Preparing a manuscript for *ScienceAsia* using LaTeX

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ABSTRACT: We summarize the commands and best practices for producing a manuscript written using LaTeX for submission to *ScienceAsia*. Most of the details given here also apply to the preparation of any technical document using LaTeX.

KEYWORDS: manuscript preparation, TeX, BibTeX

CONTENTS

INTRODUCTION

First of all, congratulations on choosing to use LaTeX[1] with the *ScienceAsia* class file to prepare your manuscript! The final versions of *ScienceAsia* articles are typeset using LaTeX and so, if your manuscript is accepted and you follow the guidelines given here, it will be processed more quickly. Also, manuscripts prepared in this way will automatically have the correct format and will look good. This will help to create a favourable initial impression with the referees. If you use `\cite{ }`, `\label{ }`, and `\ref{ }` then the cross references in your manuscript will have hyperlinks which will make navigating it easier for the referees.

This document is a detailed guide to the small number of non-standard commands associated with the *ScienceAsia* class file and a reference for all the LaTeX tricks you are likely to need. The first section deals with commands for the front matter and acknowledgements. Each of the remaining sections covers various tasks in LaTeX in increasing detail. If you are fairly new to LaTeX then at least the start of most of these sections will be essential reading. Even if you have some experience with LaTeX it is still worth looking at the sections relevant to you to check that you are using the most efficient approach.

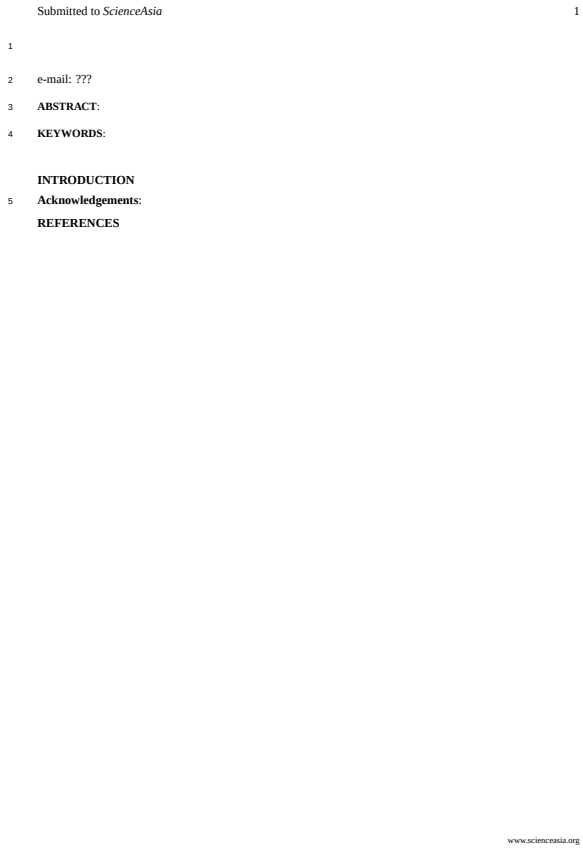
This guide should be read in conjunction with the editorial guide to publishing with *ScienceAsia* (see www.scienceasia.org/scias_guide.pdf) which deals with what you should write. The present guide tells you how to write it.

Colour coding of LaTeX commands

When referred to in the text, standard LaTeX commands (including those defined in the amsmath package) are shown in black, LaTeX commands which are defined in other standard packages (i.e., those available from ctan.tug.org) are shown in magenta, standard LaTeX commands whose action has been redefined in a significant way in `scias.cls` are shown in red, non-standard LaTeX commands (whose definitions are in `scias.cls`) are shown in blue, and examples of LaTeX commands defined for the purpose of this guide are shown in green.

Getting started

If you have not used LaTeX before on your computer you will probably need to install it if you are using Windows or Mac OS. The software is free. People with the Windows and Mac OS X operating systems normally use the MiKTeX and MacTeX distributions, respectively. LaTeX is usually present by default with Linux. If not, or if compiling the *ScienceAsia* template file gives errors, add a basic LaTeX installation and the recommended fonts to your system. E.g., in Ubuntu Linux install the texlive-latex-base, texlive-latex-recommended, and texlive-fonts-recommended packages and their dependencies.


Submitted to *ScienceAsia* 1

1

2 e-mail: ???

3 **ABSTRACT**:

4 **KEYWORDS**:

INTRODUCTION

5 **Acknowledgements**:

REFERENCES

www.scienceasia.org

Fig. 1 Output PDF file from running latex on a copy of `scias_template.tex`.

To create a manuscript for *ScienceAsia* you will need to download the zip file www.scienceasia.org/scias_latex.zip which contains the *ScienceAsia* class file (`scias.cls`), the *ScienceAsia* BibTeX style file (`scias.bst`), other style (.sty) files which are needed, and the template file (`scias_template.tex`). After unpacking the zip file, place its contents in the same directory (folder) as your manuscript .tex file (or somewhere else where latex can find it).

Copy the file `scias_template.tex` to a name of your choice and open it with your favourite text or .tex file editor. Running latex on this newly created .tex file should give no errors (apart from a warning about an empty bibliography) and the output PDF file it should produce is shown in Fig. 1.

All characters after % on a line are comments, i.e., they are ignored by latex (if the % is not immediately preceded by an odd number of \ in which case it will appear as the percent sign). When trying something out it is good practice to 'comment out' the old version by adding a % in front. If you change your mind about the new version the old one is then easily restored.

FRONT AND BACK MATTER

Title

The title of the manuscript is specified using \title{ }. Remember that only the first word and the first word after a colon need to be capitalized. The remaining words should only be capitalized if they are proper nouns.

Authors and their affiliations

Each author should be placed in a separate \author{ } command. The surname should follow the given name and initials. If a surname is made up of more than one word (e.g., El Naschie), then we need to know so that the author's entry is given correctly in the annual index of authors. The simplest way to inform us is to replace each space in the surname by a non-breaking space (~). E.g.,

```
\author{Mohammed S. El~Naschie}
```

The affiliation(s) of the author(s) are given using the \address{ } command. Use a separate command for each address. Do not attempt to format the address (by using, e.g., \\).

If authors belong to different affiliations then the lower case letters (separated by commas) are placed in the optional arguments of \author{ } and \address{ }. E.g.,

```
\author[a]{Amita Ramanujan}
\author[a,b]{Charles A. Eppes}
\author[c,*]{Sheldon L. Cooper}
\address[a]{Mathematics Department,
California Institute of Science
and Technology, Oxnard, CA 93030 USA}
\address[b]{Area 51, Edwards Airforce Base,
Groom Lake, NV 89320 USA}
\address[c]{California Institute of
Technology,  High Energy Physics,
MC 256-48, Pasadena, CA 91125 USA}
```

The lower case letters are not necessary if all the authors have the same affiliation(s). E.g.,

```
\author[*]{Rajesh R. Koothrappali}
\author{Howard J. Wolowitz}
\address{Department of Applied Physics,
California Institute of Technology,
MC 128-95, Pasadena, CA 91125 USA}
\address{NASA Goddard Institute for Space
Studies, New York, NY 10025 USA}
```

Remember that the affiliation is a place of work of the author, and not the address of a funding body.

If there is more than one author, a * is placed in the optional argument of the corresponding author, after the lower case letter if present.

E-mail address

The (long-term) e-mail address of the corresponding author should be given using \ead{ }. If the corresponding author wishes to give two e-mail addresses, the second can be given by placing it in an additional \ead{ }. Note that you do not need to precede underscores (_) in the e-mail address by \ in this case. E.g.,

```
\ead{sheldon_cooper@caltech.edu}
\ead{sheldon.l.cooper@gmail.com}
```

Abstract

The abstract is placed in the argument of \abstract{ }. It should only be one paragraph (and therefore not contain any blank lines). It should not contain any displayed equations (i.e., no \[, \], etc.). You should also not use \displaystyle. Mathematical expressions inside $ $ are permitted but they should be kept simple as the abstract will need to be rendered in HTML (without images) for the *ScienceAsia* website.

Note that you do not need to write the word ABSTRACT as this is generated automatically.

Keywords

The keywords are given as a comma separated list of uncapitalized words or phrases placed inside \keywords{ }. The keywords should all differ from words in the title.

The keywords for the annual index are selected later by the editors, although you are welcome to make suggestions for this (by placing each entry in a separate \kwidx{ } command) based on the type of entries in last year's index.

Note that you do not need to write the word KEYWORDS as this is generated automatically.

Acknowledgements

If you have them, acknowledgements are put inside \acknowledgements{ } which is placed just before the references. If there are no acknowledgements then delete or comment out this command.

