or-not-to-hyphenate>.
- [25] Oxford English Dictionary, *out of date*. [Online]. Available: <https://www.oed.com/view/Entry/133785?redirectedFrom=out+of+date>.
- [26] Meriam-Webster, *Deprecate*. [Online]. Available: <https://www.merriam-webster.com/dictionary/deprecated>.
- [27] W. contributors, *Startup company*, version 986754217, Nov. 2, 2020. [Online]. Available: https://en.wikipedia.org/w/index.php?title=Startup_company.

- [28] Online Slang Dictionary, *peace out*. [Online]. Available: <http://onlineslangdictionary.com/search/?q=peace+out&sa=Search>.
- [29] E. A. Feffin, *The chemplants package*, version 0.9.8, Nov. 19, 2019. [Online]. Available: <https://ctan.math.illinois.edu/graphics/pgf/contrib/chemplants/chemplants-doc.pdf>.
- [30] M. Hensel, *The mhchem bundle*, Jun. 22, 2018. [Online]. Available: <https://ctan.org/pkg/mhchem?lang=en>.
- [31] R. Meerman, *The mathematics of weight loss*. [Online]. Available: <https://www.youtube.com/watch?v=vullsN32WaE>.
- [32] C. Tellechea, *Chemfig: A T_EX package for drawing molecules*, version 1.56, Jul. 13, 2020. [Online]. Available: <https://ctan.org/pkg/chemfig?lang=en>.
- [33] Wikibooks, *L^AT_EX/linguistics*. [Online]. Available: <https://en.wikibooks.org/wiki/LaTeX/Linguistics>.
- [34] N. V. Tambe, *Doulossil — a font for typesetting the international phonetic alphabet (ipa)*, version 0.1, Sep. 21, 2020. [Online]. Available: <https://www.ctan.org/pkg/doulossil>.
- [35] American Mathematical Society, L^AT_EX3 Project, *User's guide for the amsmath package*, version 2.1, Oct. 14, 2019. [Online]. Available: <http://mirrors.ctan.org/info/amslatex/english/amslatex/amslatex.pdf>.
- [36] G. Grätzer, *More Math Into L^AT_EX*, 5th ed. Springer International Publishing, ISBN: 978-3-319-23796-1. DOI: [10.1007/978-3-319-23796-1](https://doi.org/10.1007/978-3-319-23796-1).
- [37] American Mathematical Society, L^AT_EX3 Project, *User's guide for the amsmath package*, version 2.1, Oct. 14, 2019. [Online]. Available: <https://ctan.org/tex-archive/info/amslatex/english?lang=en>.
- [38] ISO/TC 12 Committee, *ISO 80000-2:2019 Quantities and units — part 2: Mathematics*, Aug. 2019. [Online]. Available: <https://www.iso.org/standard/64973.html>.
- [39] M. Reid, *Jerk, jounce, snap, crackle and pop*, Dec. 11, 2013. [Online]. Available: <http://wordpress.mrreid.org/2013/12/11/jerk-jounce-snap-crackle-and-pop/>.
- [40] K. Academy, *Quadratic formula proof review*. [Online]. Available: <https://www.khanacademy.org/math/algebra/quadratics/solving-quadratics-using-the-quadratic-formula/a/quadratic-formula-proof-review>.

- [41] Wikipedia, *Feynman diagram*, 2020. [Online]. Available: https://simple.wikipedia.org/wiki/Feynman_diagram.
- [42] J. Ellis, *Tikz-feynman: Feynman diagrams with TikZ*, version 1.1.0, Feb. 5, 2016. [Online]. Available: <https://mirrors.concertpass.com/tex-archive/graphics/pgf/contrib/tikz-feynman/tikz-feynman.pdf>.
- [43] H. Menke, *Tikz graphdrawing differences between luatex versions*. [Online]. Available: <https://tex.stackexchange.com/questions/468466>.
- [44] J. Ellis, *Half of the diagram is mirror image*. [Online]. Available: <https://github.com/JP-Ellis/tikz-feynman/issues/47>.
- [45] Thesis and Dissertation Office, The Graduate School, Purdue University, *Template-One.docx Microsoft Word thesis template*. [Online]. Available: <https://purdue.edu/gradschool/documents/thesis/Template-One.docx>.
- [46] Thesis and Dissertation Office, The Graduate School, Purdue University, *Template-Two.docx Microsoft Word thesis template*. [Online]. Available: <https://purdue.edu/gradschool/documents/thesis/Template-Two.docx>.
- [47] Thesis and Dissertation Office, The Graduate School, Purdue University, *Template-Three.docx Microsoft Word thesis template*. [Online]. Available: <https://purdue.edu/gradschool/documents/thesis/Template-Three.docx>.

A. ABOUT THE APPENDICES

These appendices are single-spaced to save space. Your thesis should use the default 1.5 line spacing.

There are two groups of appendices. The first group are general appendices; the second group are domain-specific appendices.

These appendices are a series of examples. They are a work in progress.

Each example consists of some \LaTeX output followed by the corresponding input lines. Some \LaTeX input lines only define things and don't produce any output. Each chunk in the input file begins with `\begin{VerbatimOut}{z.out}` then has the \LaTeX input for the example, and ends with `\end{VerbatimOut}`, followed by a blank line, followed by a line that begins with `\My`.

```
1 \chapter{ABOUT THE APPENDICES}
2
3 % Use single spacing in the appendices from now on to save space.
4 \ZZbaselinestretch{1}
5
6 \textcolor{red}{%
7   \textbf{%
8     These appendices are single-spaced to save space.
9     Your thesis should use the default-1.5 line spacing.%
10  }}%
11 }
12
13 There are two groups of appendices.
14 The first group are general appendices;
15 the second group are domain-specific appendices.
16
17 These appendices are a series of examples.
18 They are a work in progress.
19
20 Each example consists of some  $\LaTeX$  output
21 followed by the corresponding input lines.
22 Some  $\LaTeX$  input lines only define things
23 and don't produce any output.
24 Each chunk in the input file begins with
25 \verb+\begin{VerbatimOut}{z.out}+
26 then has the  $\LaTeX$  input for the example,
27 % Don't literally end VerbatimOut on next line.
28 and ends with {\tt \char'134 end\char'173 VerbatimOut\char'175},
29 followed by a blank line,
30 followed by a line that begins with
31 \verb+\My+.
32
```

A.1 Paragraphs

This is the first paragraph. Paragraphs are separated by blank lines.
This is the second paragraph.

A.2 Section Heading

This is a sentence. This is a sentence. This is a sentence. This is a sentence. This is a sentence.

A.2.1 Subsection heading

This is a sentence. This is a sentence. This is a sentence. This is a sentence. This is a sentence.

Subsubsection heading

This is a sentence. This is a sentence. This is a sentence. This is a sentence. This is a sentence.

```
1
2
3 \section{Paragraphs}
4
5 This is the first paragraph.
6 Paragraphs are separated by blank lines.
7
8 This is the second paragraph.
9
10
11 \section{Section Heading}
12
13 This is a sentence.
14 This is a sentence.
15 This is a sentence.
16 This is a sentence.
17 This is a sentence.
18
19
20 \subsection{Subsection heading}
21
22 This is a sentence.
23 This is a sentence.
24 This is a sentence.
25 This is a sentence.
26 This is a sentence.
27
28
29 \subsubsection{Subsubsection heading}
30
31 This is a sentence.
32 This is a sentence.
33 This is a sentence.
34 This is a sentence.
35 This is a sentence.
```


A.3 Text math

If items in a list are narrow like these Greek characters,

α , β , and γ

I'd input the line like this

α , β , and γ

where the “~” is a tie that ties together what's before and after it on the same line of the output. This is to avoid having a line start awkwardly with a Greek character.

This text is the correct length to show what happens with and without ties: α , β , and γ . See how the line gets split and the γ is at the beginning of the line?

This text is the correct length to show what happens with and without ties: α , β , and γ . See how the line gets compressed a little bit so the γ is not at the beginning of the line?

```
1
2
3 \section{Text math}
4
5 If items in a list are narrow like these Greek characters,\\
6 \I2 \verb+\alpha$, \beta$, and \gamma$+\\
7 I'd input the line like this\\
8 \I2 \verb+\alpha$,~\beta$, and~\gamma$+\\
9 where the ``\verb+~+' is a tie
10 that ties together what's before and after it on the same line of the output.
11 This is to avoid having a line start awkwardly with a Greek character.
12
13 This text is the correct length to show what happens with and without ties:
14 \alpha$,
15 \beta$,
16 and \gamma$.
17 See how the line gets split
18 and the~\gamma$ is at the beginning of the line?
19
20 This text is the correct length to show what happens with and without ties:
21 \alpha$,~\beta$,
22 and~\gamma$.
23 See how the line gets compressed a little bit so the~\gamma$
24 is not at the beginning of the line?
```


C. CITATIONS

```
1 \chapter{CITATIONS}
```

For L^AT_EX answers I refer to [8] and then to [9] or [10]. [10] is an update to [11] (the 1995 edition).

```
1 For \LaTeX\ answers I refer to
2 \cite{lampport1994}
3 and then to
4 \cite{goossens1994}
5 or
6 \cite{kopka1999}.
7 \cite{kopka1999}
8 is an update to \cite{kopka1995} (the 1995 edition).
```

Here is an example .bib file entry:

```
1 @misc{example2020,
2   address   = {Imaginaryville, Indiana},
3   author    = {Andrew Anteater and Bertha Bear and Charles Cheetah and Davida Deer and Ethan Eagle},
4   date      = {2020-10-27},
5   doi       = {00.0000/000-0-000-00000-0},
6   editor    = {Mark Senn},
7   edition   = {2},
8   isbn      = {{000\FigureDash 0\FigureDash 000\FigureDash 00000\FigureDash 0}},
9   publisher = {Bogus International Publishing Company},
10  title     = {An Imaginary Document Not About {Mark Senn} or {NASA}},
11  url       = {https://bogus.com/bogus.html},
12  urldate   = {2020-10-27},
13  version   = {1.0},
14 }
```

Here are some example BibLaTeX citations. Depending on the style being used these will produce different results.

Input

```
\cite{example2020}
\cite*{example2020}
\citeauthor{example2020}
\citeauthor*{example2020}
\citedate{example2020}
\citetitle{example2020}
\citetitle*{example2020}
\citeurl{example2020}
\citeyear{example2020}
\parencite{example2020}
\textcite{example2020}
```

Output

```
[12]
[12]
Anteater, Bear, Cheetah, et al.
Anteater et al.
Oct. 27, 2020
An Imaginary Document Not About Mark Senn or NASA
An Imaginary Document Not About Mark Senn or NASA
https://bogus.com/bogus.html
2020
[12]
Anteater, Bear, Cheetah, et al. [12]
```

D. COMMON MISTAKES

The following Headings, Mathematics, and Text sections describe some common mistakes.

D.1 Headings

Farkas [13, page 289] wrote

The practice of stacking headings is routinely condemned by style manuals and other authorities. Here is a typical statement, taken from Houghton Mifflin's guidelines for authors.

Avoid “stacking” heads, or placing two levels of headings together without intervening text. A heading cannot substitute for the transitional or introductory paragraphs that guide the reader through a chapter. Remember too that a chapter opening looks better in type when one or more paragraphs of text precede the first heading.

```
1 \chapter{COMMON MISTAKES}
2
3 The following Headings, Mathematics, and Text
4 sections describe some common mistakes.
5
6
7 \section{Headings}
8
9 \ifthen{\equal{\bibprocessor}{bibtex}}
10 {\textcite[page~289]{farkas2011} }
11 \ifthen{\equal{\bibprocessor}{biblatex}}
12 {\cite{farkas2011} }
13 wrote
14
15 \begin{quotation}
16   The practice of stacking headings
17   is routinely condemned by style manuals
18   and other authorities.
19   Here is a typical statement,
20   taken from Houghton Mifflin's guidelines for authors.
21   \begin{quotation}
22     Avoid ``stacking'' heads,
23     or placing two levels
24     of headings together without intervening text.
25     A heading cannot substitute
26     for the transitional
27     or introductory paragraphs
28     that guide the reader through a chapter.
29     Remember too that a chapter opening looks better in type
30     when one
31     or more paragraphs
32     of text precede the first heading.
33   \end{quotation}
34 \end{quotation}
```

D.2 Mathematics

D.2.1 Put a little extra horizontal space before dx.

```
1
2
3 \section{Mathematics}
4
5 \subsection{Put a little extra horizontal space before dx.}
```

D.3 Text

```
1
2
3 \section{Text}
```

D.3.1 e.g.

“e.g.” should always be followed by a comma.

```
1
2 \subsection{e.g.}
3 \index{.e.g.,}
4
5 ``e.g.'' should always be followed by a comma.
```

D.3.2 “et al.” is an abbreviation

The phrase “et al.” is an abbreviation and should always be followed by a period. It should be in the normal font for your document—do not italicize or underline it.

Example:

input	Thun et al.~used data from Santa Claus.
output	Thun et al. used data from Santa Claus.
comment	my recommendation
input	Thun et al. used data from Santa Claus.
output	Thun et al. used data from Santa Claus.
comment	too much space after period— LaTeX thinks period is end of sentence
input	Thun et al\@. used data from Santa Claus.
output	Thun et al. used data from Santa Claus.
comment	spacing is right but the “et al.” could occur at end of a line

```
1
2 \subsection{`et al.' is an abbreviation}
3 \index{et al.}
4
5 The phrase `et al.'
6 is an abbreviation
7 and should always be followed by a period.
8 It should be in the normal font for your document---%
9 do not italicize or underline it.
10
11 Example:\[6pt]
12 \indent\indent
13 \begin{tabular}{@{}l@{}}
14   input& \verb+Thun et al.~used data from Santa Claus.+\\
15   output& Thun et al.~used data from Santa Claus.\\
16   comment& my recommendation\][6pt]
17   input& \verb+Thun et al. used data from Santa Claus.+\\
18   output& Thun et al. used data from Santa Claus.\\
19   comment& too much space after period---\LaTeX\ thinks period is end of sentence\][6pt]
20   input& \verb+Thun et al\@. used data from Santa Claus.+\\
21   output& Thun et al\@. used data from Santa Claus.\\
22   comment& spacing is right but the `et al.' could occur at end of a line\\
23 \end{tabular}
```

D.3.3 i.e.

“i.e.” should always be followed by a comma.

```
1
2 \subsection{i.e.}
3 \index{i.e.,}
4
5 `i.e.' should always be followed by a comma.
```

E. DEFINING COMMANDS

The next paragraph demonstrates how to define and use a command.

Editors recommend that a chapter title should never be followed by a section heading without some intervening text. I suggest writing for readers

```
1 \chapter{DEFINING COMMANDS}
2
3 The next paragraph demonstrates how to define and use a command.
4
5 \renewcommand{\t}[2]
6 {%
7   Editors recommend that a #1 should never be
8   followed by a #2 without some intervening text.
9   I suggest writing for readers
10
11 }
12
13 \t{chapter title}{section heading}
```


F. CHAPTER APPENDICES

Using `\chapterappendix` or `\chapterappendices` in the first chapter will number sections, for example, 1.1, 1.2, 1.A.

Using `\chapterappendix` or `\chapterappendices` in the first appendix will number sections, for example, A.1, A.2, A.A.

Only use `\chapterappendix` or `\chapterappendices` in chapters. Using them in appendices is too confusing.

F.1 This is a section headings

This is a paragraph.

Use `\chapterappendix` or `chapterappendices` to make sections until the end of the next chapter be appendices.

F.A This is a chapter appendix

This is a paragraph.

```
1 \chapter{CHAPTER APPENDICES}
2
3 Using \verb+\chapterappendix+ or \verb+\chapterappendices+
4 in the first chapter will number sections, for example,
5 1.1, 1.2, 1.A.
6
7 Using \verb+\chapterappendix+ or \verb+\chapterappendices+
8 in the first appendix will number sections, for example,
9 A.1, A.2, A.A.
10
11 Only use \verb+\chapterappendix+ or \verb+\chapterappendices+
12 in chapters.
13 Using them in appendices is too confusing.
14
15 \section{This is a section headings}
16
17 This is a paragraph.
18
19 Use \verb+\chapterappendix+ or \verb+chapterappendices+
20 to make sections until the end of the next chapter
21 be appendices.
22
23 \chapterappendix
24
25 \section{This is a chapter appendix}
26
27 This is a paragraph.
```

G. FIGURES

```
1 \chapter{FIGURES}
2
```

The `h` specifier used in all the examples below tells `LATEX` to put the figure “here” instead of trying to find a good spot at the top or bottom of a page. Specifiers can be combined, for example, “`\begin{figure}[htbp!]`”.

```
1
2 The
3 \verb+h+
4 specifier used in all the examples below
5 tells \LaTeX\ to put the figure
6 ``here''
7 instead of trying
8 to find a good spot
9 at the top or bottom of a page.
10 Specifiers can be combined,
11 for example,
12 ``\verb+\begin{figure}[htbp!]+''.
```

The complete list of specifiers:

Specifier	Description
<code>b</code>	bottom of page
<code>h</code>	here on page
<code>p</code>	on separate page of figures
<code>t</code>	top of page
<code>!</code>	try hard to put figure as early as possible

```
1
2 The complete list of specifiers:
3 \vspace*{6pt}
4 \begin{center}
5 \begin{tabular}{@{}ll@{}}
6 \toprule
7 \bf Specifier& \bf Description\cr
8 \midrule
9 \noalign{\vspace*{2pt}}
10 \tt b& bottom of page\cr
11 \tt h& here on page\cr
12 \tt p& on separate page of figures\cr
13 \tt t& top of page\cr
14 \tt !& try hard to put figure as early as possible\cr
15 \bottomrule
16 \end{tabular}
17 \end{center}
```

This is the first paragraph. This is the first paragraph. This is the first paragraph. This is the first paragraph. This is the first paragraph.

```

1
2 % MyRepeat is defined in MyRepeat.sty.
3 \MyRepeat{This is the first paragraph. }{5}

```

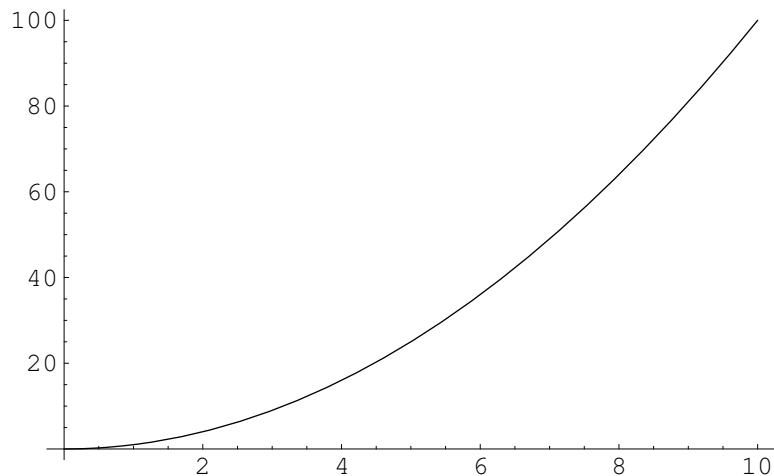


Figure G.1. By default figures are not centered. This is a long caption to demonstrate that captions are single spaced.

```

1
2 \begin{figure}[ht]
3   \includegraphics{gr-plot.pdf}
4   \caption{%
5     By default figures are not centered.
6     This is a long caption to demonstrate that captions are single spaced.%
7   }
8   \label{fi:not-centered}
9 \end{figure}

```

This is the second paragraph. This is the second paragraph. This is the second paragraph. This is the second paragraph. This is the second paragraph. This is the second paragraph. This is the second paragraph. This is the second paragraph. This is the second paragraph.

```

1
2 \MyRepeat{This is the second paragraph. }{10}

```

```

1
2 \begin{figure}[ht]
3   \centering
4   \includegraphics{gr-plot.pdf}
5   \caption{Use {\tt \char'134centering\} to center figures.}
6   \label{fi:centered}
7 \end{figure}

```

This is the third paragraph. This is the third paragraph. This is the third paragraph. This is the third paragraph. This is the third paragraph. This is the third paragraph. This is the third paragraph. This is the third paragraph.

