LaTeX 2_ε Solutions

Text Exercises

Easy

1. A simple test sentence: the quick brown fox jumps over the lazy dog.

2. \textbf{Bold} and \textsl{italic} fonts may be used to add emphasis to the text. It is also possible to use \textsf{sans-serif} and \texttt{typewriter-style} fonts.

3. The \LaTeX{} language uses some special characters that must be preceded by a $\backslash$ or they will not be printed. These include: \$ \& \% \# _ \{ \} \~\ \^\

4. Leaving a blank line between sentences marks a break between paragraphs.

   A new paragraph should contain a new idea, of course.

5. It’s possible \newline to break the lines \newline wherever you like. You can move the text \newline \hspace*{3cm} horizontally using the $\backslash$hspace* command. (The gap is 3 cm in this case.)

   \vspace*{1.5cm} You can also move the text vertically using the $\backslash$vspace* command (Now the gap is 1.5cm). This only works between paragraphs.

6. Font size can be varied from \tiny tiny \scriptsize up \footnotesize to \small the \normalsize normalsize \large and \Large then \LARGE up \huge to \Huge Huge\normalsize. \textit{This is an example in which font size matters}.

Medium

1. \LaTeXe{} uses environments to perform useful functions; for example,
```
\begin{center} center (note US spelling) environment, \end{center}
\begin{flushleft} flushleft environment, \end{flushleft}
\begin{flushright} and flushright environment. \end{flushright}
```


2. Environments can also be used to make lists:
```
\begin{itemize}
\item itemize does not number list entries
\item bullet points are used
\end{itemize}
\begin{enumerate}
\item enumerate does number the entries
\item in fact, enumerate was used to generate the example numbers on
this sheet.
\end{enumerate}
```

3. In the verbatim environment, text will be printed directly \emph{latex commands will not be excuted}   and spaces are important.

4. Tables can also be generated easily using environments
```
\begin{center}
\begin{tabular}{cl}
 1.0 & One \\
 2.0 & Two \\
 3.0 & Three
\end{tabular}
\end{center}
```

Tricky stuff

1. Quite tricky tables can be constructed
```
\begin{center}
\begin{tabular}{|r|c|l|}
\hline
\multicolumn{3}{|c|}{\textbf{Famous Dead Mathematicians}}\\ \hline
\textit{Name} & \textsf{Fields of Study} & \texttt{Survives as} \\\hline
Archimedes & Geometry, Bath water, & A Principle, An Axiom \\
  &Ways of killing Romans &\\
\hline
& You name it, & An equation, A constant, A formula, A method \\
\raisebox{0.25cm}[0pt]{Euler}& he studied it & \\
\hline
\Huge{Gauss} & integration, integers & A distribution, A theorem\\
\hline
\end{tabular}
\end{center}
```

2. You

```
\vspace*{-0.5cm}\hspace*{1cm} can also

\vspace*{-0.5cm}\hspace*{3cm} make beautiful patterns

\vspace*{-0.3cm}\hspace*{5cm}with text

\vspace*{-0.5cm}\hspace*{3cm}
but then again\newline\hspace*{1cm}\LARGE Why ?
```

Mathematics Exercises

Easy

1. Any equation can be directly inserted into text, `$x^{2} + 1 = 0$`.

2. Longer (or taller) equations are best inserted using the equation
```
environment
\begin{equation}
\int \frac{x^{2} + 3x + 1}{2x + 7} \text{ d} x.
\end{equation}
 An advantage is that your equations will be automatically numbered.
```

3. Traditional mathematical typesetting demands that variables are
```
italicised and this is the default in math-mode. The \verb+\mbox+
or \verb+\text+ (part of the amsmath package) commands must be used to
generate normal text. Compare
\begin{equation}
  a = b + c\quad if b > c,
\end{equation}
to
\begin{equation}
 a = b +c\quad\text{if } b > c.
\end{equation}
```

