LaTeX 2ε Exercises

Reproduce each example as shown. Don't worry about exact font size unless explicitly specified.

Text Exercises

Easy

1. A simple test sentence: the quick brown fox jumps over the lazy dog.
2. **Bold** and *italic* fonts may be used to add emphasis to the text. It is also possible to use sans-serif and `typewriter-style` fonts.
3. The LaTeX language uses some special characters that must be preceded by a \ or they will not be printed. These include: $ & % # _ { } ˜ ˆ
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
to break the lines
wherever you like. You can move the text
horizontally using the \hspace* command. (The gap is 3 cm in this case.)

   You can also move the text vertically using the \vspace* command (Now the gap is 1.5cm). This only works between paragraphs.
6. Font size can be varied from tiny up to the normalsize and then up to Huge. *This is an example in which font size matters.*

Medium

1. LaTeX 2ε uses environments to perform useful functions; for example,

   center (note US spelling) environment,

   flushleft environment,

   and flushright environment.
2. Environments can also be used to make lists:
   - itemize does not number list entries
   - bullet points are used

   1. enumerate does number the entries
   2. in fact, enumerate was used to generate the example numbers on this sheet.
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

1.0	One
2.0	Two
3.0	Three

Tricky stuff

1. Quite tricky tables can be constructed

Famous Dead Mathematicians		
Name	Fields of Study	`Survives as`
Archimedes	Geometry, Bath water, Ways of killing Romans	A Principle, An Axiom
Euler	You name it, he studied it	An equation, A constant, A formula, A method
Gauss	integration, integers	A distribution, A theorem

2. You can also make beautiful patterns with text but then again

   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
$$\int \frac{x^2+3x+1}{2x+7}\,\mathrm{d}x. \tag{1}$$
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 `\mbox` or `\text` (part of the amsmath package) commands must be used to generate normal text. Compare
$$a=b+c \quad if b>c, \tag{2}$$
to
$$a=b+c \quad \text{if } b>c. \tag{3}$$
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 `\boldmath` command; i.e. the vector, $\boldsymbol{x}$. Boldmath remains on until turned off with the `\unboldmath` command. Check this now $a^2+b^k=c^k$.
7. Brackets change size automatically
$$(A+B)\,, \text{ is smaller than } \left[\frac{A+B}{C+D}\right].$$

Medium

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
$$y=\begin{cases} 0 & \text{if } x>0,\\ 1 & \text{if } x<0,\\ \infty & \text{if x = 0.} \end{cases}$$
3. There are no automatic line breaks in equations, you must specify them by hand
$$f_{il}^{(F)}=\int\!\!\int\!\!\int \frac{\mathrm{Bo}}{\mathrm{Ca}}k_i\psi_l^{(F)}\,\mathrm{d}V+\int\!\!\int\!\!\int\left[p\frac{\partial\psi_l^{(F)}}{\partial x_i}-\left(\frac{\partial u_i}{\partial x_j}+\frac{\partial u_j}{\partial x_i}\right)\frac{\partial\psi_l^{(F)}}{\partial x_i}\right]\,\mathrm{d}V-\int\!\!\int p_b\psi_l^{(F)}n_i\,\mathrm{d}S$$
$$-\frac{1}{\mathrm{Ca}}\oint\psi_l^{(F)}m_i\,\mathrm{d}s, \tag{4}$$
4. It's not obvious how to generate boldsymbols in formulæ
$$\int\!\!\int\!\!\int_V \boldsymbol{\nabla.u}\,\mathrm{d}V=\int\!\!\int_\Gamma \boldsymbol{u.n}\,\mathrm{d}S,$$
but the amsmath package includes a useful command to help `\boldsymbol`