SECTIONS

Headings

Section and subsection headings are done using the \section{ } and \subsection{ } commands. A section heading automatically appears in capital

letters – there is no need to write the argument of \section{ } in capital letters. E.g.,

```
\section{Introduction}
```

will appear as in Fig. 1. Any part of a section heading which should not appear as capitals should be enclosed in \NoCaseChange{ }. This would be needed for an abbreviation containing lower case letters but not for lower case letters appearing inside $ $ or \ce{ }. E.g.,

```
\section{Solutions of the \NoCaseChange{gNLS}
equation when $p=1/2$}
```

It is also necessary when the heading contains a reference to a label containing a lower case letter. E.g.,

```
\section{Proof of
Theorem~\NoCaseChange{\ref{T:main}}}
```

Paragraphs

ScienceAsia follows the default LaTeX style of not indenting the paragraph immediately after a heading. You should not try to change this by using \indent.

A new paragraph is made by simply leaving an empty line. Never use \newline or \\ and \indent to get a new paragraph.

Gaps

Sometimes there will be a large gap between blocks of text and headings or equations. It is often caused by long blocks of equations which by default LaTeX will not split. You can allow the equations to be split between columns or pages by enclosing the whole block of equations within {\allowpagebreaks }. You should only be concerned about gaps if you think the referees will find them distracting. Do not attempt to fix them by using \vspace{ }.

Sometimes there will be large gaps in the body of the text where mathematical expressions have been stretched to ensure the text is right justified. Don't worry too much about this. If you think it looks too ugly, you can try displaying some of the longer expressions (by placing them inside \[and \]). Don't use \\ within the text.

Labelling

As there are no section or subsection numbers in *ScienceAsia* articles, you should not label sections or subsections (using \label{ }) and then refer to them (using \ref{ }).

REFERENCES AND CITATIONS

BibTeX

If your research group regularly uses LaTeX to write articles we recommend building a BibTeX database (i.e., one or more .bib files) containing references you cite. Most journals that encourage submission in LaTeX supply a bibliography style (.bst) file as well as a class file. Running bibtex on your .tex file will automatically produce a list of references in the format required by the journal.

An example of an entry in a .bib file is

```
@Article{KPR98,
  author = {R A Kraenkel and J G Pereira
and de Rey Neto, E C},
  title = {Linearizability of the
perturbed {Burgers} equation},
  journal =      PRE,
  year =         1998,
  volume =       {58},
  number =       {2},
  pages =        {2526-2530},
  doi = {10.1103/PhysRevE.58.2526}
}
```

Notice that names are separated by and. The final word in a name is assumed to be the surname unless there is a comma in which case the surname is taken as the word(s) before the comma. In the title, words whose case should never be changed (such as proper nouns and abbreviations) should be enclosed in braces. We suggest that instead of writing the journal name in full or as the standard abbreviation, you instead write it as a one-word abbreviation (of your choice) and give the full name and abbreviation in files called, for example, long.bib and short.bib, respectively. For PRE you would have

```
@String{PRE = {Physical Review E}}
```

in long.bib and

```
@String{PRE = {Phys. Rev. E}}
```

in short.bib.

References using BibTeX

The line with \bibliographystyle{scias} should be uncommented and put somewhere before \begin{document}. Replace the begin and end bibliography commands and everything in between by \bibliography{ }. The argument of this command should contain a comma-separated list (without spaces) of .bib files with entries for all the citations in your manuscript with files giving definitions of abbreviations listed first. E.g., if the entries for the articles you refer to are in papers.bib then use

```
\bibliography{short,papers}
```

if the journal expects abbreviated journal names. When the journal requests your .tex file you should replace \bibliography{ } by the contents of the .bbl file which bibtex has created.

Note that if a field called DOI (which contains the correct DOI) is present in a BibTeX entry, a hyperlink to the article will appear in the list of references.

References without using BibTeX

For each reference you cite in the manuscript there should be a corresponding \bibitem{ } whose argument is the citation key. This is followed by the actual reference. These \bibitem{ } commands are placed inside the \thebibliography environment. E.g.,

```
\begin{thebibliography}{2}
\bibitem{Lam=94}
Lamport L (1994) \textit{\LaTeX: A Document
Preparation System}, 2nd edn,
Addison-Wesley, Reading, MA.

\bibitem{BH04}
Brihaye Y, Hartmann B (2004)
Fullerenic solitons. \textit{J Phys A}
\textbf{37}, 1181--1192.
\end{thebibliography}
```

If you know the DOI of the reference then you may create a hyperlink to it using \bihl{ }{ } as in the following example.

```
\bibitem{BH04}
\bihl{10.1088/0305-4470/37/4/006}{
Brihaye Y, Hartmann B (2004)
Fullerenic solitons. \textit{J Phys A}
\textbf{37}, 1181--1192.}
```

Symbols for non-English languages

For words or names from languages other than English, accented characters or other text symbols are sometimes needed. The accent commands (\`{ }, \'{ }, \"{ }, \^{ }, \~{ }, \c{ }, \H{ }, \={ }, \.{ }, \u{ }, \v{ }, \r{ }, \t{ }, \d{ }, \b{ }, \k{ }) can be applied to any character for which there is a need. If an accent is applied to an 'i' then you should use the dotless 'i' obtained using \i. E.g., `Garc\'{\i}a` gives García. Some examples: `Amp\`ere` gives Ampère, `Poincar\'e` gives Poincaré, `Schr\"odinger` gives Schrödinger, `l'H\^opital` gives l'Hôpital, `Do\~nana` gives Doñana, `gar\c{c}on` gives garçon, `E\H{o}tv\H{o}s` gives Eőtvős, `\=o\.o\u{o}\v{o}\r{u}\t{oo}` gives ōȯŏůo͡o, `\d{o}\b{o}\k{e}` gives o̩o̲ę. Note that these accent commands should not be used in mathematical expressions.

You might sometimes need the following symbols as well: \oe, \OE, \ae, \AE, \aa, \AA, \o, \O, \l, \L, \ss. Note that these commands should be enclosed in braces. E.g., `{\oe}uvre` gives œuvre, `{\OE}{\ae}{\AE}` gives ŒæÆ, `T{\aa}kern` gives Tåkern, `{\AA}` gives Å, `Fr{\o}yland` gives Frøyland, `{\O}` gives Ø, `Jarno{\l}towek` gives Jarnołtowek, `{\L}` gives Ł, `Schlo{\ss}` gives Schloß.

Citations

To cite a reference without explicitly referring to it use \cite{ } where the argument is the key of the reference given either in the entry in one of your .bib files (if you are using BibTeX) or as the argument of one of the \bibitem{ } commands at the end of your manuscript (if you are not using BibTeX). E.g.,

```
congratulations on choosing to use
\LaTeX\cite{Lam=94} with the
```

If you want to refer to a reference explicitly then place the key inside \refcite{ } instead. E.g.,

```
See \refcite{Lam=94} for further details.
```

gives: See Ref. 1 for further details. For more than one citation at the same time, give a comma-separated list of keys. Never use dashes (i.e., don't do something like `\refcite{Lam=94}--\refcite{Slo90}`) to indicate a range of references. The key to each reference you want to cite must be given and latex will put a dash between three or more neighbouring references automatically. E.g.,

```
has been done\cite{Lam=94,BH04}.
See \refcite{Lam=94,BH04,Slo90}.
```

gives: has been done[1,2]. See Refs. 1–3.

As a result of a quirk in the production of the file for the full printed issue we have not managed to resolve, the first citation in your article must be done using \cite{ } rather than \refcite{ }.

Links to webpages

If you wish to cite a webpage, it is normally better to do so in the text rather than in the list of references. This can be done by placing the URL in the argument of \url{ }. The text showing the URL is then also a hyperlink to the page. E.g., `\url{ctan.tug.org}` gives ctan.tug.org. Characters such as _ in the URL do not need \ before them.

MATHEMATICAL EXPRESSIONS

Mathematical expressions can appear in the text by enclosing them in `$ $` or they can be 'displayed' outside of the text by putting the expression in between \[and \] or inside an equation environment (see later). [Never use `$$ $$` or `\begin{center} $ $ \end{center}`.]

Subscripts and superscripts

A single character inside an expression can be made into a subscript or superscript by preceding it with a _ or ^, respectively. E.g., `$a_ib^i$` gives $a_i b^i$. If more than one character is in the sub- or superscript,

the characters must be enclosed in braces. E.g., `cm$^{-1}$` gives cm^{-1}.

If the sub- or superscript causes the overall expression to have a large enough vertical extent, the spacing between lines will be increased wherever the expression occurs in the text. To prevent a change in line spacing, the expression should be enclosed in `\smash[t]{ }` if the superscript is too large and `\smash[b]{ }` if the subscript is too large. E.g., `$\smash[t]{C_G^{(n)}}$` gives $C_G^{(n)}$. This may result in a part of the top of the expression 'smashing into' the characters in the line above. A slight rewording may prevent this.