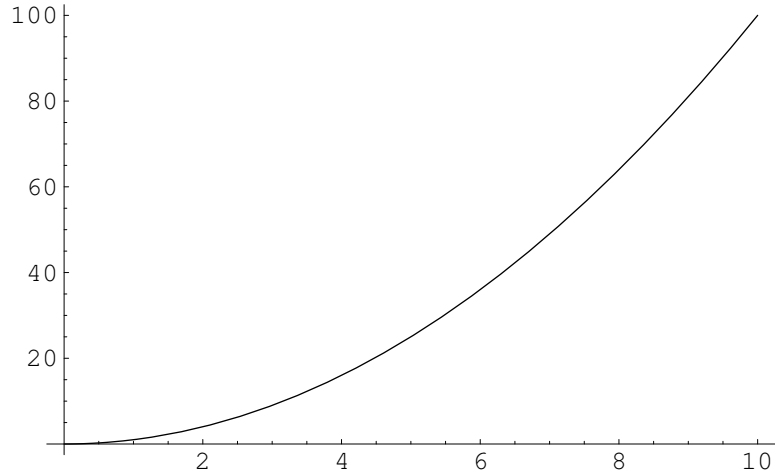


Figure G.2. Use `\centering` to center figures.

is the third paragraph. This is the third paragraph. This is the third paragraph. This is the third paragraph. This is the third paragraph. This is the third paragraph. This is the third paragraph. This is the third paragraph.

```

1
2 \MyRepeat{This is the third paragraph. }{15}

```

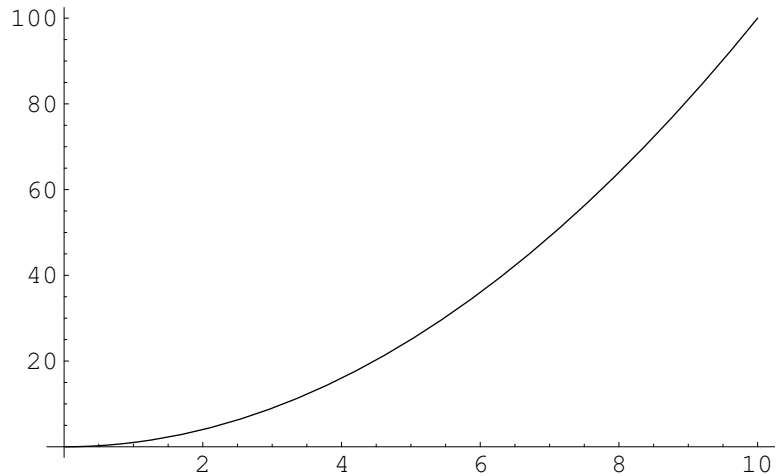


Figure G.3. This is another figure.

```

1
2 \begin{figure}[ht]
3   \centering
4   \includegraphics{gr-plot.pdf}
5   \caption{This is another figure.}
6   \label{fi:another}
7 \end{figure}

```

This is the fourth paragraph. This is the fourth paragraph. This is the fourth paragraph. This is the fourth paragraph. This is the fourth paragraph. This is the fourth paragraph. This is the fourth paragraph. This is the fourth paragraph. This is the fourth paragraph.

```

1
2 \MyRepeat{This is the fourth paragraph. }{10}

```

First subfigure.	Second subfigure.
(a) First subcaption.	(b) Second subcaption.

Figure G.4. This figure has two parts.

```

1
2 \begin{figure}[ht]
3   \centering
4   \subcaptionbox
5     {First subcaption.\label{sf:two-parts-a}}%
6     [2in]%
7     {\bfseries First subfigure.}%
8   \hskip 0.5truein
9   \subcaptionbox
10    {Second subcaption.\label{sf:two-parts-b}}%
11    [2in]%
12    {\bfseries Second subfigure.}%
13  \caption{This figure has two parts.}
14  \label{fi:two-parts}
15 \end{figure}

```

This is the fifth paragraph. This is the fifth paragraph. This is the fifth paragraph. This is the fifth paragraph. This is the fifth paragraph. This is the fifth paragraph. This is the fifth paragraph. This is the fifth paragraph. This is the fifth paragraph. This is the fifth paragraph.

```

1
2 \MyRepeat{This is the fifth paragraph. }{10}

```

First subfigure.	Second subfigure.
(a) First subcaption.	(b) Second subcaption.
Third subfigure.	Fourth subfigure.
(c) Third subcaption.	(d) Fourth subcaption.

Figure G.5. This figure has four parts.

```

1
2 \newpage
3
4 \begin{figure}[ht]
5   \centering
6   \subcaptionbox
7     {First subcaption.\label{sf:four-parts-a}}
8     [2in]%
9     {\bfseries First subfigure.}%
10  \hskip 0.5truein
11  \subcaptionbox
12    {Second subcaption.\label{sf:four-parts-b}}
13    [2in]%
14    {\bfseries Second subfigure.}%
15  \vspace*{\baselineskip}
16  \subcaptionbox
17    {Third subcaption.\label{sf:four-parts-c}}
18    [2in]%
19    {\bfseries Third subfigure.}%
20  \hskip 0.5truein
21  \subcaptionbox
22    {Fourth subcaption.\label{sf:four-parts-d}}
23    [2in]%
24    {\bfseries Fourth subfigure.}%
25  \caption{This figure has four parts.}
26  \label{fi:four-parts}
27 \end{figure}

```

This is the sixth paragraph. This is the sixth paragraph. This is the sixth paragraph. This is the sixth paragraph. This is the sixth paragraph. This is the sixth paragraph. This is the sixth paragraph. This is the sixth paragraph. This is the sixth paragraph.

```

1
2 \MyRepeat{This is the sixth paragraph. }{10}

```

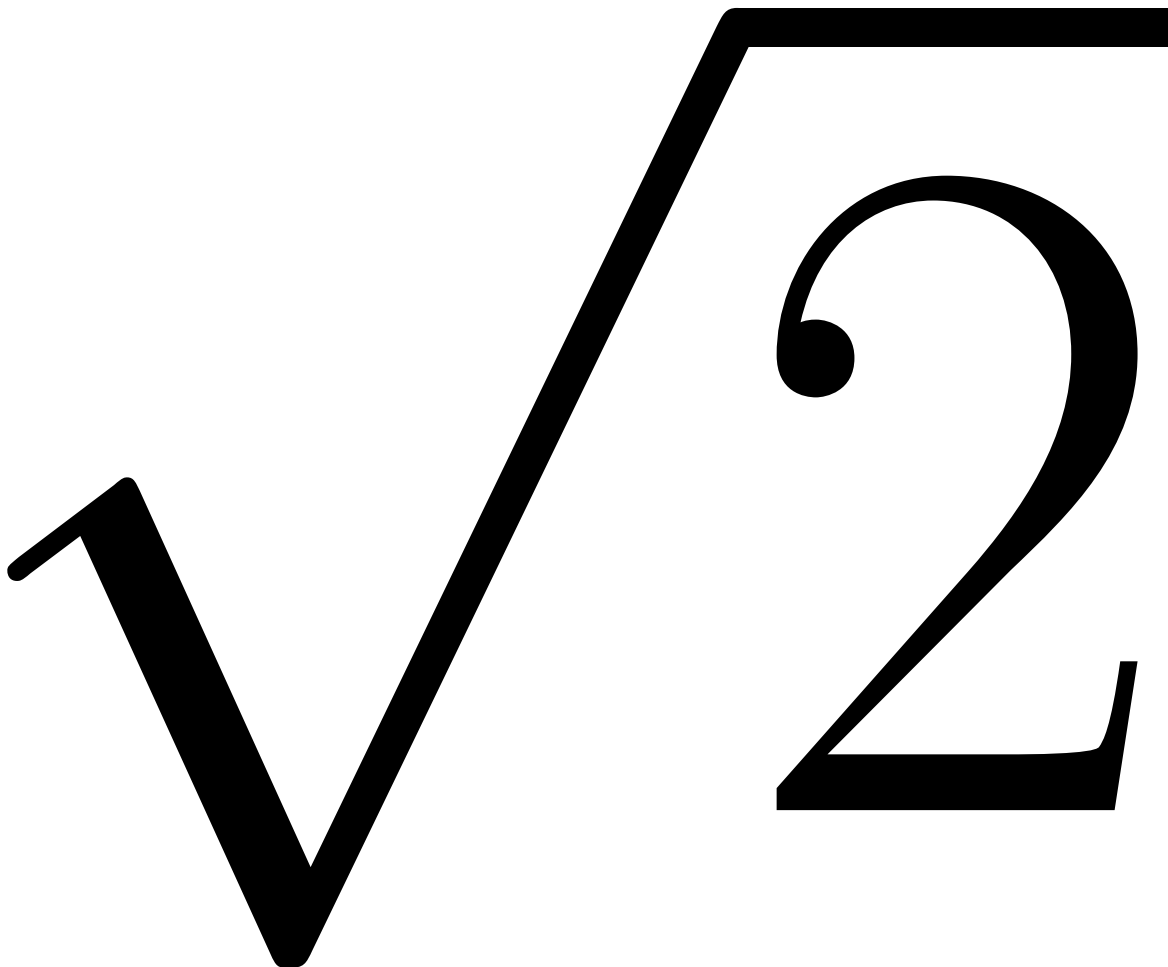


Figure G.6. \LaTeX can make output big enough for T-shirts or posters. Square roots are printed with space before them, I put some negative horizontal space before this one to center it.

```
1
2 \newpage
3
4 \begin{figure}[ht]
5   \centering
6   % Use a 5" font.
7   {\fontsize{5in}{5in}\selectfont{\hspace*{-0.07em}\sqrt 2\}}
8   \caption{%
9     \LaTeX\ can make output big enough for T-shirts or posters.
10    Square roots are printed with space before them,
11    I put some negative horizontal space before this one to center it.%
12   }
13 \end{figure}
```

The remainder of this file tests having lots of figures. There are 20 figures in this test.



Figure G.7. Use `\centering` to center figures.



Figure G.8. Use `\centering` to center figures.



Figure G.9. Use `\centering` to center figures.



Figure G.10. Use `\centering` to center figures.



Figure G.11. Use `\centering` to center figures.



Figure G.12. Use `\centering` to center figures.



Figure G.13. Use `\centering` to center figures.



Figure G.14. Use `\centering` to center figures.



Figure G.15. Use `\centering` to center figures.



Figure G.16. Use `\centering` to center figures.



Figure G.17. Use `\centering` to center figures.



Figure G.18. Use `\centering` to center figures.



Figure G.19. Use `\centering` to center figures.

```

1
2 \newpage
3
4 The remainder of this file tests having lots of figures.
5 There are 20 figures in this test.
6
7 \begin{figure}[ht]
8   \centering
9   \includegraphics[scale=0.1]{gr-plot.pdf}
10  \caption{Use {\tt \char'134centering\} to center figures.}
11  \label{fi:centered}
12 \end{figure}
13
14 \begin{figure}[ht]
15   \centering
16   \includegraphics[scale=0.1]{gr-plot.pdf}
17   \caption{Use {\tt \char'134centering\} to center figures.}
18   \label{fi:centered}
19 \end{figure}
20
21 \begin{figure}[ht]
22   \centering
23   \includegraphics[scale=0.1]{gr-plot.pdf}
24   \caption{Use {\tt \char'134centering\} to center figures.}
25   \label{fi:centered}
26 \end{figure}
27
28 \begin{figure}[ht]

```



Figure G.20. Use `\centering` to center figures.



Figure G.21. Use `\centering` to center figures.



Figure G.22. Use `\centering` to center figures.



Figure G.23. Use `\centering` to center figures.



Figure G.24. Use `\centering` to center figures.



Figure G.25. Use `\centering` to center figures.



Figure G.26. Use `\centering` to center figures.

H. GRAPHICS

There are many ways to make graphics for \LaTeX . I like to use a system that uses \LaTeX fonts so the appearance of the output is more professional.

```
1 \chapter{GRAPHICS}
2
3 There are many ways to make graphics for \LaTeX.
4 I like to use a system that uses \LaTeX fonts
5 so the appearance of the output is more professional.
```

H.1 Mathematica (Wolfram)

```
1
2 \section{Mathematica (Wolfram)}
```

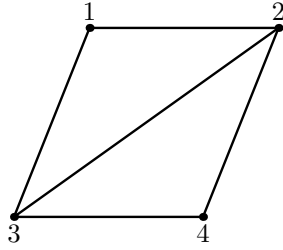
H.2 MATLAB

```
1
2 \section{MATLAB}
```

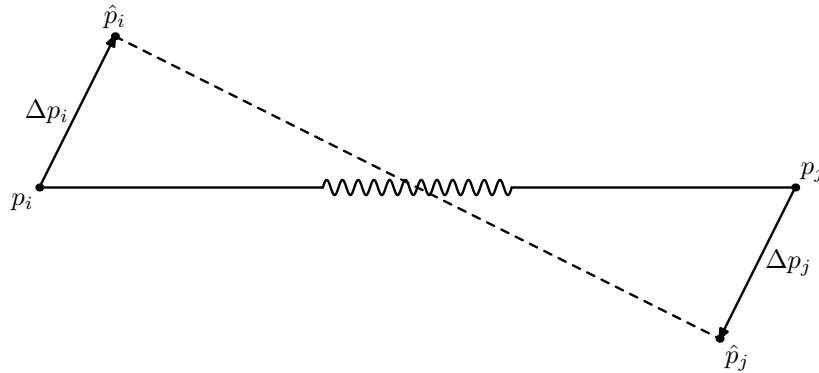
H.3 METAPOST (uses \LaTeX fonts)

I did this METAPOST [14] example for Yanghyun Kim [15].

```
1
2 \section{\METAPOST\ (uses \LaTeX fonts)}
3
4 I did this \METAPOST\ \cite{metapost} example
5 for Yanghyun Kim \cite{kim2009}.
```



(a) gr-kim1.pdf



(b) gr-kim2.pdf

Figure H.1. Graphics answers for Yanghyun Kim.

```

1
2 \newpage
3
4 \begin{figure}[ht]
5   \centering
6   \subcaptionbox
7     {\bfseries gr-kim1.pdf}%
8     {\includegraphics{gr-kim1.pdf}}%
9     \vskip 0.1truein
10  \subcaptionbox
11    {\bfseries gr-kim2.pdf}%
12    {\includegraphics{gr-kim2.pdf}}%
13    \caption{Graphics answers for Yanghyun Kim.}
14 \end{figure}

```

H.4 R

```

1
2 \section{R}

```

H.5 TikZ and PGF (uses L^AT_EX fonts)

```

1
2 \section{\TikZ\ and PGF (uses \LaTeX\ fonts)}

```

H.5.1 Clock

```
1
2 \subsection{Clock}
```

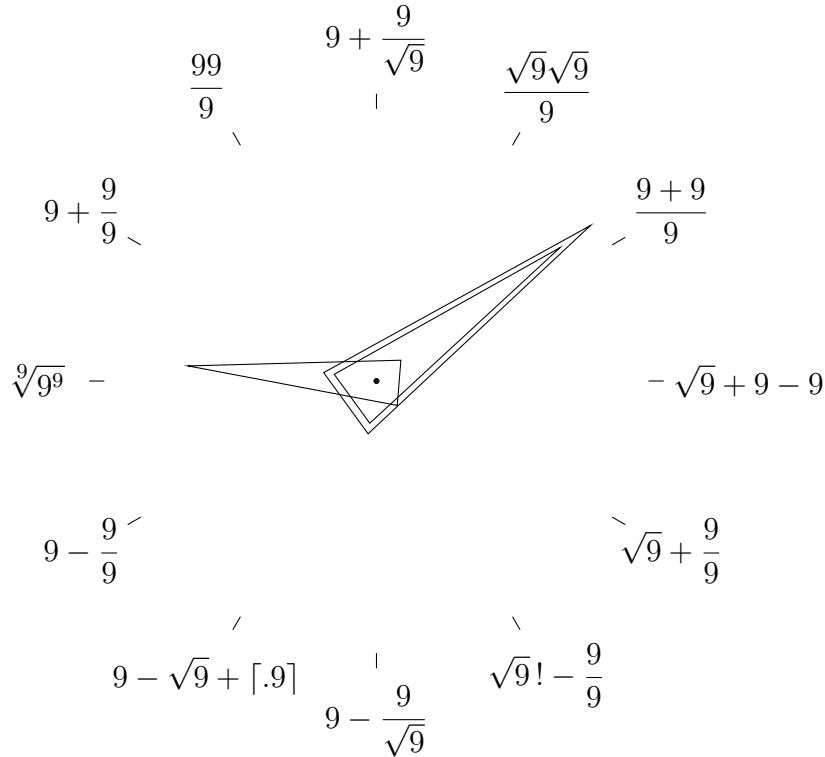


Figure H.2. The idea for this clock was originally from a Google+ posting by Afamefuna “Ferdy” Ibeabuchia.

```
1
2 \begin{figure}[ht]
3 \hbox to\textwidth{%
4 \hfil
5 \begin{tikzpicture}
6 \def\CenterRadius{0.04cm}
7 \def\InnerTickRadius{3.6cm}
8 \def\OuterTickRadius{3.8cm}
9 % Make \LR be an abbreviation for \LabelRadius so the
10 % lines below will fit within the width of the page.
11 \def\LabelRadius{4.5cm} \let\LR=\LabelRadius
12 \def\HourHandRadius{2.5cm} \def\HourHandBase{0.3cm}
13 \def\MinuteHandRadius{3cm} \def\MinuteHandBase{0.4cm}
14 \def\SecondHandRadius{3.5cm} \def\SecondHandBase{0.5cm}
15 \def\DS{\displaystyle}
16 \fill (0,0) circle (\CenterRadius);
17 \foreach \i in {0,30,...,330}
18 \draw (\i:\InnerTickRadius)--(\i:\OuterTickRadius);
```

```

19 \node at ( 0:\LR) {\$ \DS \quad \sqrt{9 + 9 - 9}}; % 3
20 \node at ( 30:\LR) {\$ \DS \frac{9+9}{9}}; % 2
21 \node at ( 60:\LR) {\$ \DS \frac{\sqrt{9}\sqrt{9}}{9}}; % 1
22 \node at ( 90:\LR) {\$ \DS 9 + \frac{9\sqrt{9}}{9}}; % 12
23 \node at (120:\LR) {\$ \DS \frac{99}{9}}; % 11
24 \node at (150:\LR) {\$ \DS 9 + \frac{99}{9}}; % 10
25 \node at (180:\LR) {\$ \DS \sqrt[\scriptstyle 9]{9^9}}; % 9
26 \node at (210:\LR) {\$ \DS 9 - \frac{99}{9}}; % 8
27 \node at (240:\LR) {\$ \DS 9 - \sqrt{9 + \lceil 9 \rceil}}; % 7
28 \node at (270:\LR) {\$ \DS 9 - \frac{9\sqrt{9}}{9}}; % 6
29 \node at (300:\LR) {\$ \DS \sqrt{9},! - \frac{99}{9}}; % 5
30 \node at (330:\LR) {\$ \DS \sqrt{9 + \frac{99}{9}}}; % 4
31 % In the following
32 % ABBREVIATION DESCRIPTION
33 % deg degrees
34 % min minutes
35 % sec seconds
36 % for second hand:
37 % (9 sec/60 sec) * 360 deg = 54 deg;
38 % 90 deg - 54 deg = 36 deg
39 \draw[rotate around={36:(0,0)}]
40 (-\SecondHandBase,\SecondHandBase) -- (\SecondHandRadius,0)
41 -- (-\SecondHandBase,-\SecondHandBase) -- cycle;
42 % for minute hand:
43 % (9 min/60 min) * 360 deg = 54 deg;
44 % 90 deg - 54 deg = 36 deg
45 \draw[rotate around={36:(0,0)}]
46 (-\MinuteHandBase,\MinuteHandBase) -- (\MinuteHandRadius,0)
47 -- (-\MinuteHandBase,-\MinuteHandBase) -- cycle;
48 % for hour hand:
49 % (9 min * (60 sec/1 min)) + 9 sec / 3600 sec
50 % = 549 sec / 3600 sec = 0.1525
51 % The hour hand is 0.1525 of the way from 9:00 to 10:00.
52 % Each hour is 30 degrees on the clock, so the hour hand
53 % position is
54 % 30 deg * 0.1525 = 4.575 deg past 9:00
55 % 180 deg - 4.575 deg = 175.425 deg
56 \draw[rotate around={175.425:(0,0)}]
57 (-\HourHandBase,\HourHandBase) -- (\HourHandRadius,0)
58 -- (-\HourHandBase,-\HourHandBase) -- cycle;
59 \end{tikzpicture}
60 % To make a one page clock document delete everything
61 % below and add
62 % \end{document}
63 \hfil
64 }
65 \caption{%
66 The idea for this clock was originally from a
67 Google+ posting by Afamefuna ``Ferdy'' Ibeabuchia.%
68 }
69 \end{figure}

```

H.5.2 Glider

```

1
2 \subsection{Glider}

```

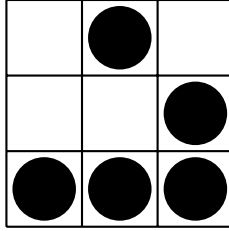


Figure H.3. The glider [16] is a pattern from the Game of Life, and it's used as an emblem representing the hacker community.

```
1
2 \begin{figure}[ht]
3   \hbox to\textwidth{%
4     \hfil
5     \begin{tikzpicture}[thick]
6       \draw (0,0) grid (3,3);
7       \foreach \c in {(0,0), (1,0), (2,0), (2,1), (1,2)}
8         \fill \c + (0.5,0.5) circle (0.42);
9     \end{tikzpicture}
10    \hfil
11  }
12  \caption
13  [%
14    The glider
15    is a pattern from the Game of Life,
16    and it's used as an emblem representing the hacker community.%
17  ]
18  {%
19    The glider \cite{hirzel2012}
20    is a pattern from the Game of Life,
21    and it's used as an emblem representing the hacker community.%
22  }
23 \end{figure}
```

I. NUMBERS AND UNITS

```
1 \chapter{NUMBERS AND UNITS}
```

Note to self: scientific prefixes, scientific suffixes, tables.

