Writing lab reports with professionalism: the CHS Physics Report package

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1 • Abstract

The CHS Physics Report package may be used to stylize lab reports written in LaTeX. The package also provides some useful commands to expedite the process of writing a lab report by providing a commands that are otherwise not very readily available to use in LaTeX. It is compatible with many other LaTeX packages and may be used, among other possibilities, for reports in physics.

2 • Introduction

I wrote this package in order to accomplish my goal of writing Lab Reports for Mr. James' AP Physics C class at Carmel High School. Because all my documents largely took the same form, I wound up writing a package in order to simplify the files I used for writing my reports. As my style of writing lab reports has drawn questions of repeating my successes with lab reports, especially amongst AP Physics 1 students at Carmel High, it looks like I have to write the documentation for this package! *Sigh!*

In all seriousness though, the intended purpose of this package is to typeset a highly technical document, for any type of science class. Although it is not designed to help to write reports in chemistry and biology, a few additional packages may supply this functionality if desired. Consequently, this package may be a nice little souvenir to keep for your other classes to use to write the professional-appearing reports you need. And you *can* keep it too! That's because the code for the CHS Physics Report package has been released into the public domain through the use of the CC0 license,[Note 2] with the exception of a small segment written by Stefan Kottwitz that I have slightly edited, available under a CC BY-SA 3.0 License. However, although this package may be freely used

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[2] A copy of the CC0 license may be found at `https://creativecommons.org/publicdomain/zero/1.0/legalcode`.

to write your reports in other AP courses, this package is neither supported nor endorsed by the CollegeBoard, which has no affiliation with this package.

To install this package, follow the directions found at

https://artofproblemsolving.com/wiki/index.php?title=LaTeX:Packages#Making_Your_Own.

To learn how to use LaTeX, the Art of Problem Solving Wiki has a mathematics-oriented guide to LaTeX that avoids most of the technical details and goes straight into how to use it to typeset mathematics.

3 • Features

The CHS Physics Report package calls upon these packages:

- amsmath
- fancyhdr
- geometry - by default, this is set to `\geometry{top = 2.5cm, bottom = 2.5cm}`
- transparent
- calc
- graphicx
- titlesec
- color - unnecessary because of xcolor
- xcolor with option `svgnames`
- letltxmacro

Some of these packages are included for convenience, not because they are so crucial that they are inseparable from the lab reports. For example, the packages transparent, xcolor, and graphicx are loaded because the Physics C lab reports that we submitted always were required to have a sketch of the setup of our lab; these packages are useful for inputting a `pdf_tex` file generated by Inkscape, among other uses.

Additional packages that you may want to use alongside the CHS Physics Report package include the following.

amssymb - allows the typesetting of certain symbols, such as blackboard bold

booktabs - helps to format tables to be neater so that they better display data

hyperref - may be used to create hyperlinks, links within your document, PDF bookmarks, and formatted URLs; also can add PDF metadata

lmodern and fontenc - when both the lmodern (Latin Modern) and fontenc packages are called, and fontenc is loaded with option `T1`, the quality of copying and pasting from your PDF is improved. You don't want to know what happens when you use fontenc without lmodern or an equivalent.

(Note that lmodern sets your font; you may use other font packages such as newtxtext as an alternative.)

fontspec - fontspec is an alternative to the combination of lmodern and fontenc, and it lets you use any font you want; however, you must use X∃LATEX or LuaLATEX in order to use fontspec

pdfpages - lets you include pages from another PDF as *entire*, *separate* pages. Note that if you want to include a page from another PDF (such as a one-page graph or a table) but you do not want to include it as an *entirely new* page, then you would not use pdfpages, but rather, as a figure on your current page, then you would say `\includegraphics{your_file.pdf}`

soul - provides working underlining

3.1   Package options

The CHS Physics Report package provides options to control page style and the style of mathematical notation. There are two page style options: `light` and `standard`, which are mutually exclusive. The `standard` option is used by default; just by calling

```
\usepackage{chs-physics-report},
```

you get the `standard` option. To select the `light` option, load the package with

```
\usepackage[light]{chs-physics-report}.
```

The `light` option is generally more suitable for short reports of one or two pages. It places your name, the names of those you worked with, and the title of your report in the header, with a black line beneath these three things.