To display or not to display

Simple expressions should not be displayed unless you need to give them an equation number. More complicated expressions (without an equation number) should be displayed if not doing so makes them difficult to read. E.g.,

```
Compare $\sum_{r=1}^\infty r^{-z}$ with
\[
\sum_{r=1}^\infty r^{-z}.
\]
```

gives: Compare $\sum_{r=1}^{\infty} r^{-z}$ with

$$\sum_{r=1}^{\infty} r^{-z}.$$

Note that even if an expression is displayed, it is still part of a sentence and therefore may require punctuation. Punctuation marks should be placed outside of `$ $` unless the marks are part of the mathematical expression. Also, never leave a blank line before an equation. Only leave a blank line after an equation if the equation ends a paragraph (which is unusual). E.g.,

```
The energy $E$ is given by
\[
E^2 = m^2 c^4+p^2c^2,
\]
where $m$, $p$, and $c$ are the rest mass,
momentum, and speed of light, respectively.
```

gives: The energy E is given by

$$E^2 = m^2c^4 + p^2c^2,$$

where m, p, and c are the rest mass, momentum, and speed of light, respectively.

Never use `\displaystyle{ }` within the text. This may cause uneven line spacing which looks ugly.

Functions

Functions denoted by a single letter of the (roman) alphabet, excluding any sub- or superscripts, should appear in italics. E.g., the associated Legendre function: `$P_l^m(x)$` gives $P_l^m(x)$. Functions denoted by more than one letter (such as ln or sin) should appear in a roman (i.e., not a slanted or italic) font (so not as ln or sin). Commonly occurring functions have already been defined in standard LaTeX or in `scias.cls`.

Trigonometric, hyperbolic, and exponential functions and their inverses `\sin`, `\cos`, `\tan`, `\csc`, `\cosec`, `\sec`, `\cot`, `\arcsin`, `\arccos`, `\arctan`, `\sinh`, `\cosh`, `\tanh`, `\cosech`, `\sech`, `\coth`, `\exp`, `\log`, `\ln`. [Note: log without a subscript always refers to the natural logarithm. If you want the base-10 logarithm you must write $\log_{10}$.] With functions such as these you should follow the usual convention of bracketing arguments only when necessary. E.g., `$\sin 2x=2\sin x\cos x$` gives $\sin 2x = 2\sin x\cos x$ and its meaning is clear.

Special functions `\erf`, `\erfc`, `\sinc`.

Functions used in analysis `\sgn`, `\max`, `\min`, `\lim`, `\liminf`, `\limsup`, `\sup`, `\inf`, `\hom`, `\Deg`. Note that `\Deg`, the degree of a polynomial, gives the function name in lower case (as is usual). E.g., `$\Deg x^2y^3=5$` gives $\deg x^2y^3 = 5$.

Functions used in complex analysis `\Re`, `\Im`, `\arg`, `\Arg`, `\Log`, `\Ln`, `\Res`.

Functions used in linear algebra `\ker`, `\det`, `\tr`, `\diag`, `\rank`.

Functions used in number theory `\gcd`, `\pmod{ }`, `\bmod`. The last two functions are for the modulo operation written with or without parentheses. E.g., `$-1\bmod 3=2$` gives $-1 \bmod 3 = 2$. E.g., `$x\equiv y\pmod{3}$` gives $x \equiv y \pmod 3$.

Functions used in statistics `\Pr`, `\Var`, `\Cov`.

Defining your own functions If the function you want is not available you can define it yourself. E.g., putting

```
% per A =  permanent of matrix A
\newcommand{\per}{\operatorname{per}}
```

somewhere before `\begin{document}` defines a function called per. E.g., `$\per H$` gives per H. This is of course not necessary for functions whose symbol is a single character (such as the Bessel functions J_n) since they are always written in italics and their arguments are always in brackets.

Square roots and nth roots `$\sqrt{x}$` gives $\sqrt{x}$, `$\sqrt[n]{y}$` gives $\sqrt[n]{y}$.

Symbols

Defining your own roman multi-character symbols As with function names, parameters symbols containing more than one letter (excluding sub- or superscripts) should be in roman font. This includes parameter symbols such as SNR which are derived from an abbreviation of the name of the parameter. To define, for example, the two letter symbol Fr, place

```
\newcommand{\Fr}{\mathrm{Fr}} % Froude number
```

before \begin{document}. Then `$\Fr$` gives Fr.

Symbols involving roman sub- or superscripts If the subscript or superscript is a letter (or letters) abbreviating a word and is not itself a variable then it should be in roman font. Roman subscripts and superscripts are most conveniently done using the commands \rs{ } and \rp{ }, respectively. E.g., initial temperature: `$T\rs{i}$` gives T_i. E.g., the transpose of a matrix A: `$A\rp{T}$` gives A^T. If you need a mix of roman and italic in the sub- or superscript then you will need to use the usual method of obtaining sub- or superscripts and enclosing the parts that should be in roman font in \mathrm{ }. E.g., `$x_{\mathrm{c}i}$` gives x_{ci}.

Greek letters

```
\[
\alpha\beta\gamma\delta\epsilon\varepsilon
\zeta\eta\theta\iota\kappa\lambda\mu\nu
\xi\pi\rho\sigma\tau\phi\varphi
\chi\psi\omega
\Gamma\Delta\Theta\Lambda\Xi\Pi
\Sigma\Upsilon\Phi\Psi\Omega
\]
```

gives:

$$\alpha\beta\gamma\delta\epsilon\varepsilon\zeta\eta\theta\iota\kappa\lambda\mu\nu\xi\pi\rho\sigma\tau\phi\varphi\chi\psi\omega\Gamma\Delta\Theta\Lambda\Xi\Pi\Sigma\Upsilon\Phi\Psi\Omega$$

Calculus

```
\[
\partial\nabla\int\oint\iint\iiint
\]
```

gives:

$$\partial\nabla\int\oint\iint\iiint$$

Binary operations

```
\[
\pm\mp\times\wedge\oplus\otimes\odot\circ
\ast\star\vee
\]
```

gives:

$$\pm\mp\times\wedge\oplus\otimes\odot\circ\ast\star\vee$$

Sets

```
\[
\varnothing\cap\cup\setminus\in\notin
\subset\subseteq\forall\exists\aleph\neg
\]
```

gives:

$$\varnothing\cap\cup\setminus\in\notin\subset\subseteq\forall\exists\aleph\neg$$

You may wish to use \Rset, \Cset, \Zset, \Nset, and \Qset as a quick way to get $\mathbb{R}$, $\mathbb{C}$, $\mathbb{Z}$, $\mathbb{N}$, and $\mathbb{Q}$, respectively.

Relations

```
\[
\ll\leq\geq\gg\equiv\sim\simeq\gtrsim\lesssim
\approx\cong\neq\propto\to\mapsto\Rightarrow
\Leftrightarrow\twoheadrightarrow
\leftrightarrow\vdash\nvdash
\]
```

gives:

$$\ll\leq\geq\gg\equiv\sim\simeq\gtrsim\lesssim\approx\cong\neq\propto\to\mapsto\Rightarrow\Leftrightarrow\twoheadrightarrow\leftrightarrow\vdash\nvdash$$

Ellipses (lines of 3 dots)

```
\[
\dots\ldots\cdots\vdots\ddots
\]
```

gives:

$$\dots\ldots\cdots\vdots\ddots$$

You should use \dots rather than .... E.g., `$a_0+a_1x+\dots+a_nx^n$` gives $a_0 + a_1x + \cdots + a_nx^n$. The dots between comma-separated objects should be 'lower dots' and those between binary operations, multiplications, or integrals should be 'central dots'. Ideally, the \dots command should detect whether to place lower or central dots, but it often fails to do this. You can specify lower or central dots using \ldots and \cdots, respectively.

Symbols used in QM and other branches of physics `$\hbar\dagger\ell\perp\parallel$` gives $\hbar\dagger\ell\perp\parallel$. To obtain degrees Celcius use \degC after the number. E.g., `22\degC` gives 22 °C. Notice that this is not in math mode. The degrees symbol on its own is obtained using \deg. E.g., `45\deg` gives 45°.

Other symbols `$\cdot\infty\e\ii$` gives $\cdot\infty\,\mathrm{e}\mathrm{i}$. Note that we use \e to denote the base of natural logarithms, and \ii to denote $\sqrt{-1}$.

Comprehensive list See ftp://ctan.tug.org/pub/ctan/info/symbols/comprehensive/symbols-a4.pdf for a complete list of available symbols. Note that for some symbols you may need to include an extra package.

Making your own symbols If the symbol you want doesn't exist, you might be able to create your own by combining existing symbols. One way is to put one symbol above another symbol using \stackrel{ }{ }. E.g., `$\stackrel{n}{\sim}$` gives $\stackrel{n}{\sim}$. You can put a diagonal line through a symbol by placing \not in front of it. Whenever you create a symbol you should make a new command for it (see later).

Other fonts To obtain caligraphic or blackboard style letters, place the letter inside \mathcal{ } and \mathbb{ }, respectively. E.g., `$\mathcal{C}$` gives $\mathcal{C}$. E.g., `$\mathbb{B}$` gives $\mathbb{B}$.