Tricky Stuff

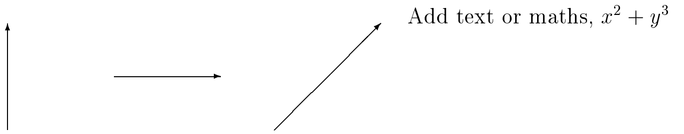
1. There are some custom maths fonts, which must be included in the preamble, such as the bbm font, $x\in\mathbb{R}$. Another useful font is the caligraphic font $x=1+2\epsilon+\mathcal{O}(\epsilon^2)$; and some people like the Fraktur font $\mathfrak{K}$.
2. Splitting brackets across lines can break the automatic sizing. Try
$$f_{il}^{(F)}=\int\!\!\int\!\!\int \frac{\mathrm{Bo}}{\mathrm{Ca}}k_i\psi_l^{(F)}\,\mathrm{d}V-\frac{1}{\mathrm{Ca}}\oint\psi_l^{(F)}m_i\,\mathrm{d}s-\int\!\!\int p_b\psi_l^{(F)}n_i\,\mathrm{d}S+\int\!\!\int\!\!\int\Big[p$$
$$\frac{\partial\psi_l^{(F)}}{\partial x_i}-\left(\frac{\partial u_i}{\partial x_j}+\frac{\partial u_j}{\partial x_i}\right)\frac{\partial\psi_l^{(F)}}{\partial x_i}\Bigg]\,\mathrm{d}V$$
3. The theorem environment can be useful, but needs to be defined in the preamble

Theorem 1 (The LaTeX 2ε Law) *Backslash is the most overused key in LaTeX.*

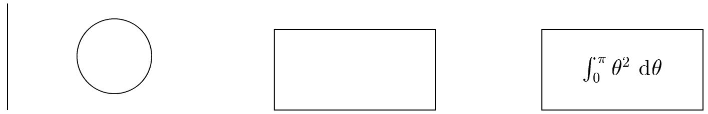
Theorem 2 (The Computer's Law) *The `delete` key will be used more than all other keys put together.*

Picture & Figure Exercises

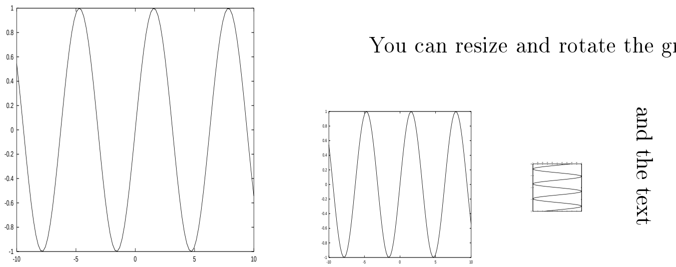
1. Many vectors may be created



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



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



4. The figure environment allows automatic labelling and captions

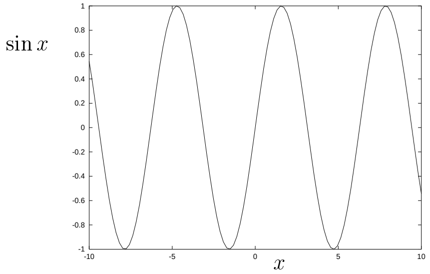


Figure 1: The graph x vs. $\sin x$

Cross-Referencing Exercise

Reproduce the following section, using automatic cross-references as often as possible. In this case, the numbers do not all start at zero as some equations, theorems and figures have appeared in previous sections.

0.1 Pythagoras' Theorem

Pythagoras' Theorem [1] is perhaps one of the most proven theorems in mathematics. It may be stated as follows:

Theorem 3 *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.*

It may also be expressed symbolically (equation 5)

$$a^2 + b^2 = c^2, \tag{5}$$

where a, b and c are shown in Figure 2

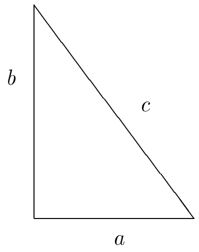


Figure 2: A right-angled triangle

This section, 0.1, contains most of the cross-referencing commands you will ever need. The next section, 0.2, is included to shown that references can be made forwards as well as backward.

0.2 Notes

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. [1]

[1] P.T.O. for the bibliography, which is automatically placed on a new page.

Bibliography

[1] Pythagoras **C. 6 BC** *An old dusty scroll of interesting mathematics.*