There are two mathematics style options: `display` and `inline-math`, which are mutually exclusive to each other, but not to the page style options. Like the `standard` option, the `display` option is the default option and results in large, display style math even when you use $math text$. To use the `inline-math` option, load the package with

```
\usepackage[inline-math]{chs-physics-report}
```

The `inline-math` option is what LATEX does normally without this package. (This package basically reverses what LATEX does by default.) The following code illustrates the difference between these two math options.

```
The series $\sum_{n = 1}^\infty\frac{1}{n(n + 1)} = 1$ is called
a telescoping series because you don't need a telescope to see
it; the series is its own telescope.

\[K = \frac{1}{2}mv^2\]
```

Using `display` (default)	Using `inline-math`
The series $\displaystyle\sum_{n=1}^{\infty} \frac{1}{n(n+1)} = 1$ is called a telescoping series because you don't need a telescope to see it; the series is its own telescope. $$K = \frac{1}{2}mv^2$$	The series $\sum_{n=1}^{\infty} \frac{1}{n(n+1)} = 1$ is called a telescoping series because you don't need a telescope to see it; the series is its own telescope. $$K = \frac{1}{2}mv^2$$

3.2 Document title and styles

`\title`
`\name`
`\ww`
To set the title, your name, and the names of those you worked with, use the `\title`, `\name`, and `\ww` commands, respectively. These each have one argument, and you should probably place them in the preamble of your document.

The `\author` macro may be used in place of `\name`; both are defined to be identical. The CHS Physics Report package redefines some LaTeX internal commands relating to titles, so be aware that this package may not be compatible with other packages or document classes that set titles. If you are using the `light` option, the title will automatically appear; however, if you are using the `standard` option, you must enter `\maketitle` at the beginning of your document to make your title appear. As always, you may only use `\maketitle` once.

`\titlestyle`
`\subtitlestyle`
To change the style of the main title of your lab report, you may insert the appropriate style macros as arguments of `\titlestyle`. To change the style of the subtitles (your name and those you worked with), insert the appropriate style macros as arguments of `\subtitlestyle`. Do note that these macros are those that change an entire group of text, such as `\itshape` or `\bfseries`; they do NOT include macros such as `\emph` or `\textbf`. To change the style of `\sectionstyle` the section headers, `\sectionstyle` takes the appropriate style macros as arguments. Do note that while `\titlestyle` and `\subtitlestyle` apply styles in *addition* to the default styles, `\sectionstyle` *resets* the default style, and *then* applies the styles you chose! (There's no good reason for this design; I just wound up writing the package like this.) However, all of these three macros reset their previous values if called a second time.

These are the default values for each:

- Title: `\Huge\bfseries` with `standard` and `\small\itshape` with `light`

- Subtitle: `\small`

- Section: `\Large\bfseries`

By the way, if you want to center your section header, `\centering` will not

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work. You are better off redefining the section style by `\titlesection{⟨`*style macros*`⟩}{\thesection $\bullet$}{0mm}{}`.

The following code illustrates the macros discussed.

```
1  \documentclass[12pt]{article}
2  \usepackage{chs-physics-report}
3
4  \subtitlestyle{\itshape}
5  % sets subtitle (name and names of those worked with) to italic
6
7  \title{Exploring ancient death trap sites: an anthropological
       survey}
8  \name{Hugo First}
9  \ww{Dooby Careful}
10
11 \begin{document}
12
13 \maketitle
14
15 \section{Abstract}
16
17 To enter, or not to enter, that is the question.
18 \end{document}
```

This produces the following:

Exploring ancient death trap sites: an anthropological survey

Hugo First

Worked with Dooby Careful

1 • Abstract

To enter, or not to enter, that is the question.

3.3 Content macros

`\fig` This macro takes one argument, and outputs it after the word FIGURE.

```
\fig 1 is a graph of the height
of the object as it falls off
the cliff with respect to time.
If you replace the $y$-axis
with my grade in this class,
\fig1 will still remain true.
```

> FIGURE 1 is a graph of the height of the object as it falls off the cliff with respect to time. If you replace the y-axis with my grade in this class, FIGURE 1 will still remain true.

`\haiku`
`\haikus` These macros provide an easy way to add a haiku to your lab report. The outputs of these macros depend on whether you are using the `light` or `standard` options. Also, the distinction between `\haiku` and `\haikus` only exists when using the `light` option.