4. There are some special commands function names
```
$$ \sin^{2}x + \cos^{2}x = 1, \quad f^{’’}(x) = \ln x.$$
```

5. Lots of mathematical symbols are easily accessible
```
$$ \Upsilon \notin [1,\infty),\quad R \propto C^{\frac{1}{2}}, \text{
as } C \to \infty, \quad \sum_{k=1}^{\infty} (-1)^{k+1}\frac{1}{k^{2}}
= \frac{\pi^{2}}{12}. $$
```

6. Vectors may be denoted using the \verb+\boldmath+ command;
```
i.e. the vector, \boldmath$x$. Boldmath remains on until turned off
with the \verb+\unboldmath+ command. Check this now \unboldmath$a^{2}
+ b^{k} = c^{k}$.
```

7. Brackets change size automatically
```
$$ \left(A + B\right),\text{ is smaller than }
\left[\frac{A+B}{C+D}\right].$$
```

Medium

Commands needed in the preamble

```
\usepackage{amsmath}
```

1. Matrices are written by combining the array environment and brackets
```
$$ \left(\begin{array}{ccc} a & b & c \\ d & e & f \\ g & h & i
\end{array}\right).$$
```

2. This structure can also be used in the following example
```
$$ y = \left\{ \begin{array}{l@{\quad}l} 0 & \text{if } x > 0, \\
      1 & \text{if } x < 0, \\
      \infty & \text{if x = 0.} \end{array} \right.
$$
```

3. There are no automatic line breaks in equations, you must specify them by hand
```
$$
f^{(F)}_{il} =  \int\int\int \frac{\text{Bo}}{\text{Ca}} k_{i}
\psi^{(F)}_{l} \text{ d}V +
  \int\int\int \left[p\frac{\partial
\psi^{(F)}_{l}}{\partial x_{i}} - \left(\frac{\partial u_{i}}{\partial
x_{j}} + \frac{\partial u_{j}}{\partial x_{i}}\right)
\frac{\partial \psi^{(F)}_{l}}{\partial x_{i}} \right]\text{ d}V
- \int\int p_{b} \psi^{(F)}_{l} n_{i}\text{ d}S
$$
\begin{equation}
-\frac{1}{\text{Ca}}\oint \psi^{(F)}_{l} m_{i} \text{ d} s,
\end{equation}
```

4. It’s not obvious how to generate boldsymbols in formul\ae
```
$$ \int\int\int_{V} \boldsymbol{\nabla.u} \text{ d}V =
\int\int_{\Gamma} \boldsymbol{u.n} \text{ d}S, $$
 but the amsmath package includes a useful command to help \verb+\boldsymbol+
```

Tricky Stuff

Commands needed in the preamble

```
\usepackage{amsmath,bbm,eufrak}
\newtheorem{theorem}{Theorem}
```

1. There are some custom maths fonts, which must be included in the preamble, such as the bbm font, $ x \in \mathbbm{R}$. Another useful font is the caligraphic font $x = 1 + 2\epsilon + \mathcal{O}(\epsilon^{2})$; and some people like the Fraktur font $\mathfrak{K}$.

2. Splitting brackets across lines can break the automatic sizing. Try
```
$$
f^{(F)}_{il} =  \int\int\int \frac{\text{Bo}}{\text{Ca}} k_{i}
\psi^{(F)}_{l} \text{ d}V -\frac{1}{\text{Ca}}\oint \psi^{(F)}_{l}
m_{i} \text{ d} s - \int\int p_{b} \psi^{(F)}_{l} n_{i}\text{ d}S
+\int\int\int \bigg[p $$
$$\left. \frac{\partial\psi^{(F)}_{l}}{\partial x_{i}}
- \left(\frac{\partial u_{i}}{\partial
x_{j}} + \frac{\partial u_{j}}{\partial x_{i}}\right)
\frac{\partial \psi^{(F)}_{l}}{\partial x_{i}} \right]\text{ d}V
$$
```