Accents

Single characters or symbols may be modified using the accent commands \dot{ }, \ddot{ }, \dddot{ }, \ddddot{ }, \hat{ }, \check{ }, \tilde{ }, \bar{ }, \breve{ }. E.g.,

```
\[
\dot{x}\ddot{x}+\dddot{x}+\ddddot{x}+
\hat{x}\check{x}\tilde{x}\bar{x}\breve{x}.
\]
```

gives:

$$\dot{x}\ddot{x} + \dddot{x} + \ddddot{x} + \hat{x}\check{x}\tilde{x}\bar{x}\breve{x}.$$

To get a line above the whole of an expression (rather than a short bar of fixed length) use \overline{ }. E.g., `$\overline{x^2+y^2}$` gives $\overline{x^2+y^2}$.

Space and text

To put a space between two displayed expressions on the same line use \qquad. E.g.,

```
\[
u_t+u^pu_x=0, \qquad p>0.
\]
```

gives:

$$u_t + u^p u_x = 0, \qquad p > 0.$$

A smaller gap is obtained using \quad instead. LaTeX normally does a good job with formatting equations. If you need to make small adjustments, a thin space is obtained using \, and \; gives a slightly thicker one. A small amount of space is deleted using \! and this is often used with integrals (see later).

If you need to use ordinary text in displayed expressions put it inside \text{ }. Be aware, however, that text is often not really needed. E.g.,

```
\[
u_t+u^pu_x=0, \quad \text{where $p>0$}.
\]
```

gives:

$$u_t + u^p u_x = 0, \quad \text{where } p > 0.$$

Notice that it often easier to place text-style maths expressions inside \text{ } as well, rather than adding another \quad after the word.

Fractions

Only use \frac{ }{ } in the text if the numerator and denominator are small positive integers. Otherwise use / (with brackets if necessary). E.g., `$\frac{2}{3}$, $a/2(b+c)$` gives $\frac{2}{3}$, $a/2(b+c)$. In displayed expressions where the numerator and denominator are single digits, a text-style fraction obtained using \tfrac{ }{ } sometimes looks better. E.g.,

```
\[
\sin\frac{1}{2}(a+b)+\cos\tfrac{1}{2}(a+b).
\]
```

gives:

$$\sin\frac{1}{2}(a+b) + \cos\tfrac{1}{2}(a+b).$$

If an expression such as a sum or integral which looks better in display style is in the numerator or denominator you should use \dsfrac{ }{ } instead of \frac{ }{ }. E.g.,

```
\[
\frac{\int_{-1}^1P\sod{x}}{\sum_jQ_j},\qquad
\dsfrac{\int_{-1}^1P\sod{x}}{\sum_jQ_j}.
\]
```

gives:

$$\frac{\int_{-1}^{1} P\,\mathrm{d}x}{\sum_j Q_j}, \qquad \dsfrac{\int_{-1}^{1} P\,\mathrm{d}x}{\sum_j Q_j}.$$

Use \cfrac{ }{ } to get continued fractions. E.g.,

```
\[
\pi=3+\cfrac{1}{7+\cfrac{1}{15+
\cfrac{1}{1+\cfrac{1}{292+\ddots}}}}.
\]
```

gives:

$$\pi = 3 + \cfrac{1}{7 + \cfrac{1}{15 + \cfrac{1}{1 + \cfrac{1}{292 + \ddots}}}}.$$

Brackets and other delimiters

```
\[
()[]\{\}|\|\langle\rangle
\lfloor\rfloor\lceil\rceil
\lvert\rvert\lVert\rVert
\]
```

gives:

$$()[]\{\}|\|\langle\rangle\lfloor\rfloor\lceil\rceil\|\|$$

Ideally, brackets and norms should be of about the same height as the tallest object they enclose. If the delimiter is used on its own, the smallest size delimiter is used which gives ugly results if the enclosed expression is much larger. E.g.,

```
\[
(\frac{x}{1+x})^2.
\]
```

gives:

$$(\frac{x}{1+x})^2.$$

To automatically get the delimiters which are at least as high as the enclosed expression, put `\left` and `\right` in front of both delimiters. To save typing you might prefer to use `\lrp{ }`, `\lrs{ }`, `\lrb{ }`, `\lrm{ }`, `\lrn{ }`, and `\av{ }` instead of `\left( \right)`, `\left[ \right]`, `\left\{ \right\}`, `\left| \right|`, `\left\| \right\|`, and `\left\langle \right\rangle`, respectively. E.g.,

```
\[
\left(\frac{x}{1+x}\right)^2
+\lrp{\frac{x}{1+x}}^2
+\av{\frac{1}{1+x^2}}.
\]
```

gives:

$$\left(\frac{x}{1+x}\right)^2+\left(\frac{x}{1+x}\right)^2+\left\langle\frac{1}{1+x^2}\right\rangle.$$

Note that the 'recommended' way to obtain the modulus and norm symbols is to use, respectively, `\lvert` and `\rvert` rather than two `|` and `\lVert` and `\rVert` rather than two `\|`. This is what is done in the definitions of `\lrm{ }` and `\lrn{ }`. However, in many instances the difference between the two ways is not noticeable.

For every `\left` there must be a `\right` on the same line (i.e., before the end of the environment or `\\`, whichever comes first). To get just one delimiter on a line, use a dot instead of the missing delimiter. E.g.,

```
\[
\left.\frac{1}{1+x^2}\right|_0^\infty.
\]
```

gives:

$$\frac{1}{1+x^2}\Bigg|_0^\infty.$$

Sometimes using `\left` and `\right` doesn't give satisfying results. To specify exactly which size of bracket you want, replace `\left` by `\bigl`, `\Bigl`, `\biggl`, or `\Biggl` and replace `\right` by `\bigr`, `\Bigr`, `\biggr`, or `\Biggr` to obtain delimiters of increasing size. Alternatively, the `\lrp{ }`, etc., commands have an optional numeric argument ranging from 1–5 to specify the size of the delimiters (1 corresponds to the smallest size). The following example shows how specifying the delimiter size can give nicer looking results.

```
\[
\lrs{\sum_ia_i\lrm{\sum_{ij}x_{ij}}^p}^{1/p}
+\lrs[3]{\sum_ia_i
\lrm[2]{\sum_{ij}x_{ij}}^p}^{1/p}.
\]
```

gives:

$$\left[\sum_i a_i\left|\sum_{ij}x_{ij}\right|^p\right]^{1/p}+\left[\sum_i a_i\Big|\sum_{ij}x_{ij}\Big|^p\right]^{1/p}.$$

Derivatives and integrals

The (ordinary) differential 'd' should be in a roman font. The easiest way to ensure this is to use the command `\od{ }` to obtain the differential. E.g., `$\od{y}/\od{x}$` gives $\mathrm{d}y/\mathrm{d}x$. For displayed first derivatives and nth derivatives you may find it easier to use `\fod{ }{ }` and `\fodn{ }{ }{ }`, respectively. E.g.,

```
\[
\fodn{y}{x}{2}+\fod{y}{x}
\]
```

gives:

$$\frac{\mathrm{d}^2y}{\mathrm{d}x^2}+\frac{\mathrm{d}y}{\mathrm{d}x}$$

although the 'dash notation' (i.e., `$y''+y'$` gives $y''+y'$) in such a case is often preferable since it takes up less space. Similarly, for time derivatives use the 'dot notation' (e.g., `$\ddot{y}+\dot{y}$` gives $\ddot{y}+\dot{y}$).

For partial derivatives you may prefer to use `\pd` instead of `\partial` to save typing. Displayed partial derivatives are easily done using `\fpd{ }{ }` and `\fpdn{ }{ }{ }`. E.g.,

```
\[
\fpd{n}{t}=\fpdn{n}{x}{2}.
\]
```

gives:

$$\frac{\partial n}{\partial t}=\frac{\partial^2 n}{\partial x^2}.$$

However, if you are using partial derivatives a lot then you should use the suffix notation instead (e.g., `$n_t=n_{xx}$` gives $n_t = n_{xx}$).