With the `standard` option:

```
\haiku{\itshape
One two three four five\\
Ay Bee See Dee Ea Eff Gee\\
Refrigerator
}
```

> *One two three four five*
> *Ay Bee See Dee Ea Eff Gee*
> *Refrigerator*

With the `light` option:

```
1 \haiku{\itshape
2 One two three four five / Ay Bee See Dee Ea Eff Gee /
      Refrigerator
3 }
4
5 \haikus{\itshape
6 One two three four five / Ay Bee See Dee Ea Eff Gee /
      Refrigerator\\
7 \indent\indent This is not really / a haiku but it does have /
      enough syllables
8 }
```

Haiku:	*One two three four five / Ay Bee See Dee Ea Eff Gee / Refrigerator*
Haikus:	*One two three four five / Ay Bee See Dee Ea Eff Gee / Refrigerator*
	This is not really / a haiku but it does have / enough syllables

I personally prefer to employ italic in my haikus; this is why `\itshape` is present. However, you can set your haikus however you want.

`\diff`   To typeset the upright letter *d* in a differential instead of using the italic letters normally given in math mode, `\diff` provides an easy shortcut.

```
\[
\frac{\diff^2 x}{\diff t^2} = a
\]
```

$$\frac{\mathrm{d}^2 x}{\mathrm{d}t^2} = a$$

`\sqrt`   The CHS Physics Report package also redefines the square root to have a descender, which serves to distinguish what is in the square root from what is outside the square root. The code used to implement the new square root comes from Stefan Kottwitz with some of my own edits, and is available under a CC BY-SA 3.0 license. It is the only part of the package not in the public domain.

```
\[
\sqrt[4]{\frac{1}{9}} =
\frac{1}{\sqrt{3}}
\]
```

$$\sqrt[4]{\frac{1}{9}} = \frac{1}{\sqrt{3}}$$

`\sfsum`
`\sfprod`   Oh, by the way, since we are on the topic of math, here are two macros from a long time ago that I forgot to remove when writing this package. They allow you to use sans-serif sum and product notation. You can have fun with them if you would like to use them, but they are largely useless for physics lab reports, and they are still here as part of my early experiences with TeX. However, these macros are so badly designed that I will not give an explanation of how to (functionally) use them. The example below uses sans-serif math, although the code to do so is not shown.

```
\[\raisebox{-.4em}{$\sfsum_{n=
1}^\infty$}\frac{1}{n^2}=
\frac{\pi^2}{6}\]
\[\raisebox{-.4em}{$\sfprod_{n=
1}^k$}\frac{n + 1}{n} = k + 1
\quad\forall k\geq 1\]
```

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$$

$$\prod_{n=1}^{k} \frac{n+1}{n} = k+1 \quad \forall k \geqslant 1$$

`\footnote`   Footnotes are also redefined so that they do not cause confusion with exponents. Now each footnote looks…[Note 3]

`\degree`
`\degrees`   The macros `\degree` and `\degrees` are used to output a degree symbol. They only work in math mode and are compatible with other packages that also implement a `\degree` command.

```
If the potato is at $91\degrees
$C, then is the angle of its
temperature in degrees or
centigrade?
```

If the potato is at $91°\mathrm{C}$, then is the angle of its temperature in degrees or centigrade?

---

[3]Something like this! (There never has been a good way to illustrate what footnotes look like without actually adding a footnote in the documentation at the very bottom of the page. It's not even really possible to have small boxes of code on the side; I have to awkwardly break off my sentence and end it in a footnote to show what a footnote looks like.)

4 • Implementation

The following section details the implementation of the CHS Physics Report package. I do explain many of the idiosyncrasies and inefficiencies within this package, although I do not plan on making any further major changes to this package in the future. That's partly to keep the portability of the package, and partly because I like that the date on the package is all prime numbers. However, if you're thinking about editing it for your own use, go ahead! Except for the code by Stefan Kottwitz, all of the package is in the public domain, so feel free to edit your version of the package to how you'd like it.

First, we initiate the CHS Physics Report package and load the various packages that it uses.

```
1  \NeedsTeXFormat{LaTeX2e}
2  \ProvidesPackage{chs-physics-report}[2017/11/23 CHS Physics Lab
      Report]
3  \RequirePackage{amsmath}
4  \RequirePackage{fancyhdr}
5  \RequirePackage{geometry}
6  \geometry{top = 2.5cm, bottom = 2.5cm}
7  \RequirePackage{transparent}
8  \RequirePackage{calc}
9  \RequirePackage{graphicx}
10 \RequirePackage{titlesec}
11 \RequirePackage{color}
12 \RequirePackage[svgnames]{xcolor}
13 \RequirePackage{letltxmacro}
```