The puthesis 2.0 and after documentclass uses the siunitx package with some extra definitions in the puthesis.cls file to do numbers and units.

```
1
2 Note to self: scientific prefixes, scientific suffixes, tables.
3
4 The puthesis 2.0 and after documentclass uses the siunitx
5 package with some extra definitions in the puthesis.cls
6 file to do numbers and units.
```

I.1 Number Examples

```
1
2 \section{Number Examples}
```

Input	Output	Comment
<code>\num{-0.12345}</code>	-0.123 45	note the small space after the “3”
<code>\num{-0.1234}</code>	-0.1234	note no space between the “3” and “4”
<code>\num{-.123}</code>	-0.123	the “0.” is inserted automatically
<code>\num{123}</code>	123	
<code>\num{1234}</code>	1234	
<code>\num{12345}</code>	12 345	note the small space after the “2”
<code>\num{2e4}</code>	2×10^4	
<code>\num{e5}</code>	10^5	
<code>\num{2.34567e6}</code>	$2.345\ 67 \times 10^6$	note the small space after the “5”

```
1 \noindent\begin{tabular}{@{}l1l1@{}}
2 \bfseries Input& \bfseries Output& \bfseries Comment\\
3 \tabularspace
4 \verb+\num{-0.12345}+& \num{-0.12345}& note the small space after the ``3''\\
5 \verb+\num{-0.1234}+& \num{-0.1234}&
6 \num{-0.1234}&
7 note no space between the ``3'' and ``4''\\
8 \verb+\num{-.123}+& \num{-.123}& the ``0.'' is inserted automatically\\
9 \verb+\num{123}+& \num{123}\\
10 \verb+\num{1234}+& \num{1234}\\
11 \verb+\num{12345}+& \num{12345}& note the small space after the ``2''\\
12 \verb+\num{2e4}+& \num{2e4}\\
13 \verb+\num{e5}+& \num{e5}\\
14 \verb+\num{2.34567e6}+& \num{2.34567e6}&
15 \num{2.34567e6}&
16 note the small space after the ``5''\\
17 \end{tabular}
```


I.2 Unit Examples

```
1
2 \section{Unit Examples}
```

See page 62 for the complete list of units defined by the nputhesis documentclass.

Input	Output	Comment
<code>\si{\kg}</code>	kg	kilogram
<code>\si{\m}</code>	m	meter
<code>\si{\kg\per\m\squared}</code>	kg m^{-2}	= kg/m ²

```
1
2 See page-\pageref{se:Complete-List-of-Units}
3 for the complete list
4 of units defined by the nputhesis documentclass.
5
6 \noindent\begin{tabular}{@{}l|l|l@{}}
7 \bfseries Input& \bfseries Output& \bfseries Comment\\
8 \tabularspace
9 \verb+\si{\kg}+& \si{\kg}& kilogram\\
10 \verb+\si{\m}+& \si{\m}& meter\\
11 \verb+\si{\kg\per\m\squared}+&
12 \si{\kg\per\m\squared}&
13 \ (= \si{\kg}/\si{\m\squared})\\
14 \end{tabular}
```

I.3 Combined Number and Unit Examples

```
1
2 \section{Combined Number and Unit Examples}
```

Input	Output	Comment
<code>\SI{12}{\kg}</code>	12 kg	12 kilograms
<code>\SI{34}{\m}</code>	34 m	34 meters
<code>\SI{4.5e3}{\kg\per\m\squared}</code>	$4.5 \times 10^3 \text{ kg m}^{-2}$	= $4.5 \times 10^3 \text{ kg/m}^2$

```
1 \begin{tabular}{@{}l|l|l@{}}
2 \bfseries Input& \bfseries Output& \bfseries Comment\\
3 \tabularspace
4 \verb+\SI{12}{\kg}+& \SI{12}{\kg}& 12 kilograms\\
5 \verb+\SI{34}{\m}+& \SI{34}{\m}& 34 meters\\
6 % The next input line is too wide for the margins
7 % so I'm splitting it into pieces.
8 \verb+\SI{4.5e3}{\kg\per\m\squared}+&
9 \SI{4.5e3}{\kg\per\m\squared}&
10 \ (= \num{4.5e3}\, \si{\kg}/\si{\m\squared})\\
11 \end{tabular}
```

How many seconds are in a non-leap year that does not have any leap seconds?

$$\begin{aligned} \frac{365\cancel{d}}{y} \times \frac{24\cancel{h}}{\cancel{d}} \times \frac{60\cancel{min}}{\cancel{h}} \times \frac{60\cancel{s}}{\cancel{min}} &= 31\,536\,000 \frac{s}{y} \\ &= 31\,536\,000 \text{ s y}^{-1} \\ &\approx 3 \times 10^7 \text{ s y}^{-1} \\ &\approx 30 \text{ million s y}^{-1} \end{aligned}$$

```

1
2 How many seconds are in a non-leap year that does not have any leap seconds?
3 % I tried several things and could not get \cancel to work with \per.
4 % Mark Senn 2019-12-29
5 \begin{align*}
6 \quad \frac{\SI{365}{\cancel{d}}{\si{y}}
7 \quad \times \frac{\SI{24}{\cancel{h}}{\si{\cancel{d}}}}{\cancel{d}}
8 \quad \times \frac{\SI{60}{\cancel{min}}{\si{\cancel{h}}}}{\cancel{h}}
9 \quad \times \frac{\SI{60}{s}}{\si{\cancel{min}}}
10 \quad % From http://www.emerson.emory.edu/services/latex/latex_119.html
11 \quad % Spacing in Math Mode
12 \quad % In a math environment, LaTeX ignores the spaces you type
13 \quad % and puts in the spacing that it thinks is best. LaTeX formats
14 \quad % mathematics the way it's done in mathematics texts. If you
15 \quad % want different spacing, LaTeX provides the following four
16 \quad % commands for use in math mode:
17 \quad % \; - a thick space
18 \quad % \: - a medium space
19 \quad % \, - a thin space
20 \quad % \! - a negative thin space
21 \quad & = \num{31536000}\; \frac{\si{s}}{\si{y}} \\
22 \quad & = \SI{31536000}{\s\per y} \\
23 \quad & \approx \SI{3e7}{\s\per y} \\
24 \quad & \approx \text{30 million}\, \si{\s\per y} \\
25 \end{align*}

```

I.4 Binary Prefixes

```

1
2 \section{Binary Prefixes}

```

The `\kibi ... \yobi` commands are defined immediately after the `\usepackage{siunitx}` command in the `PurdueThesis.cls` file.

```

1
2 The \verb+\kibi+ \ldots \verb+\yobi+
3 commands are defined immediately after the \verb+\usepackage{siunitx}+ command
4 in the PurdueThesis.cls file.

```

Power	Prefix	Symbol	Command	Comment
10	kibi	Ki	<code>\si{\kibi}</code>	2 ¹⁰ bytes is a KiB, 10 ³ bytes is a KB
20	mebi	Mi	<code>\si{\mebi}</code>	2 ²⁰ bytes is a MiB, 10 ⁶ bytes is a MB
30	gibi	Gi	<code>\si{\gibi}</code>	2 ³⁰ bytes is a GiB, 10 ⁹ bytes is a GB
40	tebi	Ti	<code>\si{\tebi}</code>	2 ⁴⁰ bytes is a TiB, 10 ¹² bytes is a TB
50	pebi	Pi	<code>\si{\pebi}</code>	2 ⁵⁰ bytes is a PiB, 10 ¹⁵ bytes is a PB
60	exbi	Ei	<code>\si{\exbi}</code>	2 ⁶⁰ bytes is a EiB, 10 ¹⁸ bytes is a EB
70	zebi	Zi	<code>\si{\zebi}</code>	2 ⁷⁰ bytes is a ZiB, 10 ²¹ bytes is a ZB
80	yobi	Yi	<code>\si{\yobi}</code>	2 ⁸⁰ bytes is a YiB, 10 ²⁴ bytes is a YB

```

1
2 \newcolumntype{m}{>{r}<{r}} % math mode version of "r" column type
3 \renewcommand\t[4]{(2^{#1}\) bytes is a #2, \((10^{#3}\) bytes is a #4}
4 \begin{tabular}{@{}mllll@{}}
5 \multicolumn{1}{l}{\bfseries Power}&
6 \bfseries Prefix&
7 \bfseries Symbol&
8 \bfseries Command&
9 \bfseries Comment\\
10 \tabularspace
11 10& kibi& \si{\kibi}& \verb+\si{\kibi}+& \t{10}{KiB}{3}{KB}\\
12 20& mebi& \si{\mebi}& \verb+\si{\mebi}+& \t{20}{MiB}{6}{MB}\\
13 30& gibi& \si{\gibi}& \verb+\si{\gibi}+& \t{30}{GiB}{9}{GB}\\
14 40& tebi& \si{\tebi}& \verb+\si{\tebi}+& \t{40}{TiB}{12}{TB}\\
15 50& pebi& \si{\pebi}& \verb+\si{\pebi}+& \t{50}{PiB}{15}{PB}\\
16 60& exbi& \si{\exbi}& \verb+\si{\exbi}+& \t{60}{EiB}{18}{EB}\\
17 70& zebi& \si{\zebi}& \verb+\si{\zebi}+& \t{70}{ZiB}{21}{ZB}\\
18 80& yobi& \si{\yobi}& \verb+\si{\yobi}+& \t{80}{YiB}{24}{YB}\\
19 \end{tabular}

```

I.5 Decimal Prefixes

```

1
2 \section{Decimal Prefixes}

```

Power	Prefix	Symbol	Command	Comment
-24	yocto	y	<code>\si{\yocto}</code>	
-21	zepto	z	<code>\si{\zepto}</code>	
-18	atto	a	<code>\si{\atto}</code>	
-15	femto	f	<code>\si{\femto}</code>	
-12	pico	p	<code>\si{\pico}</code>	
-9	nano	n	<code>\si{\nano}</code>	
-6	micro	μ	<code>\si{\micro}</code>	
-3	milli	m	<code>\si{\milla}</code>	
-2	centi	c	<code>\si{\centi}</code>	
-1	deci	d	<code>\si{\deci}</code>	
1	deca	da	<code>\si{\deca}</code>	
1	deka	da	<code>\si{\deka}</code>	same as <code>\si{\deca}</code>
2	hecto	h	<code>\si{\hecto}</code>	
3	kilo	k	<code>\si{\kilo}</code>	
6	mega	M	<code>\si{\mega}</code>	
9	giga	G	<code>\si{\giga}</code>	
12	tera	T	<code>\si{\tera}</code>	
15	peta	P	<code>\si{\peta}</code>	
18	exa	E	<code>\si{\exa}</code>	
21	zetta	Z	<code>\si{\zetta}</code>	
24	yotta	Y	<code>\si{\yotta}</code>	

```

1
2 \newcolumntype{m}{>{r}<{r}} % math mode version of "r" column type
3 \begin{tabular}{@{}mllll@{}}
4 \multicolumn{1}{l}{\bfseries Power}&&&&
5 \bfseries Prefix&&&&
6 \bfseries Symbol&&&&
7 \bfseries Command&&&&
8 \bfseries Comment\\
9 \tabularspace
10 -24& yocto& \si{yocto}& \verb+\si{yocto}+\\
11 -21& zepto& \si{zepto}& \verb+\si{zepto}+\\
12 -18& atto& \si{atto}& \verb+\si{atto}+\\
13 -15& femto& \si{femto}& \verb+\si{femto}+\\
14 -12& pico& \si{pico}& \verb+\si{pico}+\\
15 -9& nano& \si{nano}& \verb+\si{nano}+\\
16 -6& micro& \si{micro}& \verb+\si{micro}+\\
17 -3& milli& \si{milli}& \verb+\si{milla}+\\
18 -2& centi& \si{centi}& \verb+\si{centi}+\\
19 -1& deci& \si{deci}& \verb+\si{deci}+\\
20 1& deca& \si{deca}& \verb+\si{deca}+\\
21 1& deka& \si{deka}& \verb+\si{deka}+&& same as \verb+\si{deca}+\\
22 2& hecto& \si{hecto}& \verb+\si{hecto}+\\
23 3& kilo& \si{kilo}& \verb+\si{kilo}+\\
24 6& mega& \si{mega}& \verb+\si{mega}+\\
25 9& giga& \si{giga}& \verb+\si{giga}+\\
26 12& tera& \si{tera}& \verb+\si{tera}+\\
27 15& peta& \si{peta}& \verb+\si{peta}+\\
28 18& exa& \si{exa}& \verb+\si{exa}+\\
29 21& zetta& \si{zetta}& \verb+\si{zetta}+\\
30 24& yotta& \si{yotta}& \verb+\si{yotta}+\\
31 \end{tabular}

```

I.6 SI Units

```

1
2 \section{SI Units}

```

The International System of Units (SI) is the modern form of the metric system. There are seven SI base units:

Name	Unit Of	Symbol
ampere	electrical current	A
candela	luminous intensity	cd
kelvin	thermodynamic temperature	K
kg	mass	kg
meter	length	m
mole	amount of substance	mol
second	time	s

```

1
2 The International System of Units
3 (SI)
4 % !!! Doing
5 % !!! \include{tipa}
6 % !!! in thesis.tex so \textprimstress works
7 % !!! apparently causes problems with math commands.
8 % !!! Figure out why the following doesn't work later.
9 % (
10 % SI,
11 % abbreviated from the French Syst\`eme International
12 % (d\textprimstress unit\`es)%
13 % )
14 is the modern form of the metric system.
15 There are seven SI base units:
16
17 \hspace{40pt}
18 \begin{tabular}{@{}l|l|l@{}}
19 \tabularspace
20 \bfseries Name& \bfseries Unit Of& \bfseries Symbol\\
21 \tabularspace
22 ampere& electrical current& \si{\ampere}\\
23 candela& luminous intensity& \si{\candela}\\
24 kelvin& thermodynamic temperature& \si{\kelvin}\\
25 kg& mass& \si{\kilogram}\\
26 meter& length& \si{\meter}\\
27 mole& amount of substance& \si{\mole}\\
28 second& time& \si{\second}\\
29 \end{tabular}

```

I.7 Complete List of Units

```

1
2 \section{Complete List of Units}
3 \label{se:Complete-List-of-Units}

```

Table I.1. Units and Corresponding Symbols

Name	Unit Of	Symbol	Command	Is equal to
ampere	electrical current	A	<code>\si{\A}</code>	(SI base unit)
picoampere	"	pA	<code>\si{\pA}</code>	10^{-12} A
nanoampere	"	nA	<code>\si{\nA}</code>	10^{-9} A
microampere	"	μ A	<code>\si{\uA}</code>	10^{-6} A
milliampere	"	mA	<code>\si{\mA}</code>	10^{-3} A
kiloampere	"	kA	<code>\si{\kA}</code>	10^3 A
arcminute	plane angle	'	<code>\si{\arcmin}</code>	$1/60^\circ$

continued on next page

Table I.1. *continued*

Name	Unit Of	Symbol	Command	Is equal to
arcsecond	plane angle	"	<code>\si{\arcsec}</code>	1/60'
astronomical unit	length	au	<code>\si{\au}</code>	mean earth to sun distance
atomic mass unit	mass	u	<code>\si{\amu}</code>	1/12 mass of carbon-12 atom
bar	pressure	bar	<code>\si{\bar}</code>	10 ⁻⁵ Pa
millibar	"	mbar	<code>\si{\mbar}</code>	10 ⁻³ bar
barn	area	b	<code>\si{\b}</code>	10 ⁻²⁸ m ²
becquerel	radioactivity	Bq	<code>\si{\Bq}</code>	one radioactive decay per second
bel	sound intensity	B	<code>\si{\B}</code>	10 decibels
decibel	"	dB	<code>\si{\dB}</code>	10 ⁻¹ B
bohr	length	<i>a</i> ₀	<code>\si{\bohr}</code>	distance between nucleus and electron in hydrogen atom
bushel	quantity	bu	<code>\si{\bu}</code>	see [17]
candela	luminous intensity	cd	<code>\si{\cd}</code>	(SI base unit)
coulomb	electrical charge	C	<code>\si{\C}</code>	A s ⁻¹
dalton	mass	Da	<code>\si{\Da}</code>	another name for atomic mass unit
day	time	d	<code>\si{\d}</code>	86 400 s
degree	plane angle	°	<code>\si{\degree}</code>	1/360 of a circle
degree Celsius	temperature	°C	<code>\si{\celsius}</code>	xxx
electron mass	mass	<i>m</i> _e	<code>\si{\em}</code>	xxx
electronvolt	energy	eV	<code>\si{\eV}</code>	xxx
millielectronvolt	"	meV	<code>\si{\meV}</code>	10 ⁻³ eV
kiloelectronvolt	"	keV	<code>\si{\keV}</code>	10 ³ eV
megaelectronvolt	"	MeV	<code>\si{\MeV}</code>	10 ⁶ eV
gigaelectronvolt	"	GeV	<code>\si{\GeV}</code>	10 ⁹ eV

continued on next page

Table I.1. *continued*

Name	Unit Of	Symbol	Command	Is equal to
teraelectronvolt	"	TeV	<code>\si{\TeV}</code>	10^{12} eV
elementary charge	electrical charge	e	<code>\si{\ec}</code>	$\approx 1.6 \times 10^{19}$ C
farad	electrical capacitance	F	<code>\si{\F}</code>	$\text{s}^4 \text{A}^2 \text{m}^{-2} \text{kg}^{-1}$
femtofarad	"	fF	<code>\si{\fF}</code>	10^{-15} F
picofarad	"	pF	<code>\si{\pF}</code>	10^{-12} F
foot	length	ft	<code>\si{\ft}</code>	0.3048 m
gray	absorbed dose of ionizing radiation	Gy	<code>\si{\Gy}</code>	J kg^{-1}
hartree	energy used in molecular orbital calculations	E_h	<code>\si{\hartree}</code>	xxx
hectare	area	ha	<code>\si{\ha}</code>	10^4 m ²
henry	electrical inductance	H	<code>\si{\H}</code>	$\text{kg m}^2 \text{s}^{-2} \text{A}^{-2}$
hertz	frequency	Hz	<code>\si{\Hz}</code>	s^{-1}
millihertz	"	mHz	<code>\si{\mHz}</code>	10^{-3} Hz
kilohertz	"	kHz	<code>\si{\kHz}</code>	10^3 Hz
megahertz	"	MHz	<code>\si{\MHz}</code>	10^6 Hz
gigahertz	"	GHz	<code>\si{\GHz}</code>	10^9 Hz
terahertz	"	THz	<code>\si{\THz}</code>	10^{12} Hz
horsepower	power	hp	<code>\si{\hp}</code>	≈ 745.7 W, IMPORTANT: see Horsepower
hour	time	h	<code>\si{\h}</code>	3600 s
inch	length	in	<code>\si{\in}</code>	25.4 mm
joule	work or energy	J	<code>\si{\J}</code>	$\text{kg m}^2 \text{s}^{-2}$
microjoule	"	μJ	<code>\si{\uJ}</code>	10^{-6} J
millijoule	"	mJ	<code>\si{\mJ}</code>	10^{-3} J
kilojoule	"	kJ	<code>\si{\kJ}</code>	10^3 J

continued on next page

Table I.1. *continued*

Name	Unit Of	Symbol	Command	Is equal to
megajoule	"	MJ	<code>\si{\MJ}</code>	10^6 J
katal	catalytic activity	kat	<code>\si{\kat}</code>	mols^{-1}
kelvin	thermodynamic temperature	K	<code>\si{\K}</code>	(SI base unit)
kilogram	mass	kg	<code>\si{\kg}</code>	(SI base unit)
femtogram	"	fg	<code>\si{\fg}</code>	10^{-15} g
picogram	"	pg	<code>\si{\pg}</code>	10^{-12} g
nanogram	"	ng	<code>\si{\ng}</code>	10^{-9} g
microgram	"	μg	<code>\si{\ug}</code>	10^{-6} g
milligram	"	mg	<code>\si{\mg}</code>	10^{-3} g
gram	"	g	<code>\si{\g}</code>	10^{-3} kg
kilowatt hour	electrical energy	kWh	<code>\si{\kWh}</code>	kW h
knot	speed	kn	<code>\si{\kn}</code>	M h^{-1}
liter	volume	L	<code>\si{\L}</code>	10^{-3} m ³
microliter	"	μL	<code>\si{\uL}</code>	10^{-6} L
milliliter	"	mL	<code>\si{\mL}</code>	10^{-3} L
hectoliter	"	hL	<code>\si{\hL}</code>	10^2 L
lumen	luminous flux	lm	<code>\si{\lm}</code>	cd sr
lux	illumination	lx	<code>\si{\lx}</code>	lm m^{-2}
meter	length	m	<code>\si{\m}</code>	(SI base unit)
picometer	"	pm	<code>\si{\pm}</code>	10^{-12} m
nanometer	"	nm	<code>\si{\nm}</code>	10^{-9} m
micrometer	"	μm	<code>\si{\um}</code>	10^{-6} m
millimeter	"	mm	<code>\si{\mm}</code>	10^{-3} m
centimeter	"	cm	<code>\si{\cm}</code>	10^{-2} m
decimeter	"	dm	<code>\si{\dm}</code>	10^{-1} m
kilometer	"	km	<code>\si{\km}</code>	10^3 m
millimeter of mercury	pressure	mmHg	<code>\si{\mmHg}</code>	≈ 133 Pa
minute	time	min	<code>\si{\min}</code>	60 s
mole	amount of substance	mol	<code>\si{\mol}</code>	(SI base unit)