For integrals there should be a space between the integrand and the differential. This can be done by placing the integration variable inside `\sod{ }`. E.g.,

```
\[
\int\sin x\sod{x}.
\]
```

gives:

$$\int \sin x \,\mathrm{d}x.$$

If the integral has limits you may find you need to use a few `\!` before the integrand for the best results. E.g.,

```
\[
\int_{-\infty}^\infty\!\!\!\!\sech^2x\sod{x}.
\]
```

gives:

$$\int_{-\infty}^{\infty} \operatorname{sech}^2 x \,\mathrm{d}x.$$

Sums, unions, and products

To form a sum, product, or union use the commands `\sum`, `\product`, and `\bigcup` and specify the limits using sub- and superscripts. E.g.,

```
\[
\det M=\prod_{i=1}^n\lambda_i.
\]
```

gives:

$$\det M = \prod_{i=1}^{n} \lambda_i.$$

To obtain multiline limits use `\substack{ }` inside the sub- or superscript and specify new lines using `\\`. E.g.,

```
\[
\Phi_j=
-\sum_{\substack{i=1\\i\neq j}}^n
\frac{Gm_i}{r_{ij}}.
\]
```

gives:

$$\Phi_j = -\sum_{\substack{i=1 \\ i\neq j}}^{n} \frac{Gm_i}{r_{ij}}.$$

The following symbols can be used in a similar way.

```
\[
\coprod\bigcap\bigvee\bigwedge
\bigoplus\bigotimes\bigodot
\]
```

gives:

$$\coprod\bigcap\bigvee\bigwedge\bigoplus\bigotimes\bigodot$$

Matrices and determinants

Place elements of a matrix between `\begin{pmatrix}` (or `\bpm`) and `\end{pmatrix}` (or `\epm`). Separate elements on the same row by `&` and put a `\\` at end of each row except the last row. E.g.,

```
\[
\begin{pmatrix}
a&b&c\\d&e&f\\g&h&i
\end{pmatrix}.
\]
```

gives:

$$\begin{pmatrix} a & b & c \\ d & e & f \\ g & h & i \end{pmatrix}.$$

Use `\begin{vmatrix}` (or `\bvm`) and `\end{vmatrix}` (or `\evm`) to obtain determinants in a similar way. E.g.,

```
\[
\begin{vmatrix}
A_{11} & A_{12} & \cdots & A_{1n} \\
A_{21} & A_{22} & \cdots & A_{2n} \\
\vdots & \vdots & \ddots & \vdots \\
A_{n1} & A_{n2} & \cdots & A_{nn}
\end{vmatrix}.
\]
```

gives:

$$\begin{vmatrix} A_{11} & A_{12} & \cdots & A_{1n} \\ A_{21} & A_{22} & \cdots & A_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ A_{n1} & A_{n2} & \cdots & A_{nn} \end{vmatrix}.$$

The elements of matrices and determinants are centred when done this way. This might not look so good if some of the elements have minus signs. There are two possible ways to deal with this. The first is to add invisible characters to balance the element using the `\phantom{ }` command. E.g.,

```
\[
\bpm -1&2\\ 3&4\epm
\bpm -1&2\\ \phantom{-}3&4\epm.
\]
```

gives:

$$\begin{pmatrix} -1 & 2 \\ 3 & 4 \end{pmatrix} \begin{pmatrix} -1 & 2 \\ 3 & 4 \end{pmatrix}.$$

The other way is to replace the begin and end matrix commands by `\begin{array}{ }` and `\end{array}` and enclose these commands with the appropriate delimiters. The argument of `\begin{array}{ }` must contain n characters if the matrix has n columns. Each character can be `l`, `c`, or `r` which correspond to left, centre, and right justification, respectively. E.g.,

```
\[
\lrp{\begin{array}{rc}
-1&2\\3&4
\end{array}}.
\]
```

gives:

$$\left(\begin{array}{rc} -1 & 2 \\ 3 & 4 \end{array} \right).$$

For binomial coefficients, rather than constructing a 2×1 matrix, you can just use \tbinom{ }{ } for binomial coefficients in the text and \binom{ }{ } for displayed binomial coefficients. E.g., `$\tbinom{4}{2}$` gives $\binom{4}{2}$. E.g.,

```
\[
\binom{n}{k}.
\]
```

gives:

$$\binom{n}{k}.$$

Piecewise functions

For functions whose expression depends on the argument, treat the expressions and conditions like elements in a matrix but instead of the begin and end matrix commands use \begin{cases} and \end{cases}. E.g.,

```
\[
\sgn(x)=\begin{cases}
1, & x>0,\\
0, & x=0,\\
-1, & x<0.
\end{cases}
\]
```

gives:

$$\operatorname{sgn}(x) = \begin{cases} 1, & x > 0, \\ 0, & x = 0, \\ -1, & x < 0. \end{cases}$$

If any of the expressions require more than one line then use \\ followed by \quad as in the following example.

```
\[
q(x,y)=\begin{cases}
a+b+c+d+e\\
\quad\mbox{}+f+g+h, & x>1,\\
0, & \text{$x<1$ and $y=0$},\\
-1, & \text{otherwise}.
\end{cases}
\]
```

gives:

$$q(x,y) = \begin{cases} a+b+c+d+e \\ \quad\mbox{}+f+g+h, & x > 1, \\ 0, & x < 1 \text{ and } y = 0, \\ -1, & \text{otherwise}. \end{cases}$$

The \mbox{} is used to get the correct spacing after the + sign it precedes.

If the cases contain fractions, you normally get better results if you use \dsfrac{ }{ }. You may also need to increase the spacing between lines by adding `[1.5ex]` after each \\. E.g.,

```
\[
x=\begin{cases}
\dsfrac{ac(\e^{\alpha t}-1)}
{a\e^{\alpha t}-bc}, & a>bc,\\[1.5ex]
\dsfrac{ac(\e^{\alpha t}-1)}
{bc\e^{\alpha t}-a}, & a<bc,\\[1.5ex]
\dsfrac{c\beta t}{1+\beta t}, & a=bc.
\end{cases}
\]
```

gives:

$$x = \begin{cases} \dfrac{ac(\mathrm{e}^{\alpha t}-1)}{a\,\mathrm{e}^{\alpha t}-bc}, & a > bc, \\[1.5ex] \dfrac{ac(\mathrm{e}^{\alpha t}-1)}{bc\,\mathrm{e}^{\alpha t}-a}, & a < bc, \\[1.5ex] \dfrac{c\beta t}{1+\beta t}, & a = bc. \end{cases}$$

Vectors

Vectors (in the physical sciences, at least) should be shown using bold font (and not by underlining or using $\vec{}$). This is easily done using the \vect{ } command. A unit vector (denoted by a bold font character with a hat) is obtained using \uvect{ }. E.g.,

```
\[
\vect{a}\times\vect{b}=\uvect{n}ab\sin\theta.
\]
```

gives:

$$\mathbf{a} \times \mathbf{b} = \hat{\mathbf{n}} ab \sin\theta.$$

Care is needed over what is placed in the argument of these commands. For example, the \dot{ } used to denote the time derivative should be applied after \vect{ }. E.g., `$\dot{\vect\omega}$` gives $\dot{\boldsymbol{\omega}}$.

The scalar product dot is obtained using \spdot. E.g.,

```
\[
\vect{a}\spdot\vect{b}=ab\cos\theta.
\]
```

gives:

$$\mathbf{a} \cdot \mathbf{b} = ab\cos\theta.$$

The commands \grad, \div, and \curl have been defined in the expected way. E.g.,

```
\begin{multline*}
\curl(\vect{a}\times\vect{b})\equiv
(\div\vect{b})\vect{a}
-(\div\vect{a})\vect{b}\\
+(\vect{b}\spdot\grad)\vect{a}
-(\vect{a}\spdot\grad)\vect{b}.
\end{multline*}
```

gives:

$$\boldsymbol{\nabla} \times (\mathbf{a} \times \mathbf{b}) \equiv (\boldsymbol{\nabla} \,.\, \mathbf{b})\mathbf{a} - (\boldsymbol{\nabla} \,.\, \mathbf{a})\mathbf{b} + (\mathbf{b} \,.\, \boldsymbol{\nabla})\mathbf{a} - (\mathbf{a} \,.\, \boldsymbol{\nabla})\mathbf{b}.$$

Equations

A displayed equation should only have an equation number if either you refer to the equation later in the manuscript or the equation is a key result which others may wish to refer to when mentioning your article.

Numbering, labelling, and referring to equations For a single numbered equation which needs only one line use `\begin{equation}` and `\end{equation}` instead of `\[` and `\]`. If you refer to the equation it will need a label which you can assign using `\label{ }`. We strongly recommend that the label you use for equations starts with `e:` and that the label you choose is meaningful (to you, at least). The worst choice for a label is an equation number since the actual number of the equation may change if you later add or delete equations before it or if you copy and paste the equation to another document. E.g.,

```
\begin{equation}\label{e:s2id}
\sech^2x=1-\tanh^2x.
\end{equation}
```

gives:

$$\operatorname{sech}^2 x = 1 - \tanh^2 x. \tag{1}$$

To refer to the equation later use `\eqref{ }`. The argument of this command is the same as the label used in `\label{ }`. Brackets are generated automatically. E.g., `using \eqref{e:s2id}` gives using (1). Only use the word 'equation' or 'Eq.' before `\eqref{ }` if it starts a sentence.