The code below was written by Stefan Kottwitz on TeX StackExchange to change the look of square roots. I have edited his code to improve the resolution of the square root at up to 15000% zoom, and to improve the spacing of the square root. This code is available under the CC BY-SA 3.0 License.

```
14 \let\oldr@@t\r@@t
15 \def\r@@t#1#2{%
16 \setbox0=\hbox{$\oldr@@t#1{#2\,}$}\dimen0=\ht0
17 \advance\dimen0-0.167\ht0
18 \setbox2=\hbox{\vrule height\ht0 depth -\dimen0}%
19 {\box0\lower0.478pt\box2}}
20 \LetLtxMacro{\oldsqrt}{\sqrt}
21 \renewcommand*{\sqrt}[2][\ ]{\oldsqrt[#1]{#2\!}}
```

The code that follows, however, is in the public domain.

Here, we define macros that hold the values of our title information and style information (those with an @ in their name). We then define commands to help us set the value of our style commands (`\titlestyle`, `\subtitlestyle`, and `\sectionstyle`).

```
22 \let\@title\undefined
23 \let\@author\undefined
24 \def\@titleArgs{}
25 \def\@subTitleArgs{}
26 \def\@sectionArgs{\Large\bfseries}
27 \newcommand{\titlestyle}[1]{\def\@titleArgs{#1}}
28 \newcommand{\subtitlestyle}[1]{\def\@subTitleArgs{#1}}
29 \newcommand{\sectionstyle}[1]{\def\@sectionArgs{#1}}
```

The following is the definition of the `light` option. It defines a page style `light-first-page` for the first page of the lab report, and another page style `light` for all other pages. The `light-first-page` style is the page style for the page at which the document begins (i.e. the first page), but because `light` is document's page style, only the first page has the `light-first-page` style, which sets the lab report's title.

Other things that we do are to define the macros for writing haikus and to ensure that `\maketitle` throws a warning because the title is in the header of the first page. It is helpful to throw a warning if a user switches from the `standard` option to the `light` option, although not completely necessary.

```
30 \DeclareOption{light}{
31   \fancypagestyle{light}{
32     \fancyhf{}
33     \cfoot{\textsf{\textbf{-\raisebox{-.7pt}{\thepage}-}}}
34     \renewcommand{\headrulewidth}{0pt}
35   }
36   \fancypagestyle{light-first-page}{
37     \fancyhf{}
38     \lhead{
39         \emph{\small\@titleArgs\@title}\\
40     }
41     \rhead{
42         {\small\@subTitleArgs\@author%
43         \@workedWith}%
44     }
45     \cfoot{\textsf{\textbf{-\raisebox{-.7pt}{\thepage}-}}
46     }
47     \renewcommand{\headrulewidth}{.6pt}
48     \fancyhfoffset{13mm}
49   }
50   \pagestyle{light}
51   \AtBeginDocument{\thispagestyle{light-first-page}}
```

```
52  \def\haiku{\hspace{-55pt}\emph{Haiku:}\hspace{35.25pt}}
53  \def\haikus{\hspace{-60pt}\emph{Haikus:}\hspace{35.25pt}}
54  \def\maketitle{\PackageWarning{chs-physics-report}{
55    Remember that maketitle is no longer useful
56    because you are using the light option of
57    CHS Physics Report, so all the information
58    that would have been included in maketitle
59    is now in the header of the first page.}}
60  }
```

The `standard` option is much shorter.

```
61  \DeclareOption{standard}{
62    \renewcommand{\maketitle}{%
63      \begin{center}{\Huge\textbf{\@titleArgs\@title}}\\%
64      {\small\@subTitleArgs\@author\@workedWith}
65      \end{center}
66    }
67    \ifx\@workedWith\undefined
68      \def\@workedWith{{Please set the names of those whom you %
69        worked with by typing \texttt{\char`\\%
70        ww\{\textrm{\emph{others in your lab group}}\}}}}
71    \fi
72    % for compatibility with the light option:
73    \newcommand{\haiku}[1]{\begin{center}#1\end{center}}
74    \newcommand{\haikus}[1]{\begin{center}#1\end{center}}
75  }
```

In the event that `\@author`, `\@title`, or `\@workedWith` is not defined, we define them so that they tell the user to define them ahead of time. You may think that it would be best to throw an error if they are undefined, but I have tried `\errmessage` and `\PackageError` for these if statements, and neither work better than what I have here, bad though it is. The reason is that the package is called before the document begins, so these commands are necessarily undefined before TeX reaches `\title`, `\name`, and `\ww`.