3. The theorem environment can be useful, but needs to be defined in the preamble
```
\begin{theorem}[The \LaTeXe Law]
Backslash is the most overused key in \LaTeX.
\end{theorem}
\begin{theorem}[The Computer’s Law]
The \texttt{delete} key will be used more than all other keys put together.
\end{theorem}
```

Picture & Figure Exercises

Commands needed in the preamble

```
\usepackage[dvips]{graphics}
```

Commands needed in the text

```
\setlength{\unitlength}{1cm}
```

1. Many vectors may be created

```
\begin{picture}(10,3)
\put(0,0){\vector(0,1){2}}
\put(2,1){\vector(1,0){2}}
\put(5,0){\vector(1,1){2}}
\put(7.5,2){Add text or maths, $x^{2} + y^{3}$}
\end{picture}
```

2. It's also easy to draw circles, lines and boxes

```
\begin{picture}(10,3)
\put(0,0){\line(0,1){2}}
\put(2,1){\circle{1.5}}
\put(5,0){\framebox(3,1.5){}}
\put(10,0){\framebox(3,1.5){$\int_{0}^{\pi} \theta^{2} \text{ d}\theta$}}
\end{picture}
```

3. It's also possible to import external graphics (it's best if the file is saved in Encapsulated PostScript (.eps))

```
\begin{picture}(10,5.5)
\put(0,0){\resizebox{5cm}{5cm}{\includegraphics{sin.eps}}}
\put(6,0){\resizebox{3cm}{3cm}{\includegraphics{sin.eps}}}
\put(10,2){\rotatebox{-90}{\resizebox{1cm}{1cm}{\includegraphics{sin.eps}}}}
\put(7,4){You can resize and rotate the graphics}
\put(12,3){\rotatebox{-90}{and the text}}
\end{picture}
```

4. The figure environment allows automatic labelling and captions

```
\begin{figure}[htb]
\begin{picture}(10,5)
\put(5,0){\resizebox{7cm}{5cm}{\includegraphics{sin.eps}}}
\put(9,-0.1){$x$}
\put(4,4){$\sin x$}
\end{picture}
\caption{The graph $x$ vs. $\sin x$}
\end{figure}
```

Cross-Referencing Exercise

```
\section{Pythagoras' Theorem}
\label{sec_pyth}
  Pythagoras' Theorem \cite{pyth} is perhaps one of the most proven
  theorems in mathematics. It may be stated as follows:
  \begin{theorem}
  In a right-angled triangle, the sum of the squares of the lengths of
  the sides containing the right angle is equal to the square of the
  hypotenuse.
 \end{theorem}

 It may also be expressed symbolically (equation \ref{py_eqn})
 \begin{equation}
 a^{2} + b^{2} = c^{2}, \label{py_eqn}
 \end{equation}
 where $a$, $b$ and $c$ are shown in Figure \ref{tri}
 \begin{figure}[!htb]
 \begin{picture}(10,4.5)
 \put(6,0.5){\line(1,0){3}}
 \put(6,0.5){\line(0,1){4}}
 \put(6,4.5){\line(3,-4){3}}
 \put(7.5,0){$a$}
 \put(5.5,3){$b$}
 \put(8,2.5){$c$}
 \end{picture}
 \caption{A right-angled triangle}
 \label{tri}
 \end{figure}

 This section, \ref{sec_pyth}, contains most of the cross-referencing
 commands you will ever need. The next section, \ref{sec_filler}, is
 included to shown that references can be made forwards as well as
 backward.

\section{Notes}
\label{sec_filler}

 Note that you need to run the latex command twice in order to get the
 cross-references correct. This is because latex stores the references
 in an intermediate file which is generated on the first run and
 read-in on the second. Any missing references will show up as notes
 when compiling the latex sources.


\begin{thebibliography}{99}
\bibitem{pyth} Pythagoras \textbf{C. 6 BC} \textsl{An old dusty scroll
of interesting mathematics.}
\end{thebibliography}
```