continued on next page

Table I.1. *continued*

Name	Unit Of	Symbol	Command	Is equal to
femtomole	"	fmol	<code>\si{\fmol}</code>	10^{-15} mol
picomole	"	pmol	<code>\si{\pmol}</code>	10^{-12} mol
nanomole	"	nmol	<code>\si{\nmol}</code>	10^{-9} mol
micromole	"	μ mol	<code>\si{\umol}</code>	10^{-6} mol
millimole	"	mmol	<code>\si{\mmol}</code>	10^{-3} mol
kilomole	"	kmol	<code>\si{\kmol}</code>	10^3 mol
nautical mile	distance	M	<code>\si{\M}</code>	1852 m
neper	gain, loss, and relative values	Np	<code>\si{\Np}</code>	1
newton	force	N	<code>\si{\N}</code>	kg m s^{-2}
millinewton	"	mN	<code>\si{\mN}</code>	10^{-3} N
kilonewton	"	kN	<code>\si{\kN}</code>	10^3 N
meganewton	"	MN	<code>\si{\MN}</code>	10^6 N
ohm	electrical resistance	Ω	<code>\si{\ohm}</code>	$\text{kg m}^2 \text{s}^{-3} \text{A}^{-2}$
milliohm	"	m Ω	<code>\si{\mohm}</code>	10^{-3} ohm
kiloohm	"	k Ω	<code>\si{\kohm}</code>	10^3 ohm
megaohm	"	M Ω	<code>\si{\Mohm}</code>	10^6 ohm
pascal	pressure	Pa	<code>\si{\Pa}</code>	$\text{kg m}^{-1} \text{s}^{-2}$
kilopascal	"	kPa	<code>\si{\kPa}</code>	10^3 Pa
megapascal	"	MPa	<code>\si{\MPa}</code>	10^6 Pa
gigapascal	"	GPa	<code>\si{\GPa}</code>	10^9 Pa
percent	hundredths	%	<code>\si{\percent}</code>	10^{-2}
pound	weight	lb	<code>\si{\lb}</code>	0.453 592 37 kg
radian	plane angular measurement	rad	<code>\si{\rad}</code>	$180/\pi^\circ$
reduced Planck constant	angular momentum	\hbar	<code>\si{\planckbar}</code>	$\approx 1.05 \times 10^{-34}$ J s
second	time	s	<code>\si{\s}</code>	(SI base unit)
attosecond	"	as	<code>\si{\as}</code>	10^{-18} s
femtosecond	"	fs	<code>\si{\fs}</code>	10^{-15} s
picosecond	"	ps	<code>\si{\ps}</code>	10^{-12} s
nanosecond	"	ns	<code>\si{\ns}</code>	10^{-9} s
microsecond	"	μ s	<code>\si{\us}</code>	10^{-6} s

continued on next page

Table I.1. *continued*

Name	Unit Of	Symbol	Command	Is equal to
millisecond	"	ms	<code>\si{\ms}</code>	10^{-3} s
siemens	conductance	S	<code>\si{\S}</code>	$\text{kg}^{-1} \text{ m}^{-2} \text{ s}^3 \text{ A}^2$
sievert	dosage of ionizing radiation	Sv	<code>\si{\Sv}</code>	$\text{m}^2 \text{ s}^{-2}$
speed of light	speed	c_0	<code>\si{\clight}</code>	$299\,792\,458 \text{ m s}^{-1}$
standard deviation	amount of variation	SD	<code>\si{\SD}</code>	$\sqrt{\frac{1}{N-1} \sum_{i=1}^N (x_i - \bar{x})^2}$
steradian	measure of solid angles	sr	<code>\si{\sr}</code>	$1 \text{ m}^2 \text{ m}^{-2}$
tesla	magnetic flux density	T	<code>\si{\T}</code>	$\text{kg s}^{-2} \text{ A}^{-1}$
metric ton	mass	t	<code>\si{\t}</code>	10^3 kg
volt	electrical potential difference	V	<code>\si{\V}</code>	$\text{kg m}^2 \text{ s}^{-3} \text{ A}^{-1}$
picovolt	"	pV	<code>\si{\pV}</code>	10^{-12} V
nanovolt	"	nV	<code>\si{\nV}</code>	10^{-9} V
microvolt	"	μV	<code>\si{\uV}</code>	10^{-6} V
millivolt	"	mV	<code>\si{\mV}</code>	10^{-3} V
kilovolt	"	kV	<code>\si{\kV}</code>	10^3 V
watt	power	W	<code>\si{\W}</code>	$\text{kg m}^2 \text{ s}^{-3}$
microwatt	"	μW	<code>\si{\uW}</code>	10^{-6} W
milliwatt	"	mW	<code>\si{\mW}</code>	10^{-3} W
kilowatt	"	kW	<code>\si{\kW}</code>	10^3 W
megawatt	"	MW	<code>\si{\MW}</code>	10^6 W
gigawatt	"	GW	<code>\si{\GW}</code>	10^9 W
weber	magnetic flux	Wb	<code>\si{\Wb}</code>	$\text{kg m}^2 \text{ s}^{-2} \text{ A}^{-1}$
yard	length	yd	<code>\si{\yd}</code>	0.9144 m
year	time	y	<code>\si{\y}</code>	$\approx 365.25 \text{ d}$

```

1
2  {%
3  \ZZbaselinestretch{1}
4  \newcommand\vsp{\noalign{\vspace*{6pt}}}
5  % From
6  % https://tex.stackexchange.com/questions/31508/flushleft-with-p-option-in-tabular
7  %     It's necessary to use the \arraybackslash in the last column,

```

```

8 % otherwise \\ would not end the table row. You can use \newline
9 % to end lines in the last column cells (and the regular \\ in
10 % the other column cells).
11 % ...
12 % If you need it often, consider defining a new column type using
13 % array features, as I did here:
14 % \newcolumntype{P}[1]{>{\raggedright\arraybackslash}p{#1}}
15 \newcolumntype{P}[1]{>{\raggedright\arraybackslash}p{#1}}%
16 % \begin{longtable}{@{}P{1.4in}P{1in}lP{1.8in}@{}}
17 % \begin{longtable}{@{}P{1in}P{1in}lP{1.8in}@{}}
18 % \begin{longtable}{@{}P{1.2in}P{1in}lP{1.8in}@{}}
19 % \begin{longtable}{@{}P{90.72pt}P{1in}lP{1.8in}@{}} % 1.2in (86.72pt) + 4pt = 90.72pt
20 \begin{longtable}{@{}P{1.4in}P{1in}lP{1.8in}@{}}% 1.2in (86.72pt) + 4pt = 90.72pt
21 \caption{Units and Corresponding Symbols}\\
22 \bfseries Name&
23 \bfseries Unit Of&
24 \bfseries Symbol&
25 \bfseries Command&
26 \bfseries Is equal to\\
27 \vsp
28 \endfirsthead
29 \caption[]{-\emph{continued}}\\
30 \bfseries Name&
31 \bfseries Unit Of&
32 \bfseries Symbol&
33 \bfseries Command&
34 \bfseries Is equal to\\
35 \vsp
36 \endhead
37 \vsp
38 % I don't know why the \hspace*{-7.5mm} was
39 % needed to center this horizontally.
40 \multicolumn{5}{@{}c@{}}{\hspace*{-7.5mm}\emph{continued on next page}}%
41 \endfoot
42 \endlastfoot
43 ampere&
44 electrical current&
45 \si{\A}&
46 \verb+\si{\A}+&
47 (SI base unit)\\
48 \quad picoampere&
49 \ditto&
50 \si{\pA}&
51 \verb+\si{\pA}+&
52 \SI{e-12}{\A}\\
53 \quad nanoampere&
54 \ditto&
55 \si{\nA}&
56 \verb+\si{\nA}+&
57 \SI{e-9}{\A}\\
58 \quad microampere&
59 \ditto&
60 \si{\uA}&
61 \verb+\si{\uA}+&
62 \SI{e-6}{\A}\\
63 \quad milliampere&
64 \ditto&
65 \si{\mA}&
66 \verb+\si{\mA}+&
67 \SI{e-3}{\A}\\
68 \quad kiloampere&
69 \ditto&
70 \si{\kA}&
71 \verb+\si{\kA}+&

```

```

72     \SI{e3}{\A}\
73 \vsp
74 % \aa ngstr\om&
75 % length&
76 % \si{\AA}&
77 % \verb+\si{\AA}+&
78 % \SI{e-10}{\m}\
79 \vsp
80 arcminute&
81 plane angle&
82 \si{\arcmin}&
83 \verb+\si{\arcmin}+&
84 \SI{1/60}{\degree}\
85 arcsecond&
86 plane angle&
87 \si{\arcsec}&
88 \verb+\si{\arcsec}+&
89 \SI{1/60}{\arcmin}\
90 \vsp
91 astronomical unit&
92 length&
93 \si{\au}&
94 \verb+\si{\au}+&
95 mean earth to\newline sun distance\
96 \vsp
97 atomic mass unit&
98 mass&
99 \si{\amu}&
100 \verb+\si{\amu}+&
101 \SI{1/12}\ mass of\newline carbon-12 atom\
102 \vsp
103 bar&
104 pressure&
105 \si{\bar}&
106 \verb+\si{\bar}+&
107 \SI{e-5}{\Pa}\
108 \quad millibar&
109 \ditto&
110 \si{\mbar}&
111 \verb+\si{\mbar}+&
112 \SI{e-3}{\bar}\
113 \vsp
114 barn&
115 area&
116 \si{\b}&
117 \verb+\si{\b}+&
118 \SI{e-28}{\m\squared}\
119 \vsp
120 becquerel&
121 radioactivity&
122 \si{\Bq}&
123 \verb+\si{\Bq}+&
124 one radioactive\newline decay per second\
125 \vsp
126 bel&
127 sound intensity&
128 \si{\B}&
129 \verb+\si{\B}+&
130 10 decibels\
131 \quad decibel&
132 \ditto&
133 \si{\dB}&
134 \verb+\si{\dB}+&
135 \SI{e-1}{\B}\

```

```

136 \vsp
137 bohr&
138   length&
139   \si{\bohr}&
140   \verb+\si{\bohr}+&
141   distance between\newline nucleus and electron\newline in hydrogen atom\\
142 \vsp
143 bushel&
144   quantity&
145   \si{\bu}&
146   \verb+\si{\bu}+&
147   see \cite{bushel}\\
148 \vsp
149 candela&
150   luminous intensity&
151   \si{\cd}&
152   \verb+\si{\cd}+&
153   (SI base unit)\\
154 \vsp
155 coulomb&
156   electrical charge&
157   \si{\C}&
158   \verb+\si{\C}+&
159   \si{\A\per\s}\\
160 \vsp
161 dalton&
162   mass&
163   \si{\Da}&
164   \verb+\si{\Da}+&
165   another name for\newline atomic mass unit\\
166 \vsp
167 day&
168   time&
169   \si{\d}&
170   \verb+\si{\d}+&
171   \SI{86400}{\s}\\
172 \vsp
173 degree&
174   plane angle&
175   \si{\degree}&
176   \verb+\si{\degree}+&
177   \SI{1/360}{\,of\ a\ cicle}\\
178 \vsp
179 degree Celsius&
180   temperature&
181   \si{\celsius}&
182   \verb+\si{\celsius}+&
183   xxx\\
184 \vsp
185 electron mass&
186   mass&
187   \si{\em}&
188   \verb+\si{\em}+&
189   xxx\\
190 \vsp
191 electronvolt&
192   energy&
193   \si{\eV}&
194   \verb+\si{\eV}+&
195   xxx\\
196 \quad millielectronvolt&
197   \ditto&
198   \si{\meV}&
199   \verb+\si{\meV}+&

```

```

200     \SI{e-3}{\eV}\
201 \quad kiloelectronvolt&
202     \ditto&
203     \si{\keV}&
204     \verb+\si{\keV}+&
205     \SI{e3}{\eV}\
206 \quad megaelectronvolt&
207     \ditto&
208     \si{\MeV}&
209     \verb+\si{\MeV}+&
210     \SI{e6}{\eV}\
211 \quad gigaelectronvolt&
212     \ditto&
213     \si{\GeV}&
214     \verb+\si{\GeV}+&
215     \SI{e9}{\eV}\
216 \quad teraelectronvolt&
217     \ditto&
218     \si{\TeV}&
219     \verb+\si{\TeV}+&
220     \SI{e12}{\eV}\
221 \vsp
222 elementary charge&
223     electrical charge&
224     \si{\ec}&
225     \verb+\si{\ec}+&
226     \href{https://en.wikipedia.org/wiki/Elementary_charge}{\SI{\approx 1.6e19}{\C}}\
227 \vsp
228 farad&
229     electrical capacitance&
230     \si{\F}&
231     \verb+\si{\F}+&
232     \si{\s\tothe{4}\A\squared\per\m\squared\per\kg}\
233 \quad femtofarad&
234     \ditto&
235     \si{\fF}&
236     \verb+\si{\fF}+&
237     \SI{e-15}{\F}\
238 \quad picofarad&
239     \ditto&
240     \si{\pF}&
241     \verb+\si{\pF}+&
242     \SI{e-12}{\F}\
243 \vsp
244 foot&
245     length&
246     \si{\ft}&
247     \verb+\si{\ft}+&
248     \SI{0.3048}{\m}\ % not an SI unit
249 \vsp
250 % gauss: The gauss, symbol G, sometimes Gs, is the cgs unit of measurement of magnetic flux.
251 gray&
252     absorbed dose of ionizing radiation&
253     \si{\Gy}&
254     \verb+\si{\Gy}+&
255     \si{\J\per\kg}\
256 \vsp
257 hartree&
258     energy used in molecular orbital calculations&
259     \si{\hartree}&
260     \verb+\si{\hartree}+&
261     xxx\
262 \vsp
263 hectare&

```

```

264     area&
265     \si{\ha}&
266     \verb+\si{\ha}+&
267     \SI{e4}{\m\squared}\l
268     \vsp
269     henry&
270     electrical inductance&
271     \si{H}&
272     \verb+\si{H}+&
273     \si{\kg\m\squared\per\s\squared\per\A\squared}\l
274     \vsp
275     hertz&
276     frequency&
277     \si{Hz}&
278     \verb+\si{Hz}+&
279     \si{\per\s}\l
280     \quad millihertz&
281     \ditto&
282     \si{mHz}&
283     \verb+\si{mHz}+&
284     \SI{e-3}{\Hz}\l
285     \quad kilohertz&
286     \ditto&
287     \si{kHz}&
288     \verb+\si{kHz}+&
289     \SI{e3}{\Hz}\l
290     \quad megahertz&
291     \ditto&
292     \si{MHz}&
293     \verb+\si{MHz}+&
294     \SI{e6}{\Hz}\l
295     \quad gigahertz&
296     \ditto&
297     \si{GHz}&
298     \verb+\si{GHz}+&
299     \SI{e9}{\Hz}\l
300     \quad terahertz&
301     \ditto&
302     \si{THz}&
303     \verb+\si{THz}+&
304     \SI{e12}{\Hz}\l
305     \vsp
306     horsepower&
307     power&
308     \si{hp}&
309     \verb+\si{hp}+&
310     \SI{\approx 745.7}{W}, {\bfseries IMPORTANT:newline
311     see \href{https://en.wikipedia.org/wiki/Horsepower#Mechanical_horsepower}{Horsepower}}\l
312     % not an SI unit
313     \vsp
314     hour&
315     time&
316     \si{h}&
317     \verb+\si{h}+&
318     \SI{3600}{\s}\l
319     \vsp
320     inch&
321     length&
322     \si{in}&
323     \verb+\si{in}+&
324     \SI{25.4}{\mm}\l % not an SI unit
325     \vsp
326     joule&
327     work or energy&

```



```

328     \si{\J}&
329     \verb+\si{\J}+&
330     \si{\kg\m\squared\per\s\squared}\\
331 \quad microjoule&
332     \ditto&
333     \si{\uJ}&
334     \verb+\si{\uJ}+&
335     \SI{e-6}{\J}\\
336 \quad millijoule&
337     \ditto&
338     \si{\mJ}&
339     \verb+\si{\mJ}+&
340     \SI{e-3}{\J}\\
341 \quad kilojoule&
342     \ditto&
343     \si{\kJ}&
344     \verb+\si{\kJ}+&
345     \SI{e3}{\J}\\
346 \quad megajoule&
347     \ditto&
348     \si{\MJ}&
349     \verb+\si{\MJ}+&
350     \SI{e6}{\J}\\
351 \vsp
352 katal&
353     catalytic activity&
354     \si{\kat}&
355     \verb+\si{\kat}+&
356     \si{\mol\per\s}\\
357 \vsp
358 kelvin&
359     thermodynamic temperature&
360     \si{\K}&
361     \verb+\si{\K}+&
362     (SI base unit)\\
363 \vsp
364 kilogram&
365     mass&
366     \si{\kg}&
367     \verb+\si{\kg}+&
368     (SI base unit)\\
369 \quad femtogram&
370     \ditto&
371     \si{\fg}&
372     \verb+\si{\fg}+&
373     \SI{e-15}{\g}\\
374 \quad picogram&
375     \ditto&
376     \si{\pg}&
377     \verb+\si{\pg}+&
378     \SI{e-12}{\g}\\
379 \quad nanogram&
380     \ditto&
381     \si{\ng}&
382     \verb+\si{\ng}+&
383     \SI{e-9}{\g}\\
384 \quad microgram&
385     \ditto&
386     \si{\ug}&
387     \verb+\si{\ug}+&
388     \SI{e-6}{\g}\\
389 \quad milligram&
390     \ditto&
391     \si{\mg}&

```

```

392     \verb+\si{mg}+&
393     \SI{e-3}{g}\l
394 \quad gram&
395     \ditto&
396     \si{g}&
397     \verb+\si{g}+&
398     \SI{e-3}{kg}\l
399 \vsp
400 kilowatt hour&
401     electrical energy&
402     \si{kWh}&
403     \verb+\si{kWh}+&
404     \si{kWh}\l
405 \vsp
406 knot&
407     speed&
408     \si{kn}&
409     \verb+\si{kn}+&
410     \si{Mperh}\l
411 \vsp
412 liter&
413     volume&
414     \si{L}&
415     \verb+\si{L}+&
416     \SI{e-3}{m\cubed}\l
417 \quad microliter&
418     \ditto&
419     \si{uL}&
420     \verb+\si{uL}+&
421     \SI{e-6}{L}\l
422 \quad milliliter&
423     \ditto&
424     \si{mL}&
425     \verb+\si{mL}+&
426     \SI{e-3}{L}\l
427 \quad hectoliter&
428     \ditto&
429     \si{hL}&
430     \verb+\si{hL}+&
431     \SI{e2}{L}\l
432 \vsp
433 lumen&
434     luminous flux&
435     \si{lm}&
436     \verb+\si{lm}+&
437     \si{cd\sr}\l
438 \vsp
439 lux&
440     illumination&
441     \si{lx}&
442     \verb+\si{lx}+&
443     \si{lm\per\m\squared}\l
444 \vsp
445 meter&
446     length&
447     \si{m}&
448     \verb+\si{m}+&
449     (SI base unit)\l
450 \quad picometer&
451     \ditto&
452     \si{pm}&
453     \verb+\si{pm}+&
454     \SI{e-12}{m}\l
455 \quad nanometer&