Single multi-line equation For a single numbered equation that needs more than one line use `\begin{multline}` and `\end{multline}` instead of `\begin{equation}` and `\end{equation}` and show where the new lines are using `\\`. E.g.,

```
\begin{multline}\label{e:Gammanz}
\Gamma(z)\Gamma\lrp{z+\frac1n}
\Gamma\lrp{z+\frac2n}\cdots
\Gamma\lrp{z+\frac{n-1}{n}} \\
=(2\pi)^{(n-1)/2}n^{\frac12-nz}\Gamma(nz),
\quad n=1,2,\ldots\,.
\end{multline}
```

gives:

$$\Gamma(z)\Gamma\left(z+\frac{1}{n}\right)\Gamma\left(z+\frac{2}{n}\right)\cdots\Gamma\left(z+\frac{n-1}{n}\right) = (2\pi)^{(n-1)/2}n^{\frac{1}{2}-nz}\Gamma(nz), \quad n = 1, 2, \ldots. \tag{2}$$

For an equation with no number that needs more than one line use `\begin{multline*}` and `\end{multline*}` instead. E.g.,

```
\begin{multline*}
a+b=c-d+e+f-g+h-i\\+j-k+l-m+n\\
\mbox{}-o+p-q+r-s.
\end{multline*}
```

gives:

$$a + b = c - d + e + f - g + h - i + j - k + l - m + n - o + p - q + r - s.$$

Note that with equations that need more than one line, no line should end with $=$, $+$, or $-$. Such symbols should be moved to the next line. Also, in general, if a line starts with a $-$ then it should be preceded by `\mbox{}` in order to get the correct spacing after the $-$ sign, as in the example above.

Saving space In cases such as (2) where the expression(s) almost fill the line, there are two things you can do to help. First, just before `\begin{multline}` place a `\zmlg` (which stands for zero multline gap). This will cause the first part of the equation to be left justified. Second, use `\!` to remove unnecessary space. E.g.,

```
\zmlg
\begin{multline}\label{e:Gammanz_}
\Gamma(z)\,\Gamma\!\lrp{\!z+\frac1n}
\Gamma\!\lrp{\!z+\frac2n}\cdots
\Gamma\!\lrp{\!z+\frac{n-1}{n}} \\
=(2\pi)^{(n-1)/2}n^{\frac12-nz}\Gamma(nz),
\quad n=1,2,\ldots\,.
\end{multline}
\rmlg
```

gives:

$$\Gamma(z)\,\Gamma\left(z+\frac{1}{n}\right)\Gamma\left(z+\frac{2}{n}\right)\cdots\Gamma\left(z+\frac{n-1}{n}\right) = (2\pi)^{(n-1)/2}n^{\frac{1}{2}-nz}\Gamma(nz), \quad n = 1, 2, \ldots. \tag{3}$$

The multline gap can be restored to its usual value by adding a `\rmlg` (= restore multline gap) after `\end{multline}`.

Set of aligned equations If you have a set of similar equations of similar size or content it looks better if the equals signs (or other relational operators) are aligned. If they are numbered equations, start and end the set of equations with `\begin{align}` and `\end{align}` and show the alignment by putting an `&` before the character you wish to align. E.g.,

```
\begin{align}
\label{e:2sc}
```

```
2\sin x\cos y&=\sin(x+y)+\sin(x-y),\\
\label{e:2cc}
2\cos x\cos y&=\cos(x+y)+\cos(x-y),\\
\label{e:2ss}
2\sin x\sin y&=\cos(x-y)-\cos(x+y).
\end{align}
```

gives:

$$2\sin x\cos y = \sin(x+y)+\sin(x-y), \quad (4)$$
$$2\cos x\cos y = \cos(x+y)+\cos(x-y), \quad (5)$$
$$2\sin x\sin y = \cos(x-y)-\cos(x+y). \quad (6)$$

If the equations are not to be numbered, use \begin{align*} and \end{align*} instead. E.g.,

```
\begin{align*}
\sin(x\pm y)&=\sin x\cos y\pm\cos x\sin y,\\
\cos(x\pm y)&=\cos x\cos y\mp\sin x\sin y.
\end{align*}
```

gives:

$$\sin(x\pm y) = \sin x\cos y \pm \cos x\sin y,$$
$$\cos(x\pm y) = \cos x\cos y \mp \sin x\sin y.$$

If an equation which needs to be aligned needs more than one line, break it in the usual way using \\ and follow this by & and then \qquad. If the equation is numbered, you need to put \notag (or \nonumber) before the \\ to prevent a number appearing at that line. Take care to place the label command in a part which does have a number. E.g.,

```
\begin{align}
p&=a+b+c+d+e+f+g\notag\\
\label{e:p}
&\qquad+h+i+j+k+l,\\
\label{e:q}
q&=r+s+t.
\end{align}
```

gives:

$$p = a+b+c+d+e+f+g + h+i+j+k+l, \quad (7)$$
$$q = r+s+t. \quad (8)$$

Set of unaligned equations If the equations do not need to be aligned, use \begin{gather} and \end{gather} instead of \begin{align} and \end{align} (or \begin{gather*} and \end{gather*} if you don't need equation numbers) and omit the & everywhere. E.g.,

```
\begin{gather}
\label{e:b+c}
b+c=p+q+r,\\
\label{e:Q}
Q=d+e+g+h+i+j+k+l+m+n.
\end{gather}
```

gives:

$$b+c = p+q+r, \quad (9)$$
$$Q = d+e+g+h+i+j+k+l+m+n. \quad (10)$$

One equation number for several equations on separate lines The equations are separated by \\ and their alignment can be specified using & as usual. The equations are placed within \begin{split} and \end{split}. The split environment is placed in an equation environment where the equations are given their label. E.g.,

```
\begin{equation}\label{e:sim}
\begin{split}
x+y&=6+p,\\
2x+y+z&=7.
\end{split}
\end{equation}
```

gives:

$$\begin{aligned} x+y &= 6+p,\\ 2x+y+z &= 7. \end{aligned} \quad (11)$$

If the & are omitted the equations are right justified.

Multi-line partially aligned derivation The command structure given here needs to be used if the first line should not be aligned with the equals signs in the lines below. E.g.,

```
\begin{multline*}
a+b+c+d+e+f+g+h\\
\begin{aligned}
&=p+q+r+\biggl(\frac{s}{2}+t+l+m+n\\
&\qquad+P+Q+R\biggr)^{1/2}+A+B+C\\
&=u+v+w
\end{aligned}
\end{multline*}
```

gives:

$$\begin{aligned} a+b+c+d+e+f+g+h &\\ &= p+q+r+\left(\frac{s}{2}+t+l+m+n\right.\\ &\qquad\left.+P+Q+R\right)^{1/2}+A+B+C\\ &= u+v+w \end{aligned}$$

If an equation number is required you will need to add a newline with negative vertical space. E.g.,

```
\begin{multline}
\label{e:uvw}
a+b+c+d+e+f+g+h\\
\begin{aligned}
&=p+q+r+s+t+l+m+n\\
&\qquad+P+Q+R+A+B+C\\
&=u+v+w
\end{aligned}\\[-16pt]
\end{multline}
```

gives:

$$\begin{aligned} a+b+c+d+e+f+g+h &\\ &= p+q+r+s+t+l+m+n\\ &\qquad+P+Q+R+A+B+C\\ &= u+v+w \end{aligned} \quad (12)$$

Subequations The idea of subequations is to give a whole set of equations a separate label from the individual equations in the set. This is done by placing the complete set of labelled equations (which could be in an align or gather environment) between \begin{subequations} and \end{subequations}. The label for the whole set of equations is placed after \begin{subequations} but before the beginning of the environment giving the set of equations. E.g.,

```
\begin{subequations}
\label{e:lorenz}
\begin{align}
\label{e:lorenzx}
\dot{x}&=\sigma(y-x), \\
\label{e:lorenzy}
\dot{y}&=rx-y-xz, \\
\label{e:lorenzz}
\dot z&=xy-bz.
\end{align}
\end{subequations}
```

gives:

$$\dot{x} = \sigma(y - x), \tag{13a}$$
$$\dot{y} = rx - y - xz, \tag{13b}$$
$$\dot{z} = xy - bz. \tag{13c}$$

Only use subequations if you refer to *both* the set of equations as a whole, e.g., (13), *and* at least one of the subequations individually, e.g., (13c).

Allowing sets of equations to be split across pages or columns If you wish to allow a set of equations or a multiline equation to be split across a page or column you will need to enclose it with {\allowdisplaybreaks }. Note that this should be used for each equation which is causing problems; \allowdisplaybreaks should not be placed in the preamble. The closing brace should be placed after text rather than at end of the displayed equation.

CHEMISTRY EXPRESSIONS

The command \ce{ } is a convenient way to obtain chemical formulae (including those specifying the type of bond) and chemical (or nuclear) reactions. For more details on this command than are given here see ftp://www.ctan.org/tex-archive/macros/latex/contrib/mhchem/mhchem.pdf.