You will probably notice that I have a conditional to check if `\@workedWith` is defined, but I already have such a conditional in the `standard` option (shown above above). The two are different, although the package definitely could be made more efficient. However, I do not want to alter this package any further, so I will not make any such changes.

```
76  \ifx\@author\undefined
77    \author{Please enter your name by using \texttt{\char`\\%
78    name\char`\{\emph{your name}\char`\}}}
79  \fi
80
```

```
81  \ifx\@title\undefined
82    \title{Please set the title by typing %
83      \texttt{\char`\\%
84      title\char`\{{\emph{title of lab report}}\char`\}}}
85  \fi
86  \ifx\@workedWith\undefined
87    \def\@workedWith{{\\Please set the names of those whom you %
88      worked with by typing \texttt{\char`\\%
89      ww\char`\{{\emph{others in your lab group}}\char`\}}}}
90  \fi
```

Now, we select the `display` and `standard` options as our default options, and we've finished handling package options.

```
91  \DeclareOption{display}{\everymath{\displaystyle}}
92
93  \DeclareOption{inline-math}{\everymath{}}
94
95  \ExecuteOptions{display,standard}
96
97  \ProcessOptions\relax
```

We set `\parskip` and we define `\fig` and `\diff`.

```
98   \setlength{\parskip}{2.5mm}
99   \newcommand{\fig}[1]{\textsc{Figure~#1}}
100  \newcommand{\diff}{\mathrm d}
```

Sans-serif math operators:

```
101  \@ifpackageloaded{amsmath}{\DeclareMathOperator*{\sfsum}{\
        fontsize{.9cm}{1cm}\text{$\mathsf\Sigma$}}
102  \DeclareMathOperator*{\sfprod}{\fontsize{.9cm}{1cm}\text{$\mathsf
        \Pi$}}}
```

At this point, we create the style used for sections. The first matter of business is to set a distance that will determine how far from the text each section number will go. This distance, which we will call `\@boxwidth`, is normally set to 13 mm. If you need two-digit section numbers (10,11,12…), you may find it helpful to increase this distance.

```
103  \newlength{\@boxwidth}
104  \setlength{\@boxwidth}{13 mm}
```

Next, we use titlesec to construct a box of width `\@boxwidth`. We place the section number in the box, and we place a bullet point to the right of the

section number. We then uniformly fill the space in the box, by placing in `\hspace{\fill}` between the bullet point and the section number, and by placing another `\hspace{\fill}` between the bullet point and the right side of the box.

```
105  \titleformat{\section}
106  {%
107    \@sectionArgs%
108  }
109  {\hspace{-\@boxwidth}%
110    \makebox[\@boxwidth][l]%
111    {%
112      \thesection%
113      \hspace{\fill}%
114      {\raisebox{1.7pt}{\fontsize{14.4pt}{0pt}\selectfont$\bullet$}}
             %
115      \hspace{\fill}\hspace{.3mm}%
116    }%
117  }
118  {0cm}
119  {}
```

We change the style of footnotes. I know that what I have here is not a best practice, but I didn't know that when I first wrote the package! For best practices, I should have used `\textsuperscript` and made a `\@oldfootnote` macro.

```
120  \let\footnoteDuplic@teDuplic@te\footnote
121  \def\footnoteDuplic@te#1{$^\text{Note }$\
       footnoteDuplic@teDuplic@te{#1}}
122  \let\footnote\footnoteDuplic@te
```

To define `\degree` and `\degrees`, we use `\providecommand` instead of `\newcommand` so that if other packages that define either one of these are loaded, there will not be an error due to conflicting definitions.

```
123  \providecommand{\degree}{^\circ}
124  \providecommand{\degrees}{\degree}
```

We define `\name` and `\ww` to set the values of title information.

```
125  \newcommand{\name}[1]{\author{#1}}
126  \newcommand{\ww}[1]{\def\@workedWith{\\Worked with #1}}
```

And we're done!

```
127  \endinput
```

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5 • Having trouble?

If you can't get your document to compile as you'd like to, even if your problem is unrelated to this package, you can always contact me. Emails are fine, although if you see me in the hallways, you may always ask a question. If you would like to find me before school, my first class is physics on blue days, and my first class is statistics (A322) on gold days.

"The most common mistake is spending too long on TeX coding and not getting the document written."

–David Carlisle