```

```

456     \ditto&
457     \si{\nm}&
458     \verb+\si{\nm}+&
459     \SI{e-9}{\m}\l
460 \quad micrometer&
461     \ditto&
462     \si{\um}&
463     \verb+\si{\um}+&
464     \SI{e-6}{\m}\l
465 \quad millimeter&
466     \ditto&
467     \si{\mm}&
468     \verb+\si{\mm}+&
469     \SI{e-3}{\m}\l
470 \quad centimeter&
471     \ditto&
472     \si{\cm}&
473     \verb+\si{\cm}+&
474     \SI{e-2}{\m}\l
475 \quad decimeter&
476     \ditto&
477     \si{\dm}&
478     \verb+\si{\dm}+&
479     \SI{e-1}{\m}\l
480 \quad kilometer&
481     \ditto&
482     \si{\km}&
483     \verb+\si{\km}+&
484     \SI{e3}{\m}\l
485 \vsp
486 % mile: not an SI unit
487 millimeter of mercury&
488     pressure&
489     \si{\mmHg}&
490     \verb+\si{\mmHg}+&
491     \href{https://en.wikipedia.org/wiki/Millimetre_of_mercury}{\SI{\approx 133}{\Pa}}\l
492 \vsp
493 minute&
494     time&
495     \si{\min}&
496     \verb+\si{\min}+&
497     \SI{60}{\s}\l
498 \vsp
499 mole&
500     amount of substance&
501     \si{\mol}&
502     \verb+\si{\mol}+&
503     (SI base unit)\l
504 \quad femtomole&
505     \ditto&
506     \si{\fmol}&
507     \verb+\si{\fmol}+&
508     \SI{e-15}{\mol}\l
509 \quad picomole&
510     \ditto&
511     \si{\pmol}&
512     \verb+\si{\pmol}+&
513     \SI{e-12}{\mol}\l
514 \quad nanomole&
515     \ditto&
516     \si{\nmol}&
517     \verb+\si{\nmol}+&
518     \SI{e-9}{\mol}\l
519 \quad micromole&

```

520 \ditto&
521 \si{\umol}&
522 \verb+\si{\umol}+&
523 \SI{e-6}{\mol}\\
524 \quad millimole&
525 \ditto&
526 \si{\mmol}&
527 \verb+\si{\mmol}+&
528 \SI{e-3}{\mol}\\
529 \quad kilomole&
530 \ditto&
531 \si{\kmol}&
532 \verb+\si{\kmol}+&
533 \SI{e3}{\mol}\\
534 \vsp
535 nautical mile&
536 distance&
537 \si{\M}&
538 \verb+\si{\M}+&
539 \SI{1852}{\m}\\
540 \vsp
541 neper&
542 gain, loss, and relative values&
543 \si{\Np}&
544 \verb+\si{\Np}+&
545 1\\
546 \vsp
547 newton&
548 force&
549 \si{\N}&
550 \verb+\si{\N}+&
551 \si{\kg\m\per\s\squared}\\
552 \quad millinewton&
553 \ditto&
554 \si{\mN}&
555 \verb+\si{\mN}+&
556 \SI{e-3}{\N}\\
557 \quad kilonewton&
558 \ditto&
559 \si{\kN}&
560 \verb+\si{\kN}+&
561 \SI{e3}{\N}\\
562 \quad meganewton&
563 \ditto&
564 \si{\MN}&
565 \verb+\si{\MN}+&
566 \SI{e6}{\N}\\
567 \vsp
568 ohm&
569 electrical resistance&
570 \si{\ohm}&
571 \verb+\si{\ohm}+&
572 \si{\kg\m\squared\per\s\cubed\per\A\squared}\\
573 \quad milliohm&
574 \ditto&
575 \si{\mohm}&
576 \verb+\si{\mohm}+&
577 \SI{e-3}{\ohm}\\
578 \quad kiloohm&
579 \ditto&
580 \si{\kohm}&
581 \verb+\si{\kohm}+&
582 \SI{e3}{\ohm}\\
583 \quad megaohm&

```

584     \ditto&
585     \si{\Mohm}&
586     \verb+\si{\Mohm}+&
587     \SI{e6}{ohm}\l
588 \vsp
589 pascal&
590     pressure&
591     \si{\Pa}&
592     \verb+\si{\Pa}+&
593     \si{\kg\per\m\per\s\squared}\l
594 \quad kilopascal&
595     \ditto&
596     \si{\kPa}&
597     \verb+\si{\kPa}+&
598     \SI{e3}{\Pa}\l
599 \quad megapascal&
600     \ditto&
601     \si{\MPa}&
602     \verb+\si{\MPa}+&
603     \SI{e6}{\Pa}\l
604 \quad gigapascal&
605     \ditto&
606     \si{\GPa}&
607     \verb+\si{\GPa}+&
608     \SI{e9}{\Pa}\l
609 \vsp
610 percent&
611     hundredths&
612     \si{\percent}&
613     \verb+\si{\percent}+&
614     \SI{e-2}{}\l
615 \vsp
616 pound&
617     weight&
618     \si{\lb}&
619     \verb+\si{\lb}+&
620     \SI{.45359237}{\kg}\l % not an SI unit
621 \vsp
622 radian&
623     plane angular measurement&
624     \si{\rad}&
625     \verb+\si{\rad}+&
626     \SI{180/\pi}{\degree}\l
627 \vsp
628 reduced Planck constant&
629     angular momentum&
630     \si{\planckbar}&
631     \verb+\si{\planckbar}+&
632     \(\approx \SI{1.05e-34}{\J\cdot s})\l
633 \vsp
634 second&
635     time&
636     \si{\s}&
637     \verb+\si{\s}+&
638     (SI base unit)\l
639 \quad attosecond&
640     \ditto&
641     \si{\as}&
642     \verb+\si{\as}+&
643     \SI{e-18}{\s}\l
644 \quad femtosecond&
645     \ditto&
646     \si{\fs}&
647     \verb+\si{\fs}+&

```

```

648     \SI{e-15}{\s}\
649 \quad picosecond&
650     \ditto&
651     \si{\ps}&
652     \verb+\si{\ps}+&
653     \SI{e-12}{\s}\
654 \quad nanosecond&
655     \ditto&
656     \si{\ns}&
657     \verb+\si{\ns}+&
658     \SI{e-9}{\s}\
659 \quad microsecond&
660     \ditto&
661     \si{\us}&
662     \verb+\si{\us}+&
663     \SI{e-6}{\s}\
664 \quad millisecond&
665     \ditto&
666     \si{\ms}&
667     \verb+\si{\ms}+&
668     \SI{e-3}{\s}\
669 \vsp
670 siemens&
671     conductance&
672     \si{\S}&
673     \verb+\si{\S}+&
674     \si{\per\kg\per\m\squared\s\cubed\A\squared}\
675 \vsp
676 sievert&
677     dosage of ionizing radiation&
678     \si{\Sv}&
679     \verb+\si{\Sv}+&
680     \si{\m\squared\per\s\squared}\
681 \vsp
682 speed of light&
683     speed&
684     \si{\clight}&
685     \verb+\si{\clight}+&
686     \SI{299792458}{\m\per\s}\
687 \vsp
688 standard deviation&
689     amount of variation&
690     \si{\SD}&
691     \verb+\si{\SD}+&
692     
$$\sqrt{\frac{1}{N-1} \sum_{i=1}^N (x_i - \bar{x})^2}$$

693 \vsp
694 steradian&
695     measure of solid angles&
696     \si{\sr}&
697     \verb+\si{\sr}+&
698     \SI{1}{\m\squared\per\m\squared}\
699 \vsp
700 tesla&
701     magnetic flux density&
702     \si{\T}&
703     \verb+\si{\T}+&
704     \si{\kg\per\s\squared\per\A}\
705 \vsp
706 metric ton&
707     mass&
708     \si{\t}&
709     \verb+\si{\t}+&
710     \SI{e3}{\kg}\
711 \vsp

```

```

712     volt&
713     electrical potential difference&
714     \si{\V}&
715     \verb+\si{\V}+&
716     \si{\kg\m\squared\per\s\cubed\per\A}\
717 \quad picovolt&
718     \ditto&
719     \si{\pV}&
720     \verb+\si{\pV}+&
721     \SI{e-12}{\V}\
722 \quad nanovolt&
723     \ditto&
724     \si{\nV}&
725     \verb+\si{\nV}+&
726     \SI{e-9}{\V}\
727 \quad microvolt&
728     \ditto&
729     \si{\uV}&
730     \verb+\si{\uV}+&
731     \SI{e-6}{\V}\
732 \quad millivolt&
733     \ditto&
734     \si{\mV}&
735     \verb+\si{\mV}+&
736     \SI{e-3}{\V}\
737 \quad kilovolt&
738     \ditto&
739     \si{\kV}&
740     \verb+\si{\kV}+&
741     \SI{e3}{\V}\
742 \vsp
743 watt&
744     power&
745     \si{\W}&
746     \verb+\si{\W}+&
747     \si{\kg\m\squared\per\s\cubed}\
748 \quad microwatt&
749     \ditto&
750     \si{\uW}&
751     \verb+\si{\uW}+&
752     \SI{e-6}{\W}\
753 \quad milliwatt&
754     \ditto&
755     \si{\mW}&
756     \verb+\si{\mW}+&
757     \SI{e-3}{\W}\
758 \quad kilowatt&
759     \ditto&
760     \si{\kW}&
761     \verb+\si{\kW}+&
762     \SI{e3}{\W}\
763 \quad megawatt&
764     \ditto&
765     \si{\MW}&
766     \verb+\si{\MW}+&
767     \SI{e6}{\W}\
768 \quad gigawatt&
769     \ditto&
770     \si{\GW}&
771     \verb+\si{\GW}+&
772     \SI{e9}{\W}\
773 \vsp
774 weber&
775     magnetic flux&

```

```

776     \si{\Wb}&
777     \verb+\si{\Wb}+&
778     \si{\kg\m\squared\per\s\squared\per\A}\
779     \vsp
780     yard&
781     length&
782     \si{\yd}&
783     \verb+\si{\yd}+&
784     \SI{.9144}{\m}\ % not an SI unit
785     \vsp
786     year&
787     time&
788     \si{\y}&
789     \verb+\si{\y}+&
790     \SI{\approx 365.25}{\d}\ % not an SI unit
791 \end{longtable}
792 }

```


J. RESOURCES

From the [IEEE Editorial Style Manual](https://journals.ieeeauthorcenter.ieee.org/your-role-in-article-production/ieee-editorial-style-manual/) [18]:

- The [IEEE Editorial Style Manual for Authors](https://journals.ieeeauthorcenter.ieee.org/wp-content/uploads/sites/7/IEEE-Editorial-Style-Manual_081920.pdf) [19] contains a formal set of editorial guidelines.
- [Editing Mathematics](http://journals.ieeeauthorcenter.ieee.org/wp-content/uploads/sites/7/Editing-Mathematics.pdf) [20] illustrates how to do mathematics.
- The [IEEE Reference Guide](http://journals.ieeeauthorcenter.ieee.org/wp-content/uploads/sites/7/IEEE-Reference-Guide_081920.pdf) [21] outlines how to cite references.

```
1 \chapter{RESOURCES}
2
3 From the
4 \href
5 {https://journals.ieeeauthorcenter.ieee.org/your-role-in-article-production/ieee-editorial-style-manual/}%
6 {IEEE Editorial Style Manual}
7 \cite{ieee-editorial-style-manual}:
8 \begin{itemize}
9 \item
10 The
11 \href
12 {http://journals.ieeeauthorcenter.ieee.org/wp-content/uploads/sites/7/IEEE-Editorial-Style-Manual_081920.pdf}%
13 {IEEE Editorial Style Manual for Authors}
14 \cite{ieee-editorial-style-manual-for-authors}
15 contains a formal set of editorial guidelines.
16 \item
17 \href
18 {http://journals.ieeeauthorcenter.ieee.org/wp-content/uploads/sites/7/Editing-Mathematics.pdf}%
19 {Editing Mathematics}
20 \cite{editing-mathematics}
21 illustrates how to do mathematics.
22 \item
23 The
24 \href
25 {http://journals.ieeeauthorcenter.ieee.org/wp-content/uploads/sites/7/IEEE-Reference-Guide_081920.pdf}
26 {IEEE Reference Guide}
27 \cite{ieee-reference-guide}
28 outlines how to cite references.
29 \end{itemize}
30
```

K. TABLES

```
1 \chapter{TABLES}
2
```

Here is a really simple table.

Table K.1. The first three American Presidents.

Number	Name
1	George Washington
2	John Adams
3	Thomas Jefferson

```
1
2 Here is a really simple table.
3
4 % "h" means put table "here"---don't let it float to top or bottom of page
5 \begin{table}[ht]
6   \caption{The first three American Presidents.}
7   \vspace*{6pt}
8   \centering
9   % Table format:
10  %   WHAT   DESCRIPTION
11  %   @{}   don't put extra space before first column
12  %   r     right justify first column
13  %   l     left justify second column
14  %   @{}   don't put extra space after second column
15  \begin{tabular}{@{}rl@{}}
16    \toprule
17    \bf Number& \bf Name\\
18    \midrule
19    1& George Washington\\
20    2& John Adams\\
21    3& Thomas Jefferson\\
22    \bottomrule
23  \end{tabular}
24  \label{ta:first-three-american-presidents}
25 \end{table}
```

Here is the same table with a longer caption.

Table K.2. The first three American Presidents. This caption is much, much, much, much, much, much, much, much, much, much longer.

Number	Name
1	George Washington
2	John Adams
3	Thomas Jefferson

```

1
2 \newpage
3
4 Here is the same table with a longer caption.
5
6 % "h" means put table "here"---don't let it float to top or bottom of page
7 \begin{table}[ht]
8   \caption{%
9     The first three American Presidents.
10    This caption is
11    much, much, much, much, much, much,
12    much, much, much, much, much, much
13    longer.%
14  }
15  \vspace*{6pt}
16  \centering
17  % Table format:
18  %   WHAT   DESCRIPTION
19  %   @{}    don't put extra space before first column
20  %   r      right justify first column
21  %   l      left justify second column
22  %   @{}    don't put extra space after second column
23  \begin{tabular}{@{}rl@{}}
24    \toprule
25    \bf Number& \bf Name\\
26    \midrule
27    1& George Washington\\
28    2& John Adams\\
29    3& Thomas Jefferson\\
30    \bottomrule
31  \end{tabular}
32  \label{ta:first-three-american-presidents-longer-caption}
33 \end{table}

```

L^AT_EX can print horizontal and vertical rules in tables. I don't like the way this looks and suggest you do not use tables with lots of horizontal and vertical lines.

Table K.3. The first three American Presidents with horizontal and vertical lines

#	Name
1	George Washington
2	John Adams
3	Thomas Jefferson

```

1
2 \newpage
3
4 \LaTeX\ can print horizontal
5 and vertical rules in tables.
6 I don't like the way this looks
7 and suggest you do not use tables
8 with lots of horizontal and vertical lines.
9 \begin{table}[ht]
10 \caption{The first three American Presidents with horizontal and vertical lines}
11 \vspace*{6pt}
12 \centering
13 % Table format:
14 % WHAT DESCRIPTION
15 % | print a vertical rule
16 % c center column
17 % | print a vertical rule
18 % l left justify column
19 % | print a vertical rule
20 \begin{tabular}{|c|l|}
21 % "\hline" prints a horizontal rule
22 \hline
23 \bf\#\& \bf Name\\
24 \hline
25 1& George Washington\\
26 \hline
27 2& John Adams\\
28 \hline
29 3& Thomas Jefferson\\
30 \hline
31 \end{tabular}
32 \label{ta:American-Presidents-with-horizontal}
33 \end{table}

```

Here is a more complicated table.

Table K.4. C Bitwise Operators

A	B	A B	A&B
0	0	0	0
0	1	1	0
1	0	1	0
1	1	1	1

```

1
2 \newpage
3
4 Here is a more complicated table.
5
6 \begin{table}[ht]
7   \caption{C Bitwise Operators}
8   \vspace*{6pt}
9   \centering
10  % Table format:
11  %   WHAT   DESCRIPTION
12  %   @{}    don't put extra space before first column
13  %   c      first column is centered
14  %   c      second column is centered
15  %   c      third column is centered
16  %   c      fourth column is centered
17  %   @{}    don't put extra space after fourth column
18  \begin{tabular}{@{}cccc@{}}
19    \toprule
20    \bf A& \bf B& \bf A|$B& \bf A&B\\[2pt]
21    \midrule
22    0& 0& 0& 0\\
23    0& 1& 1& 0\\
24    1& 0& 1& 0\\
25    1& 1& 1& 1\\
26    \bottomrule
27  \end{tabular}
28  \label{ta:C-Bitwise}
29 \end{table}

```

Here is a table that is too long to fit on one page.

Table K.5. State Abbreviations

State	Abbreviation
Alabama	AL
Alaska	AK
American Samoa	AS
Arizona	AZ
Arkansas	AR
Armed Forces Europe	AE
Armed Forces Pacific	AP
Armed Forces the Americas	AA
California	CA
Colorado	CO
Connecticut	CT
Delaware	DE
District of Columbia	DC
Federated States of Micronesia	FM
Florida	FL
Georgia	GA
Guam	GU
Hawaii	HI
Idaho	ID
Illinois	IL
Indiana	IN
Iowa	IA
Kansas	KS
Kentucky	KY
Louisiana	LA
Maine	ME
Marshall Islands	MH
Maryland	MD
Massachusetts	MA
Michigan	MI
Minnesota	MN
Mississippi	MS
Missouri	MO
Montana	MT
Nebraska	NE
Nevada	NV
New Hampshire	NH
New Jersey	NJ
New Mexico	NM

continued on next page

Table K.5. *continued*

State	Abbreviation
New York	NY
North Carolina	NC
North Dakota	ND
Northern Mariana Islands	MP
Ohio	OH
Oklahoma	OK
Oregon	OR
Pennsylvania	PA
Puerto Rico	PR
Rhode Island	RI
South Carolina	SC
South Dakota	SD
Tennessee	TN
Texas	TX
Utah	UT
Vermont	VT
Virgin Islands	VI
Virginia	VA
Washington	WA
West Virginia	WV
Wisconsin	WI
Wyoming	WY

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continued on next page

Table K.5. *continued*

State	Abbreviation
make this three pages long	make this three pages long
make this three pages long	make this three pages long
make this three pages long	make this three pages long
make this three pages long	make this three pages long
make this three pages long	make this three pages long
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make this three pages long	make this three pages long
make this three pages long	make this three pages long
make this three pages long	make this three pages long
make this three pages long	make this three pages long
make this three pages long	make this three pages long

```
1
2 \newpage
3
4 Here is a table that is too long to fit on one page.
5
6 % This is very loosely based on page 106 of _A Guide to LaTeX_, third edition,
7 % by Helmut Kopka and Patrick W. Daly.
8 \begin{longtable}{@{}ll@{}}
9   \caption{State Abbreviations}\
10   \toprule
11   \bf State& \bf Abbreviation\
12   \hline
13 \endfirsthead
14   \caption[ ]{\emph{continued}}\
15   \midrule
16   \bf State& \bf Abbreviation\
17   \midrule
18 \endhead
19   \hline
20   \multicolumn{2}{r}{\emph{continued on next page}}
21 \endfoot
22   \bottomrule
23 \endlastfoot
24 Alabama& AL\
25 Alaska& AK\
26 American Samoa& AS\
27 Arizona& AZ\
28 Arkansas& AR\
29 Armed Forces Europe& AE\
30 Armed Forces Pacific& AP\
31 Armed Forces the Americas& AA\
32 California& CA\
33 Colorado& CO\
```