Formulae

Compounds No subscripts are needed if the quantities of the elements are single digits. E.g., \ce{H2SO4} gives H_2SO_4. E.g., \ce{(CH3)2S} gives $(CH_3)_2S$. In other cases subscripts must be specified in the usual way. E.g., \ce{Al_{0.25}Ga_{0.75}As} gives $Al_{0.25}Ga_{0.75}As$. E.g., \ce{Al_{x}Ga_{$1\!-\!x$}As} gives $Al_xGa_{1-x}As$. Water of crystallization is added after a dot. E.g., \ce{CuSO4.5H2O} gives $CuSO_4 \cdot 5\,H_2O$. No font change commands are needed for \ce{ } inside math mode. E.g., $\epsilon_\ce{CO2}$ gives ϵ_{CO_2}.

Ions To get a singly charged ion just add + or − to the end. E.g., \ce{NO3-} gives NO_3^-. If the ion is more than singly charged you need a ^ before the size of the charge. E.g., \ce{SO4^2-} gives SO_4^{2-}. E.g., \ce{[Zn(OH)4]^2-} gives $[Zn(OH)_4]^{2-}$.

Radicals For neutral radicals add a ^. (e.g., \ce{OH^.} gives $OH^{\cdot}$). For charged radicals the charge and dot need to be enclosed in braces. E.g., \ce{RNO2^{-.}} gives $RNO_2^{\cdot-}$.

Isotopes For isotopes place the atomic and mass numbers as sub- and superscripts before the element. E.g., \ce{_{92}^{235}U} gives $^{235}_{92}U$.

Bonds Single, double, and triple bonds are denoted by −, =, and #, respectively, if placed between two elements. E.g., \ce{A-B=C#D} gives A−B=C≡D.

Reactions

A whole reaction may be placed inside \ce{ }. The reaction may be placed in the text or in displayed form inside \[and \] or inside an equation environment. The possible types of arrow are shown in the following example.

```
\[
\ce{-> <- <-> <=> <=>> <<=> ^ v}
\]
```

gives:

$$\longrightarrow \quad \longleftarrow \quad \longleftrightarrow \quad \rightleftharpoons \quad \rightharpoonup \quad \leftharpoondown \quad \uparrow \downarrow$$

The horizontal arrows have two optional arguments, placed in square brackets immediately after the arrow symbol. The first is the expression above the arrow; the second is for below. Both expect math mode expressions so you will need to use \text{ } if you wish to place words there. E.g.,

```
\[
\ce{H+ + OH- <=>>[k_1][k_{-1}] H2O}
\]
```

gives:

$$H^+ + OH^- \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} H_2O$$

Note that the addition + must be surrounded by spaces.

If you wish to show a series of reactions and align them using & and \\ in an aligned equation environment, replace \ce{ } by \cee{ }.

Symbols

The standard state symbol is obtained using \stst. E.g., `$\Delta H\stst$` gives $\Delta H^{\ominus}$.

FLOAT ENVIRONMENTS

All float environments (i.e., tables, figures, and listings) should contain a caption and a label. In the case of tables and figures, the caption is placed in \caption{ } and the label is placed in \label{ } so that it can be referred to using \ref{ }. By default, floats will be positioned at the top of the page (or immediately below another float). They can be forced to appear at the bottom of a page by putting [b] immediately after the begin environment command.

Tables

Floating tables are placed inside \begin{table} and \end{table}. After the caption and label, the tabulated part is placed between \btsf{ } and \etsf. The argument of \btsf{ } is a list of characters, one for each column, giving the type of justification for the corresponding column: l = left; c = centre; r = right. The first column normally looks best with left justification. Elements in the tabular array are separated by & and a \\ marks the end of each row. The headings are separated from the entries below by a horizontal line made using \midrule. A slightly thinner line across columns *c1* to *c2* is obtained using \cmidrule{*c1-c2*}. It can be shortened on the left, right, or both by adding (l), (r), or (lr), respectively, before the argument opening brace. Columns on the same row can be merged using \multicolumn{ }{ }{ }. The first argument is the number of columns to be merged, the second is the justification character, and the third is the contents of the merged entries. Note that \multicolumn{1}{ }{ } can be used to change the justification of a single entry. To add an extra gap between rows use \addlinespace. If there are table notes these are placed between \btn and \etn. If they refer to specific symbols in the tabular region (placed as superscripts using \tnote{ }) then the symbol should be placed in square brackets after an \item command. E.g.,

```
\begin{table} % 1-column table
\caption{Labelling convention
for environments.}
\label{t:envlab}
\btsf{lclc}
environ- & label &
\multicolumn{2}{c}{start of reference} \\
\cmidrule(lr){3-4}
ment& start & \multicolumn{1}{c}{long form}
& short form \\ \midrule
equation\tnote{*} &\T{e}&\tc{}e & \Tc{e} \\
table & \T{t} & \tc{Table}t & \Tc{t} \\
figure & \T{f} & \tc{Fig.}f & \Tc{f} \\
lstlisting &\T{l}&\tc{Listing}l & \Tc{l} \\
\addlinespace
theorem & \T{T} & \tc{Theorem}T & \Tc{T} \\
lemma & \T{L} & \tc{Lemma}L & \Tc{L} \\
corollary &\T{C}&\tc{Corollary}C & \Tc{C}\\
proposition&\T P&\tc{Proposition}P&\Tc{P}\\
identity &\T{I}&\tc{Identity}I& \Tc{I}\\
remark & \T{R}&\tc{Remark}R& \Tc{R}\\
definition &\T{D}&\tc{Definition}D&\Tc{D}\\
example & \T{E} & \tc{Example}E & \Tc{E} \\
algorithm &\T{A}&\tc{Algorithm}A & \Tc{A}\\
\etsf
\btn
\item[*] and other environments with
equation numbers
\etn
\end{table}
```

Table 1 Labelling convention for environments.

environment	label start	start of reference: long form	start of reference: short form
equation*	e:	\eqref{e:	\eref{
table	t:	Table~\ref{t:	\tref{
figure	f:	Fig.~\ref{f:	\fref{
lstlisting	l:	Listing~\ref{l:	\lref{
theorem	T:	Theorem~\ref{T:	\Tref{
lemma	L:	Lemma~\ref{L:	\Lref{
corollary	C:	Corollary~\ref{C:	\Cref{
proposition	P:	Proposition~\ref{P:	\Pref{
identity	I:	Identity~\ref{I:	\Iref{
remark	R:	Remark~\ref{R:	\Rref{
definition	D:	Definition~\ref{D:	\Dref{
example	E:	Example~\ref{E:	\Eref{
algorithm	A:	Algorithm~\ref{A:	\Aref{

* and other environments with equation numbers

gives: [see Table 1]. To refer to a table in the text use \ref{ }. E.g., `Table~\ref{t:envlab}` gives Table 1. Alternatively, if you use \tref{ } you don't need to type Table or t: and the hyperlink to the table will include the word Table. E.g., `\tref{envlab}` gives Table 1.

A table spanning both columns is obtained by using \begin{table*} and \end{table*} instead.

Figures

The information for a figure is placed between \begin{figure} and \end{figure}. As the caption appears below, \caption{ } followed by \label{ } are placed after the graphics. The simplest way to input a graphics file is to use \incgcw{ } whose argument is the filename. This makes the width of the figure match the column width. If this makes the figure appear too large, use

\cincgcm{ }{ } instead. Its first argument is the width in cm, and the second is the filename. In the case of PDF files (or encapsulated PostScript files if you are creating a .ps file) the final .pdf (or .eps) of the filename may be omitted. The code used to produce Fig. 1 is shown below.

```
\begin{figure}
\incgcw{scias_template}
\caption{Output PDF file from running latex
on a copy of \filename{scias\_template.tex}.}
\label{f:scias_template}
\end{figure}
```

To refer to a figure in the text use \ref{ } or \fref{ }. E.g., `Fig.~\ref{f:scias_template}` gives Fig. 1. With \fref{ } the hyperlink includes the word Fig. E.g., `\fref{scias_template}` gives Fig. 1.

A figure spanning both columns is obtained by using \begin{figure*} and \end{figure*} instead.

Program listings

Code is placed between \begin{lstlisting} and \end{lstlisting}. In this case the caption and label are done differently – see the example below. E.g.,

```
\begin{lstlisting}[float=t,
caption={C function computing the roots
of $ax^2+bx+c=0$, where $a,b,c\in\bbR$.},
label={l:quadroots}]
void quadroots
(double a,double b,double c,
 double *re1,double *im1,
 double *re2,double *im2) {
  double q,dis=b*b-4*a*c;
  if (dis>0) {
    q=(b>0?-sqrt(dis)-b:sqrt(dis)-b)/2;
    *re1=q/a;
    *re2=c/q;
    *im1=*im2=0;
  } else {
    *re1=*re2=-b/a/2;
    *im2=-(*im1=sqrt(-dis)/a/2);
  }
}
\end{lstlisting}
```

gives: [see Listing 1]. If you wish the listing to appear at the bottom of the page replace `float=t` by `float=b`. The two-column version is obtained by placing a * before the t or b.