34 Connecticut& CT\\
35 Delaware& DE\\
36 District of Columbia& DC\\
37 Federated States of Micronesia& FM\\
38 Florida& FL\\
39 Georgia& GA\\
40 Guam& GU\\
41 Hawaii& HI\\
42 Idaho& ID\\
43 Illinois& IL\\
44 Indiana& IN\\
45 Iowa& IA\\
46 Kansas& KS\\
47 Kentucky& KY\\
48 Louisiana& LA\\
49 Maine& ME\\
50 Marshall Islands& MH\\
51 Maryland& MD\\
52 Massachusetts& MA\\
53 Michigan& MI\\
54 Minnesota& MN\\
55 Mississippi& MS\\
56 Missouri& MO\\
57 Montana& MT\\
58 Nebraska& NE\\
59 Nevada& NV\\
60 New Hampshire& NH\\
61 New Jersey& NJ\\
62 New Mexico& NM\\
63 New York& NY\\
64 North Carolina& NC\\
65 North Dakota& ND\\
66 Northern Mariana Islands& MP\\
67 Ohio& OH\\
68 Oklahoma& OK\\
69 Oregon& OR\\
70 Pennsylvania& PA\\
71 Puerto Rico& PR\\
72 Rhode Island& RI\\
73 South Carolina& SC\\
74 South Dakota& SD\\
75 Tennessee& TN\\
76 Texas& TX\\
77 Utah& UT\\
78 Vermont& VT\\
79 Virgin Islands& VI\\
80 Virginia& VA\\
81 Washington& WA\\
82 West Virginia& WV\\
83 Wisconsin& WI\\
84 Wyoming& WY\\
85 \multicolumn{2}{c}{make this three pages long}\\
86 \multicolumn{2}{c}{make this three pages long}\\
87 \multicolumn{2}{c}{make this three pages long}\\
88 \multicolumn{2}{c}{make this three pages long}\\
89 \multicolumn{2}{c}{make this three pages long}\\
90 \multicolumn{2}{c}{make this three pages long}\\
91 \multicolumn{2}{c}{make this three pages long}\\
92 \multicolumn{2}{c}{make this three pages long}\\
93 \multicolumn{2}{c}{make this three pages long}\\
94 \multicolumn{2}{c}{make this three pages long}\\
95 \multicolumn{2}{c}{make this three pages long}\\
96 \multicolumn{2}{c}{make this three pages long}\\
97 \multicolumn{2}{c}{make this three pages long}

```
98 \multicolumn{2}{c}{make this three pages long}\\
99 \multicolumn{2}{c}{make this three pages long}\\
100 \multicolumn{2}{c}{make this three pages long}\\
101 \multicolumn{2}{c}{make this three pages long}\\
102 \multicolumn{2}{c}{make this three pages long}\\
103 \multicolumn{2}{c}{make this three pages long}\\
104 \multicolumn{2}{c}{make this three pages long}\\
105 \multicolumn{2}{c}{make this three pages long}\\
106 \multicolumn{2}{c}{make this three pages long}\\
107 \multicolumn{2}{c}{make this three pages long}\\
108 \multicolumn{2}{c}{make this three pages long}\\
109 \multicolumn{2}{c}{make this three pages long}\\
110 \multicolumn{2}{c}{make this three pages long}\\
111 \multicolumn{2}{c}{make this three pages long}\\
112 \multicolumn{2}{c}{make this three pages long}\\
113 \multicolumn{2}{c}{make this three pages long}\\
114 \multicolumn{2}{c}{make this three pages long}\\
115 \multicolumn{2}{c}{make this three pages long}\\
116 \multicolumn{2}{c}{make this three pages long}\\
117 \multicolumn{2}{c}{make this three pages long}\\
118 \multicolumn{2}{c}{make this three pages long}\\
119 \multicolumn{2}{c}{make this three pages long}\\
120 \end{longtable}
```

```

1
2 % The table is on the next page.
3
4 \newpage
5
6 % Set \LTcapwidth (the longtable caption width)
7 % to \textwidth minus 4 paragraph indent widths.
8 \setlength{\LTcapwidth}{\textwidth}
9 \addtolength{\LTcapwidth}{-4\parindent}
10
11 \newlength{\twidth}
12 \newlength{\theight}
13
14 \setlength{\twidth}{\textwidth}
15 \setlength{\theight}{\textheight}
16
17 \begin{sidewaystable}
18 % The following two lines compensate for what I think is a bug.
19 \setlength{\textwidth}{\theight}
20 \setlength{\textheight}{\twidth}
21 \caption{Sidewaystable of the first three American Presidents.}
22 \vspace*{6pt}
23 \centering
24 \begin{tabular}{@{}rl@{}}
25 \toprule
26 \bf Number& \bf Name\\
27 \midrule
28 1& George Washington\\
29 2& John Adams\\
30 3& Thomas Jefferson\\
31 \bottomrule
32 \end{tabular}
33 \end{sidewaystable}

1 \begin{sidewaystable}
2 % The following two lines compensate for what I think is a bug.
3 \setlength{\textwidth}{\theight}
4 \setlength{\textheight}{\twidth}
5 \caption{Two tables can be placed vertically in a sidewaystable environment.}
6 \vspace*{6pt}
7 \centering
8 \begin{tabular}{@{}rl@{}}
9 \toprule
10 \bf Number& \bf Name\\
11 \midrule
12 1& George Washington\\
13 2& John Adams\\
14 3& Thomas Jefferson\\
15 \bottomrule
16 \end{tabular}
17 \vspace*{2\baselineskip}
18 \caption{This is the second table in the sideways environment.}
19 \vspace*{6pt}
20 \begin{tabular}{@{}rl@{}}
21 \toprule
22 \bf Number& \bf Name\\
23 \midrule
24 1& George Washington\\
25 2& John Adams\\
26 3& Thomas Jefferson\\
27 \bottomrule
28 \end{tabular}
29 \end{sidewaystable}

```

Table K.6. Sidewaystable of the first three American Presidents.

Number	Name
1	George Washington
2	John Adams
3	Thomas Jefferson

Table K.7. Two tables can be placed vertically in a sidewaysstable environment.

Number	Name
1	George Washington
2	John Adams
3	Thomas Jefferson

Table K.8. This is the second table in the sideways environment.

Number	Name
1	George Washington
2	John Adams
3	Thomas Jefferson

Table K.9. Live Guitar Open String Testing Data - Pitch (f_0)

Note Name	Computed f_0 (Hz)	Live Guitar Test 1			Live Guitar Test 2			Live Guitar Test 3		
		Measured f_0 (Hz)	% Error	Accuracy Range (¢)	Measured f_0 (Hz)	% Error	Accuracy Range (¢)	Measured f_0 (Hz)	% Error	Accuracy Range (¢)
E ₂	82.407	82.333	0.0897	+2	82.616	0.2538	+6	82.474	0.0814	+2
A ₂	110.000	110.092	0.0836	+2	110.092	0.0836	+2	110.092	0.0836	+2
D ₃	146.832	146.789	0.0295	-2	146.789	0.0295	-2	147.239	0.2769	+6
G ₃	195.998	196.721	0.3690	+8	195.918	0.0407	+2	196.721	0.3690	+8
B ₃	246.942	247.423	0.1949	+4	246.517	0.1720	-4	247.423	0.1949	+4
E ₄	329.628	331.034	0.4267	+8	331.034	0.4267	+8	331.034	0.4267	+8

Thanks to Kathryn Schmidt <klupacch@purdue.edu> for donating this table.

```

1 \begin{sidewaystable}[ht]%
2 % The following two lines compensate for what I think is a bug.
3 \setlength{\textwidth}{\theight}%
4 \setlength{\textheight}{\twidth}%
5 \caption{Live Guitar Open String Testing Data - Pitch (\textit{f\textsubscript{0}})}
6 \vspace*{6pt}%
7 \label{ta:live-guitar}%
8 % Define "Live Guitar Test" column.
9 \def\lgt#1{\bf Live Guitar Test #1}
10 % Define "Note", "Computed", "Measured", "%", and "Accuracy" column headings.
11 \def\note{\bf Note}
12 \def\cal{\bf Computed}
13 \def\mea{\bf Measured}
14 \def\per{\bf \%}
15 \def\acc{\bf Accuracy}
16 % Define "Name", "f_0 (Hz)", "Error", and "Range (\textcent)" column headings.
17 \def\name{\bf Name}
18 \def\fsz{\bf \textit{f\textsubscript{0}} (Hz)}
19 \def\err{\bf Error}
20 \def\ran{\bf Range (\textcent)}
21 % Make "!" be an invisible character the width of a digit.
22 % (All digits in the normal font are the same width.)
23 \catcode\!=\active \def!\{\hphantom 1}
24 \hbox to \textwidth
25 {%
26 \hss
27 % From http://zerocapcable.com/?page_id=225
28 % The units of tuning accuracy are cents. A cent is one hundredth
29 % of a semitone. Since there are 12 semitones in an octave, there
30 % are 1200 cents in an octave.
31 % The default \tabcolsep is 6.0pt.
32 \setlength{\tabcolsep}{5pt}%
33 \begin{tabular}{@{}cc|ccc|ccc|ccc@{}}
34 \hline
35 \multicolumn{2}{c|}{ }&
36 \multicolumn{3}{c|}{\lgt1}&
37 \multicolumn{3}{c|}{\lgt2}&
38 \multicolumn{3}{c|}{\lgt3}\\
39 \cline{3-11}
40 \note& \cal& \mea& \per& \acc& \mea& \per& \acc& \mea& \per& \acc\\
41 \name& \fsz& \fsz& \err& \ran& \fsz& \err& \ran& \fsz& \err& \ran\\
42 \hline
43 E\textsubscript 2& !82.407& !82.333& 0.0897& $+2$& !82.616& 0.2538& $+6$& !82.474& 0.0814& $+2$\\
44 A\textsubscript 2& 110.000& 110.092& 0.0836& $+2$& 110.092& 0.0836& $+2$& 110.092& 0.0836& $+2$\\
45 D\textsubscript 3& 146.832& 146.789& 0.0295& $-2$& 146.789& 0.0295& $-2$& 147.239& 0.2769& $+6$\\
46 G\textsubscript 3& 195.998& 196.721& 0.3690& $+8$& 195.918& 0.0407& $+2$& 196.721& 0.3690& $+8$\\
47 B\textsubscript 3& 246.942& 247.423& 0.1949& $+4$& 246.517& 0.1720& $-4$& 247.423& 0.1949& $+4$\\
48 E\textsubscript 4& 329.628& 331.034& 0.4267& $+8$& 331.034& 0.4267& $+8$& 331.034& 0.4267& $+8$\\
49 \hline
50 \multicolumn{11}{@{}l}{Thanks to Kathryn Schmidt <$klupacch@purdue.edu$> for donating this table.}\\
51 \end{tabular}
52 \hss
53 }
54 \end{sidewaystable}
55
56 % Process all unprocessed floats.
57 % None of the current floats will be after the \FloatBarrier.
58 \FloatBarrier

```

L. TEXT

L.1 Frenchspacing

The “`\frenchspacing`” command puts one space after sentences. Normally two spaces are put after sentences.

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nam cursus. Morbi ut mi. Nullam enim leo, egestas id, condimentum at, laoreet mattis, massa. Sed eleifend nonummy diam. Praesent mauris ante, elementum et, bibendum at, posuere sit amet, nibh. Duis tincidunt lectus quis dui viverra vestibulum. Suspendisse vulputate aliquam dui. Nulla elementum dui ut augue. Aliquam vehicula mi at mauris. Maecenas placerat, nisl at consequat rhoncus, sem nunc gravida justo, quis eleifend arcu velit quis lacus. Morbi magna magna, tincidunt a, mattis non, imperdiet vitae, tellus. Sed odio est, auctor ac, sollicitudin in, consequat vitae, orci. Fusce id felis. Vivamus sollicitudin metus eget eros.

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nam cursus. Morbi ut mi. Nullam enim leo, egestas id, condimentum at, laoreet mattis, massa. Sed eleifend nonummy diam. Praesent mauris ante, elementum et, bibendum at, posuere sit amet, nibh. Duis tincidunt lectus quis dui viverra vestibulum. Suspendisse vulputate aliquam dui. Nulla elementum dui ut augue. Aliquam vehicula mi at mauris. Maecenas placerat, nisl at consequat rhoncus, sem nunc gravida justo, quis eleifend arcu velit quis lacus. Morbi magna magna, tincidunt a, mattis non, imperdiet vitae, tellus. Sed odio est, auctor ac, sollicitudin in, consequat vitae, orci. Fusce id felis. Vivamus sollicitudin metus eget eros.

```
1  \chapter{TEXT}
2
3
4  \section{Frenchspacing}
5
6  The ``\verb+\frenchspacing+'' command puts one space after sentences.
7  Normally two spaces are put after sentences.
8
9  {\frenchspacing
10 Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nam
11 cursus. Morbi ut mi. Nullam enim leo, egestas id, condimentum at,
12 laoreet mattis, massa. Sed eleifend nonummy diam. Praesent mauris
13 ante, elementum et, bibendum at, posuere sit amet, nibh. Duis
14 tincidunt lectus quis dui viverra vestibulum. Suspendisse
15 vulputate aliquam dui. Nulla elementum dui ut augue. Aliquam
16 vehicula mi at mauris. Maecenas placerat, nisl at consequat
17 rhoncus, sem nunc gravida justo, quis eleifend arcu velit quis
18 lacus. Morbi magna magna, tincidunt a, mattis non, imperdiet
19 vitae, tellus. Sed odio est, auctor ac, sollicitudin in,
20 consequat vitae, orci. Fusce id felis. Vivamus sollicitudin metus
21 eget eros.\endgraf
22 }
23
24 Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nam
25 cursus. Morbi ut mi. Nullam enim leo, egestas id, condimentum at,
26 laoreet mattis, massa. Sed eleifend nonummy diam. Praesent mauris
27 ante, elementum et, bibendum at, posuere sit amet, nibh. Duis
28 tincidunt lectus quis dui viverra vestibulum. Suspendisse
29 vulputate aliquam dui. Nulla elementum dui ut augue. Aliquam
30 vehicula mi at mauris. Maecenas placerat, nisl at consequat
31 rhoncus, sem nunc gravida justo, quis eleifend arcu velit quis
32 lacus. Morbi magna magna, tincidunt a, mattis non, imperdiet
```



```

33 vitae, tellus. Sed odio est, auctor ac, sollicitudin in,
34 consequat vitae, orci. Fusce id felis. Vivamus sollicitudin metus
35 eget eros.

```

L.2 Multiple Columns

Depending on what version of L^AT_EX you're running the `multicols` package may or may not do what you want.

This is one columnThis is one column. This is one column. This is one column. This is one column. This is one column. This is one column. This is one column. This is one column. This is one column. This is one column.

This is two columns. This is two columns.	This is two columns. This is two columns.
This is two columns. This is two columns.	This is two columns. This is two columns.
This is two columns. This is two columns.	This is two columns. This is two columns.

This is three columns.	three columns.	This is	three columns.	This is
This is three columns. This	three columns.	This is	three columns.	This is three
is three columns. This is	three columns.	This is	columns.	

This is four	columns. This is four	columns. This is four	columns. This is four	columns. This is four
columns. This is four	columns. This is four	columns. This is four	columns. This is four	columns.
columns. This is four	columns. This is four	columns. This is four	columns. This is four	

This is five	This is five	This is five	This is five	This is five	This is five
columns. This is	columns. This is	columns. This is	columns. This is	columns. This is	columns. This is
five columns.	five columns.	five columns.	five columns.	five columns.	five columns.

```

1  \section{Multiple Columns}
2
3  Depending on what version of \LaTeX\ you're running
4  the \verb+multicols+ package may or may not do what
5  you want.
6
7  % The multicols package must be loaded for this to work.
8  % To load the multicols package put
9  %   \usepackage{multicols}
10 % between the "\documentclass" and "\begin{document}" commands.
11
12 % Put this amount of space between the columns.
13 % Let's use the default column separation to see what happens.
14 % \setlength{\columnsep}{0.5truein}
15
16 % Separate the columns with a vertical rule this wide.
17 % Make the column three times the default width.
18 \setlength{\columnseprule}{1.2pt}
19
20 This is one column\MyRepeat{This is one column. }{10}
21
22 \begin{multicols}{2}
23   \MyRepeat{This is two columns. }{12}
24 \end{multicols}
25

```

```

26 \begin{multicols}{3}
27   \MyRepeat{This is three columns. }{9}
28 \end{multicols}
29
30 \begin{multicols}{4}
31   \MyRepeat{This is four columns. }{10}
32 \end{multicols}
33
34 \begin{multicols}{5}
35   \MyRepeat{This is five columns. }{10}
36 \end{multicols}

```

L.3 Words

irregardless is a nonstandard word that means regardless. Use *regardless* instead [22].

out of date / out-of-date means “outmoded, obsolete”. [23].

When it comes after the noun, the compound adjective usually doesn’t get a hyphen. So we say an easy-to-remember number, but the number is easy to remember. Same goes for up to date—if it’s before a noun it needs a hyphen. A document is up to date but it’s an up-to-date document [24]. Also see [25].

In the context of writing about out-of-date software you may want to use “deprecated” [26] instead.

start-up / start-up company means a fledgling business enterprise [27]. I would use the more modern *startup* and only use *company* if not clear from the context.

peace out means “goodbye” [28]

```

1
2
3 \section{Words}
4
5 \newenvironment{entry}
6 {%
7   \bigskip
8   % Start a \vbox here.
9   % Everything in a \vbox is guaranteed to be on the same page.
10  \vbox\bgroup
11    \noindent
12  }
13 {%
14   % End the \vbox here.
15  \egroup
16 }
17
18 \begin{entry}
19   {\bfseries irregardless}\quad
20   is a nonstandard word that means regardless.
21   Use \emph{regardless} instead
22   \cite{merriam-webster-irregardless}.
23 \end{entry}
24
25 \begin{entry}
26   {\bfseries out of date / out-of-date}\quad

```

27 means ``outmoded, obsolete''.
28 \cite{merriam-webster-out-of-date}.
29
30 When it comes after the noun,
31 the compound adjective usually doesn't get a hyphen.
32 So we say an easy-to-remember number,
33 but the number is easy to remember.
34 Same goes for up to date---if it's before a noun it needs a hyphen.
35 A document is up to date but it's an up-to-date document
36 \cite{thewriter-to-hyphenate-or-not-to-hyphenate}.
37 Also see
38 \cite{oed-out-of-date}.
39
40 In the context of writing about out-of-date software you may want to
41 use ``deprecated'' \cite{merriam-webster-deprecated} instead.
42 \end{entry}
43
44 \begin{entry}
45 {\bfseries start-up / start-up company}\quad
46 means a fledgling business enterprise
47 \cite{wikipedia-startup-company}.
48 I would use the more modern \emph{startup}
49 and only use \emph{company} if not clear from the context.
50 \end{entry}
51
52 \begin{entry}
53 {\bfseries peace out}\quad
54 means
55 ``goodbye''
56 \cite{online-slang-dictionary-peace-out}
57 \end{entry}

M. VIDEO

This video example doesn't work for me using Firefox on Linux.

```
1 \chapter{VIDEO}
2
3 This video example doesn't work for me using Firefox on Linux.
4
5 % The following is based on information in
6 %   http://ctan.math.washington.edu/tex-archive/macros/latex/contrib/media9/doc/media9.pdf
7 % Embed a YouTube video.
8 \includemedia[
9   activate = pageopen,
10  flashvars = {
11    autohide      = 1 % Autohide controlbar.
12    &modestbranding = 1 % No YouTube logo in control bar.
13    &rel          = 0 % No related videos after end of this video.
14    &showinfo    = 0 % No title and other info before start of video.
15  },
16  height      = 2.25in, % 9 x 16 aspect ratio
17  width       = 4in
18 ]{{https://www.youtube.com/watch?v=CODPdy98e4c}}
```

N. ASTRONOMY

1
2 \chapter{ASTRONOMY}
3

O. BIOLOGY

1 \chapter{BIOLOGY}

P. CHEMISTRY

```
1 \chapter{CHEMISTRY}
```

P.1 Chemical Diagrams

The chemplants package [29] extends the *TikZ* package to draw chemical process units.

```
1
2 \section{Chemical Diagrams}
3
4 The chemplants package \cite{feffin2019}
5 extends the
6 \href{http://ctan.math.washington.edu/tex-archive/graphics/pgf/base/doc/pgfmanual.pdf}{\TikZ} package
7 to draw chemical process units.
```

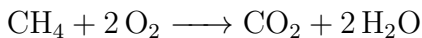
P.2 Chemical Equations

The mhchem Bundle [30] contains mhchem v4.08 (chemical equations), hpstatement v1.02 (official hazard and precautionary statements), and rsphrase v3.11 (official risk and safety phrases).

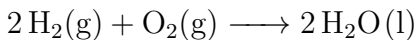
```
1
2 \section{Chemical Equations}
3
4 The mhchem Bundle \cite{hensel2018}
5 contains mhchem v4.08 (chemical equations),
6 hpstatement v1.02 (official hazard and precautionary statements),
7 and rsphrase v3.11 (official risk and safety phrases).
```

Defined in thesis.tex: NO₃⁻.

```
1
2 Defined in thesis.tex: \nitrate.
```



```
1
2 % See page 1 of
3 % https://www.thoughtco.com/what-is-a-chemical-equation-604026
4 \ce{CH4 + 2O2 -> CO2 + 2H2O}
```

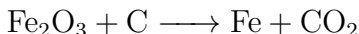


```
1
2 % See page 1 of
3 % https://www.thoughtco.com/what-is-a-chemical-equation-604026
4 \ce{2H2(g) + O2(g) -> 2H2O(l)}
```

$\text{Ag}^+(\text{aq}) + \text{NO}_3^-(\text{aq}) + \text{Na}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \longrightarrow \text{AgCl}(\text{s}) + \text{Na}^+(\text{aq}) + \text{NO}_3^-(\text{aq})$ is an ionic equation of the chemical reaction: $\text{AgNO}_3(\text{aq}) + \text{NaCl}(\text{aq}) \longrightarrow \text{AgCl}(\text{s}) + \text{NaNO}_3(\text{aq})$

```

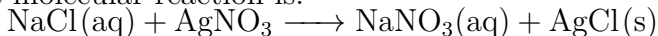
1
2 % See page 1 of
3 % https://www.thoughtco.com/definition-of-ionic-equation-605262
4 \ce{Ag+(aq) + NO3-(aq) + Na+(aq) + Cl-(aq) -> AgCl(s) + Na+(aq) + NO3-(aq)}
5 is an ionic equation of the chemical reaction:
6 \ce{AgNO3(aq) + NaCl(aq) -> AgCl(s) + NaNO3(aq)}
```



```

1
2 % See page 1 of
3 % https://www.thoughtco.com/definition-of-balanced-equation-and-examples-604380
4 \ce{Fe2O3 + C -> Fe + CO2}
```

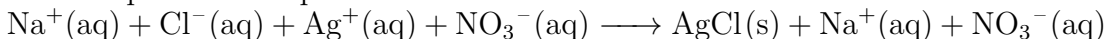
For example, in the reaction between sodium chloride (NaCl) and silver nitrate (AgNO₃), the molecular reaction is:



```

1
2 % From page 1 of
3 % https://www.thoughtco.com/definition-of-molecular-equation-605366
4
5 For example, in the reaction between sodium chloride
6 (\ce{NaCl})
7 and silver nitrate
8 (\ce{AgNO3}),
9 the molecular reaction is:
10
11 \ce{NaCl(aq) + AgNO3 -> NaNO3(aq) + AgCl(s)}
```

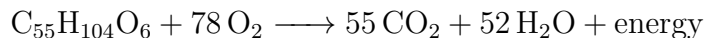
The complete ionic equation is:



```

1
2 The complete ionic equation is:
3
4 \ce{Na+(aq) + Cl-(aq) + Ag+(aq) + NO3-(aq) -> AgCl(s) + Na+(aq) + NO3-(aq)}
```

Ruben Meerman [31, starting at 5:25] claims this equation

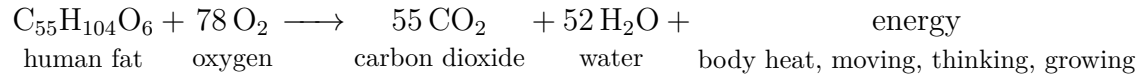


describes weight loss.

```

1
2 Ruben Meerman \cite[starting at 5:25]{meerman} claims this equation
3 \begin{center}
4 \ce{C55H104O6 + 78O2 -> 55CO2 + 52H2O + energy}\endgraf
5 \end{center}
6 describes weight loss.
```


And with better annotation:

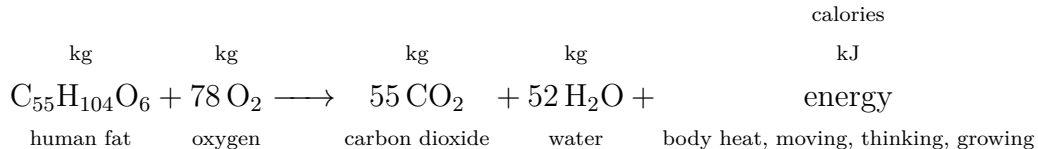


```

1
2 And with better annotation:
3
4 \begin{center}
5   \newcommand{\vph}{\vphantom{\large Ag}}
6   \ce{
7     $\underset{\text{\vph \footnotesize human fat}}{\ce{C55H104O6}}$
8     +
9     $\underset{\text{\vph \footnotesize oxygen}}{\ce{78O2}}$
10    ->
11    $\underset{\text{\vph \footnotesize carbon dioxide}}{\ce{55CO2}}$
12    +
13    $\underset{\text{\vph \footnotesize water}}{\ce{52H2O}}$
14    +
15    $\underset{\text{\vph \footnotesize body heat, moving, thinking, growing}}{\text{energy}}$
16   }
17 \end{center}

```

And with still better annotation:



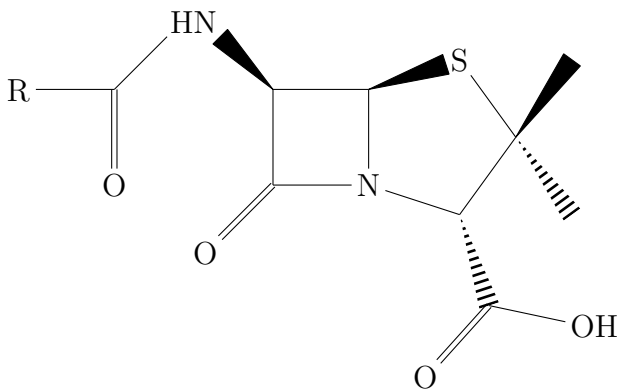
```

1
2 And with still better annotation:
3
4 \begin{center}
5 \newcommand{\Fs}{\scriptsize}
6 \begin{tabular}{@{}c{}c{}c{}c{}c{}c{}c{}c{}c{}c{}}
7 & & & & & & & & & & % 1. C55H10406
8 & & & & & & & & & & % 2. +
9 & & & & & & & & & & % 3. 7802
10 & & & & & & & & & & % 4. ->
11 & & & & & & & & & & % 5. 55C02
12 & & & & & & & & & & % 6. +
13 & & & & & & & & & & % 7. 52H20
14 & & & & & & & & & & % 8. +
15 & \Fs calories\& & & & & & & & & % 9. energy
16 %
17 \Fs kg& & & & & & & & & & % 1.
18 & & & & & & & & & & % 2.
19 \Fs kg& & & & & & & & & & % 3.
20 & & & & & & & & & & % 4.
21 \Fs kg& & & & & & & & & & % 5.
22 & & & & & & & & & & % 6.
23 \Fs kg& & & & & & & & & & % 7.
24 & & & & & & & & & & % 8.
25 \Fs kJ\& & & & & & & & & & % 9.
26 %
27 \noalign{\vspace{3pt}}
28 %
29 \ce{C55H10406} & & & & & & & & & & % 1.
30 & \ce{+} & & & & & & & & & % 2.
31 & \ce{78O2} & & & & & & & & & % 3.
32 & \ce{->} & & & & & & & & & % 4.
33 & \ce{55C02} & & & & & & & & & % 5.
34 & \ce{+} & & & & & & & & & % 6.
35 & \ce{52H20} & & & & & & & & & % 7.
36 & \ce{+} & & & & & & & & & % 8.
37 & energy\& & & & & & & & & % 9.
38 %
39 \Fs human fat& & & & & & & & & & % 1.
40 & & & & & & & & & & % 2.
41 \Fs oxygen& & & & & & & & & & % 3.
42 & & & & & & & & & & % 4.
43 \Fs carbon dioxide& & & & & & & & & & % 5.
44 & & & & & & & & & & % 6.
45 \Fs water& & & & & & & & & & % 7.
46 & & & & & & & & & & % 8.
47 \Fs body heat, moving, thinking, growing\& & & & & & & & & & % 9.
48 \end{tabular}
49 \end{center}

```

P.3 Chemical Figures

Below is an example of how to use the chemfig package [32].
Here is the chemical figure for Penicillin [32, pages 72–73]:



```
1
2
3 \section{Chemical Figures}
4
5 Below is an example of how to use the chemfig package \cite{tellechea2019}.
6
7 % Chicago Manual of Style Online, 17 edition, section 9.61 states
8 % that 72--73, not 72--3, should be used.
9 Here is the chemical figure
10 for Penicillin \cite[pages-72--73]{tellechea2019}:\
11
12 \chemfig{[: -90]HN(-[: -45](-[: -45]R)=[: +45]O)>[: +45]*4(-(=O)-N*5(-(<[: -60]O)
13 -[: +60]OH)-(<[: +0])(<[: -108])-S>--)}
```

Q. ELECTRICAL ENGINEERING

1 \chapter{ELECTRICAL ENGINEERING}

Q.1 Amplifiers

1
2 \section{Amplifiers}

Q.2 Basic Circuit Components

1
2 \section{Basic Circuit Components}

Q.3 Electronic Tubes

1
2 \section{Electronic Tubes}

Q.4 Logic Gates

1
2 \section{Logic Gates}

Q.5 Transistors

1
2 \section{Transistors}

R. LINGUISTICS

See WIKIBOOKS \LaTeX /Linguistics [33] or google for the information you need.

The doulossil font [34] is a TrueType font. Version 0.1 on September 21, 2020 claimed “it has characters that are not in other TeX IPA fonts”.

```
1 \chapter{LINGUISTICS}
2
3 See WIKIBOOKS \LaTeX/Linguistics \cite{wikibooks-latex-linguistics}
4 or google for the information you need.
5
6 The doulossil font \cite{tambe2020}
7 is a TrueType font.
8 Version 0.1 on September 21, 2020 claimed
9 ``it has characters that are not in other TeX IPA fonts''.
```

S. MATHEMATICS

PurdueThesis loads the `amsmath` package [35] to do mathematics.

```
1 \chapter{MATHEMATICS}
2
3 \PurdueThesis\ loads the \amsmath\ package \cite{amslatex3project2019}
4 to do mathematics.
```

There are two types of mathematics in \LaTeX . Text math is math that that is interspersed with text. For example, this is text math: $a = b + c$. This is display math:

$$a = b + c \tag{S.1}$$

```
1 There are two types of mathematics in \LaTeX.
2 Text math is math that that is interspersed with text.
3 For example, this is text math: \((a = b + c)\).
4 This is display math:
5 \begin{equation}
6   a = b + c
7 \end{equation}
```

S.1 Standard Functions

Standard functions should be in a roman font. Like this: $\cos\theta$.

Here is a list of standard function commands:

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

```
1 \newpage
2
3 \section{Standard Functions}
4
5 Standard functions should be in a roman font.
6 Like this:  $\cos\theta$ .
7
8 Here is a list of standard function commands:\\
9
10 \hbox to\hsize{%
11   \indent
12   \vbox{
13     \begin{tabular}{@{}l111l@{}}
14       \verb+\arccos+& \verb+\csc+& \verb+\ker+& \verb+\min+\\
15       \verb+\arcsin+& \verb+\deg+& \verb+\lg+& \verb+\Pr+\\
16       \verb+\arctan+& \verb+\det+& \verb+\lim+& \verb+\sec+\\
17       \verb+\arg+& \verb+\dim+& \verb+\liminf+& \verb+\sin+\\
18       \verb+\cos+& \verb+\exp+& \verb+\limsup+& \verb+\sinh+\\
19       \verb+\cosh+& \verb+\gcd+& \verb+\ln+& \verb+\sup+\\
20       \verb+\cot+& \verb+\hom+& \verb+\log+& \verb+\tan+\\
21       \verb+\coth+& \verb+\inf+& \verb+\max+& \verb+\tanh+\\
22     \end{tabular}
23   }
24 }
```

S.2 English Words in Math

English words in math should be in a roman font like this:

Let the maximum value of a be a_{\max} .

$a_{\max} \geq a_{\min}$ should always be true.

The temperature in the attic is t_{attic} .

```
1 \newpage
2
3 \section{English Words in Math}
4
5 English words in math should be in a roman font like this:\\
6 Let the maximum value of \(\a\) be \(\a_{\text{max}}\).\\
7 \(\a_{\text{max}} \geq a_{\text{min}}\) should always be true.\\
8 The temperature in the attic is \(\t_{\text{attic}}\).
```

S.3 Text Math

Use $\left($ to start text math and $\right)$ to end text math. Some people use $\$$ to start and end text math—I don't recommend that because L^AT_EX can give better error messages if you use $\left($ and $\right)$.

```
1 \section{Text Math}
2
3 Use \verb+\(+ to start text math and \verb+\)+ to end text math.
4 Some people use \verb+\$+ to start and end text math---I don't
5 recommend that because \LaTeX\ can give better error messages
6 if you use \verb+\(+ and \verb+\)+.
```


S.4 Displayed Equations

Do not use $\$$ to start or end displayed math like \TeX uses [36].

The `amsmath` package provides a number of additional displayed equation structures beyond the ones provided in basic \LaTeX . The augmented set includes [37]:

Environment	Used for
<code>equation</code>	used for single equations
<code>multline</code>	split single equations over multiple lines
<code>gather</code>	collect but do not align multiple equations
<code>align</code>	align multiple equations
<code>alignat</code>	aligns multiple equations at multiple places
<code>flalign</code>	aligns multiple equations at multiple places on full length lines
<code>split</code>	split a single equation over multiple lines

All but `split` can be followed by `*` to not number equations.

```
1 \section{Displayed Equations}
2
3 Do not use \verb+$$+ to start or end displayed math like \TeX\ uses
4 \cite{gratzer2016}.
5
6 The \amsmath\ package provides a number
7 of additional displayed equation structures
8 beyond the ones provided in basic \LaTeX.
9 The augmented set includes \cite{amslatex3project2019b}:
10
11 \hbox to\hsize{%
12   \indent
13   \vbox{
14     \begin{tabular}{@{}ll@{}}
15       \toprule
16       \bfseries Environment& \bfseries Used for\\
17       \midrule
18       \tt equation& used for single equations\\
19       \tt multline& split single equations over multiple lines\\
20       \tt gather& collect but do not align multiple equations\\
21       \tt align& align multiple equations\\
22       \tt alignat& aligns multiple equations at multiple places\\
23       \tt flalign& aligns multiple equations at multiple places on full length lines\\
24       \tt split& split a single equation over multiple lines\\
25       \bottomrule
26     \end{tabular}
27   }%
28 }
29
30 All but \verb+split+ can be followed by \verb+*+ to not number equations.
```

S.4.1 equation environment

The `equation` environment is used for single equations.

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

```
1
2 \subsection{\texttt{equation} environment}
3
4 The \verb+equation+ environment is used for single equations.
5
6 \begin{equation}
7   E = mc^2
8 \end{equation}
```

The `equation*` environment does single, unnumbered equations.

$$a = b_0c + \frac{1}{2}de^2 + \frac{1}{2}fg^2 + h_1 + h_2 + \cdots + h_n \quad \text{for } c \neq d \text{ and } g < \infty$$

```
1
2 The \verb+equation*+ environment does single, unnumbered equations.
3
4 \begin{equation*}
5   a = b_0c + \frac{1}{2}de^2 + {\textstyle \frac{1}{2}}fg^2
6     + h_1 + h_2 + \cdots + h_n
7   \quad \text{for } (c \neq d) \text{ and } (g < \infty)
8 \end{equation*}
```

International standard ISO 80000-2:2019 [38] states that e , i , j , and π should appear as `e`, `i`, `j` and `\pi` because they are constants. This is done automatically by the `mismath` package that is loaded by `thesis.tex`. See `thesis.tex` for more information, including what to do if you're not using those as constants.

Euler's identity is

$$e^{i\pi} + 1 = 0.$$

```
1
2 International standard ISO 80000-2:2019 \cite{iso8000022019}
3 states that  $e$ ,  $i$ ,  $j$ ,
4 and  $\pi$  should appear as
5  $e$ ,  $i$ ,  $j$ 
6 and  $\pi$  because they are constants.
7 This is done automatically by the mismath package
8 that is loaded by thesis.tex.
9 See thesis.tex for more information,
10 including what to do if you're not using those as constants.
11
12 Euler's identity is
13 \begin{equation*}
14   e^{i\pi} + 1 = 0.
15 \end{equation*}
```

Here's a simple formula relating e , i , π , and ϕ , the golden ratio

$$e^{i\pi} + 2\phi = \sqrt{5}. \tag{S.3}$$

I didn't notice anything on the web about putting the symbol for the golden ratio in a special font even though it is a constant.

```
1
2 Here's a simple formula relating  $e$ ,  $i$ ,  $\pi$ , and  $\phi$ ,
3 the golden ratio
4 \begin{equation}
5 e^{i\pi} + 2\phi = \sqrt{5}.
6 \end{equation}
7 I didn't notice anything on the web about putting the symbol for
8 the golden ratio in a special font even though it is a constant.
```

International standard ISO 80000-2:2019 [38] states that the “ d ” in math differentials should be typeset as “ d ”. So,

$$\text{use } \int x \, \mathrm{d}x \quad \text{instead of } \int x \, dx$$

```
1
2 International standard ISO 80000-2:2019 \cite{iso8000022019}
3 states that the `` $\mathrm{d}$ /$'' in math differentials
4 should be typeset as `` $\mathrm{d}$ /$''.
5 So,
6 \begin{equation*}
7 \text{\text{use } } \int x \, \mathrm{d}x \quad \text{\text{instead of } } \int x \, dx
8 \end{equation*}
```

The formula for Bekenstein-Hawking entropy:

$$S_{\text{BH}} = \frac{A}{4L_P^2} = \frac{c^3 A}{4G\hbar}$$

```
1
2 The formula for Bekenstein-Hawking entropy:
3
4 \begin{equation*}
5 S_{\text{BH}} = \frac{A}{4L_P^2} = \frac{c^3 A}{4G\hbar}
6 \end{equation*}
```

Type in the math and let L^AT_EX worry about the spacing. You only need to do fine tuning by hand if it looks bad.

Another `equation*` environment, note the spacing before the large close parenthesis:

$$\frac{a}{b} = ab^{-1} = \left(\sqrt{\frac{a}{b}}\right)^2 = \left(\sqrt{\frac{a}{b}}\right)^2 = \left(\sqrt{\frac{a}{b}}\right)^2 = \left(\sqrt{\frac{a}{b}}\right)^2 = \left(\sqrt{\frac{a}{b}}\right)^2 = \left(\sqrt{\frac{a}{b}}\right)^2$$

```

1
2 Type in the math and let \LaTeX\ worry about the spacing.
3 You only need to do fine tuning by hand if it looks bad.
4
5 Another \verb+equation*+ environment,
6 note the spacing before the large close parenthesis:
7
8 \begin{equation*}
9   \frac ab = ab^{-1}
10  % Parens are the wrong size.
11  = (\sqrt{\frac ab})^2
12  % Parens are the right size but closing paren is too close to radical.
13  = \left( \sqrt{\frac ab \right)^2
14  % Parens are right size but a negative thin space puts closing paren too close to radical.
15  = \left( \sqrt{\frac ab \!\right)^2
16  % Parens are right size but a thin space puts closing paren too close to radical.
17  = \left( \sqrt{\frac ab \,\right)^2
18  % Parens are right size but a medium space puts closing paren too close to radical.
19  = \left( \sqrt{\frac ab \:\right)^2
20  % Parens are right size and I think a thick space looks the best.
21  = \left( \sqrt{\frac ab \;\right)^2
22 \end{equation*}

```

$$(\cos x)^2 + (\sin x)^2 = \cos^2 x + \sin^2 x = 1$$

```

1
2 \begin{equation*}
3   (\cos x)^2 + (\sin x)^2 = \cos^2 x + \sin^2 x = 1
4 \end{equation*}

```

$$x \pmod 2 = \begin{cases} 0 & \text{if } x \text{ is even} \\ 1 & \text{if } x \text{ is odd} \end{cases} \quad (\text{S.4})$$

```

1
2 \begin{equation}
3   x \pmod 2 =
4   \begin{cases}
5     0 & \text{\text{if } \$x\$ is even}\backslash\backslash
6     1 & \text{\text{if } \$x\$ is odd}\backslash\backslash
7   \end{cases}
8 \end{equation}

```

The first six derivatives of distance are velocity, acceleration, jerk, snap, crackle, and pop [39].

$$\text{distance derivatives} = \left\{ \begin{array}{l} x = \text{distance} = vt \\ v = \text{velocity} = \frac{dx}{dt} \\ a = \text{acceleration} = \frac{dv}{dt} = \frac{d^2x}{dt^2} \\ j = \text{jerk} = \frac{da}{dt} = \frac{d^2v}{dt^2} = \frac{d^3x}{dt^3} \\ s = \text{snap} = \frac{dj}{dt} = \frac{d^2a}{dt^2} = \frac{d^3v}{dt^3} = \frac{d^4x}{dt^4} \\ c = \text{crackle} = \frac{ds}{dt} = \frac{d^2j}{dt^2} = \frac{d^3a}{dt^3} = \frac{d^4v}{dt^4} = \frac{d^5x}{dt^5} \\ p = \text{pop} = \frac{dc}{dt} = \frac{d^2s}{dt^2} = \frac{d^3j}{dt^3} = \frac{d^4a}{dt^4} = \frac{d^5v}{dt^5} = \frac{d^6x}{dt^6} \end{array} \right. \quad (\text{S.5})$$

```

1
2 The first six derivatives of distance are velocity, acceleration, jerk, snap, crackle, and pop \cite{reid2013}.
3
4 \begin{equation}
5 % Every array element should be in \displaystyle (a big font).
6 \AtBeginEnvironment{array}{\everymath{\displaystyle}}
7 % Set space between columns to zero, use {} = ... to add a little space before the = "by hand".
8 \arraycolsep = 0pt
9 \text{distance derivatives} = \left\{ \left\{ \begin{array}{l}
10 \begin{array}{l}
11 % I'm formatting the first 4 lines different from the last 3 so this will fit on one page.
12 x& {}=\text{distance}& {}=vt\[[2pt]
13 v& {}=\text{velocity}& {}=\frac{\di x}{\di t}\[[9pt]
14 a& {}=\text{acceleration}& {}=\frac{\di v}{\di t}& {}=\frac{\di^2x}{\di t^2}\[[9pt]
15 \mit j& {}=\text{jerk}& {}=\frac{\di a}{\di t}& {}=\frac{\di^2v}{\di t^2}&
16 {}=\frac{\di^3x}{\di t^3}\[[9pt]
17 s
18 & {}=\text{snap}
19 & {}=\frac{\di \mit j}{\di t}
20 & {}=\frac{\di^2a}{\di t^2}
21 & {}=\frac{\di^3v}{\di t^3}
22 & {}=\frac{\di^4x}{\di t^4}\[[9pt]
23 c
24 & {}=\text{crackle}
25 & {}=\frac{\di s}{\di t}
26 & {}=\frac{\di^2\mit j}{\di t^2}
27 & {}=\frac{\di^3a}{\di t^3}
28 & {}=\frac{\di^4v}{\di t^4}
29 & {}=\frac{\di^5x}{\di t^5}\[[9pt]
30 %
31 p
32 & {}=\text{pop}
33 & {}=\frac{\di c}{\di t}
34 & {}=\frac{\di^2s}{\di t^2}
35 & {}=\frac{\di^3\mit j}{\di t^3}
36 & {}=\frac{\di^4a}{\di t^4}
37 & {}=\frac{\di^5v}{\di t^5}
38 & {}=\frac{\di^6x}{\di t^6}
39 \end{array}
40 \right\}
41 \end{array}
\end{equation}