To refer to a listing in the text use \ref{ } or \lref{ }. E.g., `Listing~\ref{l:quadroots}` gives Listing 1. With \lref{ } the hyperlink includes the word Listing. E.g., `\lref{quadroots}` gives Listing 1. If you wish to refer to a variable in the code, then enclose it in \lstinline! ! where the ! can be replaced by any character which is not in the code. E.g., `\lstinline!dis! is the discriminant` gives `dis` is the discriminant.

Listing 1 C function computing the roots of $ax^2+bx+c=0$, where $a, b, c \in \mathbb{R}$.

```
void quadroots
(double a,double b,double c,
 double *re1,double *im1,
 double *re2,double *im2) {
  double q,dis=b*b-4*a*c;
  if (dis>0) {
    q=(b>0?-sqrt(dis)-b:sqrt(dis)-b)/2;
    *re1=q/a;
    *re2=c/q;
    *im1=*im2=0;
  } else {
    *re1=*re2=-b/a/2;
    *im2=-(*im1=sqrt(-dis)/a/2);
  }
}
```

Note that this environment is for showing fragments of code or pseudocode. It is not intended for displaying entire programs.

THEOREMS AND PROOFS

Theorems and similar environments

A theorem should be placed between \begin{theorem} and \end{theorem}. The text inside the theorem environment will appear in italics. You should not change the font for the whole theorem yourself. The label is placed after \begin{theorem} using \label{T: }. A theorem is referred to using \ref{T: } or \Tref{ }. The other theorem-like environments (Table 1) are used in an analogous way.

A theorem can be named by adding the name in square brackets directly after \begin{theorem}. In environments where text is italicized automatically, you should put digits inside $ $ or {\upshape } to stop them appearing in italics. E.g.,

```
\begin{lemma}[Hippasus]\label{L:sqrt2}
The square root of $2$ is irrational.
\end{lemma}
```

gives:

Lemma 1 (Hippasus) *The square root of* 2 *is irrational.*

Sub-results in theorems starting with (i), (ii), etc., can be given by placing them after \item. The items are all between \begin{enumerate} and \end{enumerate}. The \item command will automatically generate the number. Each item can be given a label. We suggest following the convention of starting the label with i:. E.g.,

```
\begin{corollary}\label{C:sqrt2}
Suppose $n$ is a non-zero integer.
\begin{enumerate}
\item \label{i:nsqrt2} $n\sqrt{2}$ is
irrational.
\item \label{i:sqrt2/n} $\sqrt{2}/n$
is irrational.
\item \label{i:(sqrt2/n)^2n}
\[
\lrp{\frac{\sqrt{2}}{n}}^{2n} \quad
\text{is rational.}
\]
\end{enumerate}
\end{corollary}
```

gives:

Corollary 1 *Suppose n is a non-zero integer.*
(i) *$n\sqrt{2}$ is irrational.*
(ii) *$\sqrt{2}/n$ is irrational.*
(iii)

$$\left(\frac{\sqrt{2}}{n}\right)^{2n} \quad \textit{is rational.}$$

The items may then be referred to using `\ref{ }` in the usual way or `\eiref{ }`. The advantage of `\eiref{ }` is that it includes the brackets and it ensures that the brackets and roman numerals inside are always upright. E.g., `from \Cref{sqrt2}\eiref{sqrt2/n}` gives from Corollary 1(ii).

Proofs

In a mathematical manuscript, a proof is placed between `\begin{proof}` and `\end{proof}`. E.g.,

```
\begin{proof}
The proof is obvious.
\end{proof}
```

gives: *Proof*: The proof is obvious. □

An exception to this is if the proof is the entire section or subsection, as indicated by the heading.

Algorithms

Steps of the algorithm can be given by placing each step after an `\item` command all in between `\begin{steps}` and `\end{steps}`. The steps (or items) may be labelled and referred to in the usual way. E.g.,

```
\begin{algorithm} \mbox{}
\begin{steps}
\item Initialize.
\item \label{i:iter} Iterate.
\item Check accuracy. If not accurate
enough go to Step~\ref{i:iter}.
\item Save results.
\end{steps}
\end{algorithm}
```

gives:

Algorithm 1

Step 1: Initialize.
Step 2: Iterate.
Step 3: Check accuracy. If not accurate enough go to Step 2.
Step 4: Save results.

Note that the `\mbox{}` after `\begin{algorithm}` is only needed if there are no words there. The steps environment can be used elsewhere – it does not need to be within the algorithm environment.

FONTS AND TEXT SYMBOLS

Text may be emphasized (for example, when giving a term which is being defined) by enclosing it in `\emph{ }` or {`\em` }. Text may be italicized by enclosing it in `\textit{ }` or {`\it` } and made bold by enclosing it in `\textbf{ }` or {`\bf` }. Small caps is obtained using `\textsc{ }` or {`\sc` }. In *ScienceAsia*, we show names of software in small caps, but this should be done by placing the name in `\prog{ }`.

Single characters that have another meaning in LaTeX can be obtained in the text (i.e., not as part of a mathematical expression) by preceding them with a \. E.g., `\% \# \& \_ \$` gives % # & _ $. If a text-symbol command ends in a letter then you need to add a \ immediately after the command if you want a space after the symbol. E.g., `20\degC\ for 1~h` gives 20 °C for 1 h.

SHORT CUTS

These are ways to save yourself some typing and time.

Short versions of commands

Shorter alternative versions of various commands have been defined in `scias.cls` (see Tables 1 and 2).

Defining your own commands

Defining your own commands has two advantages. First, it will save you some typing. Second, and more importantly, it will allow you to change notation easily. To define a command with no arguments use `\newcommand{ }{ }`. The first argument contains the new command and the second contains its definition. An example has already been given earlier in the section on defining your own multi-character symbols.

To define a new command with n arguments use `\newcommand{ }[n]{ }`. Again, the first argument is the name and the last argument is the definition. In the definition the nth argument is represented by the symbol #n. For example, suppose you find that

Table 2 Shortened versions of various commands.

original form	short form
\partial	\pd
	\phM
\begin{pmatrix}†	\bpm
\begin{vmatrix}	\bvm
\begin{equation}	\beq
\begin{multline}‡	\bml
\begin{align}	\bal
\begin{aligned}	\bald
\begin{gather}	\bga
\begin{split}	\bsp
\begin{subequations}	\bse
\begin{figure}	\bfig
\begin{table}	\btab
\begin{enumerate}	\ben
\label{e:§	\elabel{
\begin{theorem}§§	\begin{thm}
\begin{lemma}	\begin{lem}
\begin{corollary}	\begin{cor}
\begin{proposition}	\begin{prop}
\begin{identity}	\begin{idn}
\begin{remark}	\begin{rem}
\begin{definition}	\begin{defn}
\begin{algorithm}	\begin{alg}

† the short form for the end environment command is obtained by replacing b by e. E.g., the short form of \end{pmatrix} is \epm

‡ for the starred (*) form of a command add s to the end of the short form. E.g., the short form of \begin{multline*} is \bmls

§ other short forms of \label{ } follow the same pattern as for short forms of \ref{ } – see Table 1.

§§ and the short form of \end{theorem} is \end{thm}, etc.

you are using a lot of 3-d column vectors. You might decide to define a command \myv{ }{ }{ } whose 3 arguments are the coordinates. You could do this with

```
\newcommand{\myv}[3]{\bpm#1\\#2\\#3\epm}
```

and then, for example,

```
\[
\myv{4}{5}{q^{2/3}}.
\]
```

gives:

$$\begin{pmatrix} 4 \\ 5 \\ q^{2/3} \end{pmatrix}.$$

If you later decide to use the more compact notation of a horizontal row of comma-separated quantities, you just need to change the definition to `(#1,#2,#3)`.

Note that the name of your new command can only contain letters of the alphabet (i.e., a–z, A–Z, and no digits or other symbols).

Arguments of commands

If the argument of a command is only a single character (or a single LaTeX command such as \infty) it does not need to be enclosed in braces. E.g., `$\frac12$` gives $\frac{1}{2}$. But if the first argument is a single letter then it must be preceded by a space. E.g., `$\sqrt n$` gives $\sqrt{n}$.

COMMANDS NOT TO USE

Do not use any of the following commands anywhere in your manuscript.

- \def \renewcommand
- \dfrac
- \aligned \unaligned
- \begin{itemize} \end{itemize}

OTHER CLASS FILES

If you wish to use the non-standard or redefined commands explained here with other LaTeX class files you are welcome to do so. Their definitions are in the file www.scienceasia.org/scias_macros.tex (which you are free to download) and may be included by copying and pasting into the preamble of your document or by putting

```
\input{scias_macros}
```

in the preamble after you have included the required packages by placing some or all of

```
\usepackage{amsmath,amssymb}
\usepackage{graphicx}
\usepackage{threeparttable,booktabs}
\usepackage[version=3]{mhchem}
\usepackage{url}
\usepackage{listings}
```

in the preamble (if the packages are not already included by the class file you are using).

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