```

S.4.2 multiline environment

The `multiline` environment is used to split single equations over multiple lines.

$$\begin{aligned} S = a + b + c + d + e + f + g + h + i + j \\ + k + l + m + n + o + p \\ + q + r + s + t + u + v + w + x + y + z \end{aligned} \quad (\text{S.6})$$

```
1
2 \subsection{\texttt{multiline} environment}
3
4 The \verb+multiline+ environment is used
5 to split single equations over multiple lines.
6
7 \begin{multiline}
8   S = a + b + c + d + e + f + g + h + i + j\\
9     + k + l + m + n + o + p\\
10    + q + r + s + t + u + v + w + x + y + z
11 \end{multiline}
```

$$\begin{aligned} S = a + b + c + d + e \\ + f + g + h + i + j \\ + k + l + m + n + o \\ + p + q + r + s + t \\ + u + v + w + x + y \\ + z \end{aligned} \quad (\text{S.7})$$

```
1
2 \begin{multiline}
3   S = a + b + c + d + e\\
4     + f + g + h + i + j\\
5     + k + l + m + n + o\\
6     + p + q + r + s + t\\
7     + u + v + w + x + y\\
8     + z
9 \end{multiline}
```

$$\begin{aligned}
S = a + b + c + d + e \\
+ f + g + h + i + j \\
+ k + l + m + n + o \\
+ p + q + r + s + t \\
+ u + v + w + x + y \\
+ z \quad (\text{S.8})
\end{aligned}$$

```

1
2 % Calculate width of space before equation plus equation number.
3 % (All digits are the same width.)
4 \newdimen{\tdimen}
5 \settowidth{\tdimen}{\kern\multinestaggap (L.5)}
6 \begin{multline}
7   S = a + b + c + d + e\\
8   \makebox[\textwidth]{\hfill $+ f + g + h + i + j$\hfill\hfill\hfill\hfill\kern\tdimen}\\
9   \makebox[\textwidth]{\hfill\hfill$\{ + k + l + m + n + o$\hfill\hfill\hfill\kern\tdimen}\\
10  \makebox[\textwidth]{\hfill\hfill\hfill$\{ + p + q + r + s + t$\hfill\hfill\kern\tdimen}\\
11  \makebox[\textwidth]{\hfill\hfill\hfill\hfill$\{ + u + v + w + x + y$\hfill\kern\tdimen}\\
12  + z
13 \end{multline}

```

S.4.3 gather environment

The `gather` environment collects but does not align multiple equations.

$$a = b + c + d + e + f + g + h + i + j + k + l \quad (\text{S.9})$$

$$m = n + o + p + q + r + s + t + u + v + w + x + y + z \quad (\text{S.10})$$

```

1
2 \subsection{\texttt{gather} environment}
3
4 The \verb+gather+ environment collects but does not align multiple equations.
5
6 \begin{gather}
7   a = b + c + d + e + f + g + h + i + j + k + l\\
8   m = n + o + p + q + r + s + t + u + v + w + x + y + z
9 \end{gather}

```

$$\begin{aligned}
a = b + c + d + e + f + g + h + i + j + k + l \\
m = n + o + p + q + r + s + t + u + v + w + x + y + z \quad (\text{S.11})
\end{aligned}$$

```

1
2 \begin{gather}
3   a = b + c + d + e + f + g + h + i + j + k + l\notag\\
4   m = n + o + p + q + r + s + t + u + v + w + x + y + z
5 \end{gather}

```

$$\alpha = \beta + \gamma + \delta + \eta$$

$$\theta = \iota + \kappa + \lambda + \mu + \nu + \rho + \tau$$

```

1
2 \begin{gather*}
3   \alpha = \beta + \gamma + \delta + \eta\\
4   \theta = \iota + \kappa + \lambda + \mu + \nu + \rho + \tau
5 \end{gather*}

```

$$x_{\min} + x_{\max} \leq \sum_{i=1}^n x_i \tag{S.12}$$

$$x_{\min} + x_{\max} = \sum_{i=1}^n x_i - \sum_{i=2}^{n-1} x_i \quad \text{if } x \text{ is sorted} \tag{S.13}$$

$$x_{\min} \leq \left(\sum_{i=1}^n x_i \right) / n \tag{S.14}$$

```

1
2 \begin{gather}
3   x_{\text{min}} + x_{\text{max}} \le \sum_{i=1}^n x_i\\
4   x_{\text{min}} + x_{\text{max}}
5   = \sum_{i=1}^n x_i - \sum_{i=2}^{n-1} x_i \quad \text{\textit{if } $x$ is sorted}\\
6   x_{\text{min}} \le \left( \sum_{i=1}^n x_i \right) / n
7 \end{gather}

```

S.4.4 align environment

The align environment aligns multiple equations.

$$a = b + c + d \tag{S.15}$$

$$e = f + g + h + i + j \tag{S.16}$$


```

1
2 \subsection{\texttt{align} environment}
3
4 The \verb+align+ environment aligns multiple equations.
5
6 \begin{align}
7   a &= b + c + d \\
8   e &= f + g + h + i + j
9 \end{align}

```

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

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{S.17}$$

```

1
2 \begin{align}
3   x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}\notag \\
4   % Put a thin space before the b^2 to improve the appearance.
5   x = \frac{-b \pm \sqrt{\,b^2-4ac}}{2a}
6 \end{align}

```

Quadratic formula proof [40]:

$$ax^2 + bx + c = 0 \tag{S.18}$$

$$ax^2 + bx = -c$$

$$x^2 + \frac{b}{a}x = -\frac{c}{a}$$

$$x^2 + \frac{b}{a}x + \frac{b^2}{4a^2} = \frac{b^2}{4a^2} - \frac{c}{a}$$

$$\left(x + \frac{b}{2a}\right)^2 = \frac{b^2}{4a^2} - \frac{c}{a}$$

$$\left(x + \frac{b}{2a}\right)^2 = \frac{b^2}{4a^2} - \frac{4ac}{4a^2}$$

$$\left(x + \frac{b}{2a}\right)^2 = \frac{b^2 - 4ac}{4a^2}$$

$$\sqrt{\left(x + \frac{b}{2a}\right)^2} = \sqrt{\left(\frac{b^2 - 4ac}{4a^2}\right)}$$

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

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

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

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{S.19}$$

```

1
2 Quadratic formula proof \cite{khan}:
3
4 % The align environment requires the amsmath package.
5 % Use \addtolength{\jot}{6pt} to increase the space between rows in an amsmath multi-line math formula.
6 % That's not done here so everything will fit on one page.
7 \begin{align}
8   ax^2 + bx + c &= 0 \\
9   ax^2 + bx &= -c \notag \\
10  % The "\," adds a thinspace of horizontal space.
11  x^2 + \frac{b}{a}x &= -\frac{c}{a} \notag \\
12  x^2 + \frac{b}{a}x + \frac{b^2}{4a^2} &= \frac{b^2}{4a^2} - \frac{c}{a} \notag \\
13  \left(x + \frac{b}{2a}\right)^2 &= \frac{b^2}{4a^2} - \frac{c}{a} \notag \\
14  \left(x + \frac{b}{2a}\right)^2 &= \frac{b^2}{4a^2} - \frac{4ac}{4a^2} \notag \\
15  \left(x + \frac{b}{2a}\right)^2 &= \frac{b^2 - 4ac}{4a^2} \notag \\
16  \sqrt{\left(x + \frac{b}{2a}\right)^2} & \\
17   &= \sqrt{\left(\frac{b^2 - 4ac}{4a^2}\right)} \notag \\
18  x + \frac{b}{2a} &= \pm \frac{\sqrt{b^2 - 4ac}}{\sqrt{4a^2}} \notag \\
19  x + \frac{b}{2a} &= \pm \frac{\sqrt{b^2 - 4ac}}{2a} \notag \\
20  x &= -\frac{b}{2a} \pm \frac{\sqrt{b^2 - 4ac}}{2a} \notag \\
21  x &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
22 \end{align}

```

S.4.5 alignat environment

The alignat environment aligns multiple equations at multiple places.

$$a = b \qquad \text{set } a \qquad (S.20)$$

$$c = d \qquad \text{you guessed it, set } c$$

$$g = h \qquad \text{and finally, set } g \qquad (S.21)$$

I like to align input columns on the input if possible and will sometimes use windows over 250 characters wide to do so. If that won't work I sometimes do, for example,

$$a = b \qquad \text{set } a \qquad (S.22)$$

$$c = d \qquad \text{you guessed it, set } c$$

$$g = h \qquad \text{and finally, set } g \qquad (S.23)$$

Do whatever works best for you.

```

1
2 \subsection{\texttt{alignat} environment}
3
4 The \verb+alignat+ environment aligns multiple equations at multiple places.
5 \begin{alignat}{2}
6   a &= b& \quad \quad \quad \text{\text{set } $a$}\backslash\backslash
7   c &= d& \quad \quad \quad \text{\text{you guessed it, set } $c$}\notag\backslash\backslash
8   g &= h& \quad \quad \quad \text{\text{and finally, set } $g$}
9 \end{alignat}
10
11 I like to align input columns on the input if possible
12 and will sometimes use windows over-250 characters wide to do so.
13 If that won't work I sometimes do,
14 for example,
15 \begin{alignat}{2}
16   a
17   &= b
18   & \quad \quad \quad \text{\text{set } $a$}\backslash\backslash
19   & \text{\text{set } $a$}\backslash\backslash
20   c
21   &= d
22   &
23   & \text{\text{you guessed it, set } $c$}\notag\backslash\backslash
24   g
25   &= h
26   &
27   & \text{\text{and finally, set } $g$}
28 \end{alignat}
29
30 Do whatever works best for you.
31
```

Quadratic formula proof [40]:

$ax^2 + bx + c = 0$	subtract c	(S.24)
$ax^2 + bx = -c$	divide by a	
$x^2 + \frac{b}{a}x = -\frac{c}{a}$	add $\frac{b^2}{4a^2}$	
$x^2 + \frac{b}{a}x + \frac{b^2}{4a^2} = \frac{b^2}{4a^2} - \frac{c}{a}$	factor left hand side	
$\left(x + \frac{b}{2a}\right)^2 = \frac{b^2}{4a^2} - \frac{c}{a}$	multiply right-most term by $\frac{4a}{4a}$	
$\left(x + \frac{b}{2a}\right)^2 = \frac{b^2}{4a^2} - \frac{4ac}{4a^2}$	use common denominator	
$\left(x + \frac{b}{2a}\right)^2 = \frac{b^2 - 4ac}{4a^2}$	take square root of each side	
$\sqrt{\left(x + \frac{b}{2a}\right)^2} = \sqrt{\left(\frac{b^2 - 4ac}{4a^2}\right)}$	compute square root of each side	
$x + \frac{b}{2a} = \pm \frac{\sqrt{b^2 - 4ac}}{\sqrt{4a^2}}$	simplify right hand denominator	
$x + \frac{b}{2a} = \pm \frac{\sqrt{b^2 - 4ac}}{2a}$	subtract $\frac{b}{2a}$ from each side	
$x = -\frac{b}{2a} \pm \frac{\sqrt{b^2 - 4ac}}{2a}$	use common denominator	
$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$		(S.25)

```

1
2 Quadratic formula proof \cite{khan}:
3
4 % Make changes to \jot be local to the group that starts on the next line.
5 {
6 % Increase distance between lines by 6pt.
7 \addtolength{\jot}{6pt}
8 \begin{alignat}{2}
9   ax^2 + bx + c
10  &= 0
11  &
12  &\text{subtract } \$c\$ \\
13  ax^2 + bx
14  &= -c
15  &

```

```

16      &\text{divide by $a$}\notag\\
17 % The "\", " adds a thinspace of horizontal space.
18 x^2 + \frac ba\,x
19      &= -\frac ca
20      &
21      &\text{add $\displaystyle\frac{b^2}{4a^2}$}\notag\\
22 x^2+\frac ba\,x+\frac{b^2}{4a^2}
23      &= \frac{b^2}{4a^2}-\frac ca
24      &
25      &\text{factor left hand side}\notag\\
26 \left(x+\frac b{2a}\right)^2
27      &= \frac{b^2}{4a^2}-\frac ca
28      &
29      &\text{multiply right-most term by $\displaystyle\frac{4a}{4a}$}\notag\\
30 \left(x + \frac b{2a}\right)^2
31      &= \frac{b^2}{4a^2}-\frac{4ac}{4a^2}
32      &
33      &\text{use common denominator}\notag\\
34 \left(x + \frac b{2a}\right)^2
35      &= \frac{b^2-4ac}{4a^2}
36      &
37      &\text{take square root of each side}\notag\\
38 \sqrt{\left(x + \frac b{2a}\right)^2}
39      &= \sqrt{\left(\frac{b^2-4ac}{4a^2}\right)}
40      &
41      &\text{compute square root of each side}\notag\\
42 x + \frac b{2a}
43      &= \pm \frac{\sqrt{\,b^2-4ac}}{\sqrt{4a^2}}
44      &
45      &\text{simplify right hand denominator}\notag\\
46 x + \frac b{2a}
47      &= \pm \frac{\sqrt{\,b^2-4ac}}{2a}
48      &
49      &\text{subtract $\displaystyle\frac b{2a}$ from each side}\notag\\
50 x
51      &= -\frac b{2a} \pm \frac{\sqrt{\,b^2-4ac}}{2a}
52      &\quad
53      &\text{use common denominator}\notag\\
54 x
55      &= \frac{-b \pm \sqrt{\,b^2-4ac}}{2a}
56 \end{alignat}
57 }

```

S.4.6 flalign environment

The `flalign` environment aligns multiple equations at multiple places on full length lines.

$$\begin{array}{lcl} a = b & & u = v \text{ (S.26)} \\ c = d & m = n & w = x \\ g = h & & y = z \text{ (S.27)} \end{array}$$

```
1
2 \subsection{\texttt{flalign} environment}
3
4 The \verb+flalign+ environment aligns multiple equations at multiple places
5 on full length lines.
6
7 \begin{flalign}
8 a &= b& & & u &= v \\
9 c &= d& m &= n& w &= x \notag \\
10 g &= h& & & y &= z \\
11 \end{flalign}
```

S.4.7 split environment

The `split` environment ???.

```
1
2 \subsection{\texttt{split} environment}
3
4 The \verb+split+ environment ???.
```

S.5 Theorem-like environments

These theorem-like environments are defined in the `amsthm` package or in `PurdueThesis.cls`.

```
1 \section{Theorem-like environments}
2
3 These theorem-like environments are defined
4 in the amsthm package or in \verb+PurdueThesis.cls+.
```

Definition S.5.1. *This is an example definition.*

Observation S.5.1. *This is an example observation.*

Proof. This is an example proof. If $a = b$ and $b = c$ then $a = c$. □

Proposition S.5.1. *This is an example proposition.*

Theorem S.5.1. *This is an example theorem.*

```
1
2 \begin{definition}
3   This is an example definition.
4 \end{definition}
5
6 \begin{observation}
7   This is an example observation.
8 \end{observation}
9
10 \begin{proof}
11   This is an example proof.
12   If \((a = b)\) and \((b = c)\) then \((a = c)\).
13 \end{proof}
14
15 \begin{proposition}
16   This is an example proposition.
17 \end{proposition}
18
19 \begin{theorem}
20   This is an example theorem.
21 \end{theorem}
```

brackets and stuff

Nicomachus's theorem:

$$\sum_{j=1}^n j^3 = \left(\sum_{j=1}^n j \right)^2 \tag{S.28}$$

Also see the <https://mathworld.wolfram.com/ProofwithoutWords.html> on that same page.

```
1 brackets and stuff
2
3 \href{https://en.wikipedia.org/wiki/Squared_triangular_number}{Nicomachus's theorem}:
4 \begin{equation}
5   \sum_{j=1}^n j^3 = \left( \sum_{j=1}^n j \right)^2
6 \end{equation}
7
8 Also see the
9 \href{proof without words}{https://mathworld.wolfram.com/ProofwithoutWords.html}
10 on that same page.
```

T. MUSIC

U. PHYSICS

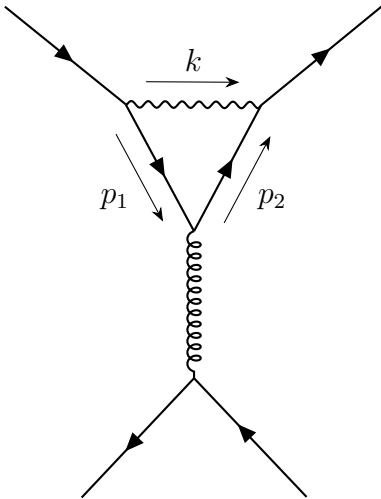
Feynman diagrams show what happens when elementary particles collide [41]. The Feynman diagrams below are from the *TikZ-Feynman: Feynman diagrams with TikZ* documentation [42]. **You must use lualatex instead of pdflatex to process documents that use the tikz-feynman package.** See the documentation for more information.

The input in the documentation is different than here because a different random number generator is used [43]. I expect this to be corrected. In the meantime try replacing `vertical` with `vertical'` and/or switch some `fermion` to `anti fermion` lines [44].

```

1 \chapter{PHYSICS}
2
3 Feynman diagrams show what happens
4 when elementary particles collide
5 \cite{feynman-diagram}.
6 The Feynman diagrams below are from the
7 \citetitle{ellis2016} documentation \cite{ellis2016}.
8 \textbf{%
9   You must use \texttt{lualatex} instead
10  of \texttt{pdflatex}
11  to process documents that use the \texttt{tikz-feynman} package.%
12 }
13 See the documentation for more information.
14
15 The input
16 in the documentation
17 is different than here because a different random number generator
18 is used \cite{menke2019}.
19 I expect this to be corrected.
20 In the meantime try replacing \texttt{vertical}
21 with \texttt{vertical'}
22 and/or switch some \texttt{fermion}
23 to \texttt{anti} \texttt{fermion} lines \cite{ellis2017}.

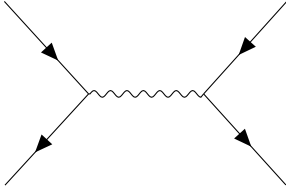
```



```

1 \feynmandiagram [large, vertical'=e to f] {
2   a -- [fermion] b -- [photon, momentum=\(k\)] c -- [fermion] d,
3   b -- [fermion, momentum=\(p_{1}\)] e -- [fermion, momentum=\(p_{2}\)] c,
4   e -- [gluon] f,
5   h -- [anti fermion] f -- [anti fermion] i,
6 };

```



```
1 \feynmandiagram [horizontal=a to b] {  
2   i1 -- [anti fermion] a -- [anti fermion] i2,  
3   a -- [photon] b,  
4   f1 -- [fermion] b -- [fermion] f2,  
5 };
```

VITA

[Put a brief autobiographical sketch here.]

PUBLICATION(S)

The following is based on information in [45]–[47].

In a publication or publications section you can

- list a single publication
- include a single publication
- list multiple publications
- include multiple publications

Use

```
\begin{publication}...\end{publication}
```

or

```
\begin{publications}...\end{publications}
```

to skip to the next page and put the appropriate heading on the top of the page.

To List a Single Publication

```
\begin{publication}
...list a single publication here...
...IMPROVE THIS LATER to show how to do that...
\end{publication}
```

To Include a Single Publication

```
\begin{publication}
...put a single publication here...
...IMPROVE THIS LATER to show how to do that...
\end{publication}
```

To List Multiple Publications

```
\begin{publications}
...list multiple publications here...
...IMPROVE THIS LATER to show how to do that...
\end{publications}
```

To Include Multiple Publications

```
\begin{publications}
...put the multiple publications here...
...IMPROVE THIS LATER to show how to do that...
\end{publications}
```

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