

## Some control sequences of Plain TeX

### A. TEXT MODE

#### (i) Document formatting:

`\hsize=4.5in`  
`\vsize=20cm`  
`\hoffset=25pt`  
`\voffset=2pc`  
`\magnification=1200`

Printed page width set at 4.5 inches  
Printed page length set at 20 cm  
Printed page offset 25 points to the right  
Printed page offset 2 picas downwards  
Whole document (all dimensions and fonts) magnified by the factor 1.2  
*Note:* Any dimension prefixed by `true` (eg. `\hsize=4.5truein`) is not affected by magnification

`\baselineskip=1pc`  
`\parskip=3pt`  
`\parindent=1in`  
`\pageno=4`  
`\nopagenumbers`  
`\headline`  
`\footline`  
`\tolerance=2000`

Line spacing set at 1 pica  
Extra vertical space of 3 points inserted between paragraphs  
Paragraph indentation set at 1 inch  
Pages will be numbered at bottom centre starting with '4'  
Refrain from inserting numbers at the bottom of each page  
Control over space at top of each page—see page 252  
Control over space at bottom of each page—see page 252  
Controls the allowable flexibility in word spacing—see page 29

#### (ii) Fonts:

`\rm`  
`\it`  
`\bf`  
`\sl`  
`\tt`  
`\font\ss=cmss10 at 11pt`

Switch to computer modern roman at 10 point size (`cmr10`)—the default font  
*Switch to computer modern italic at 10 point size (`cmli10`)*  
**Switch to computer modern bold at 10 point size (`cmb10`)**  
*Switch to computer modern slant at 10 point size (`cmsl10`)*  
Switch to computer modern typewriter at 10 point size (`cmtt10`)  
`\ss` will now cause a switch to 10 point computer modern sans serif magnified to 11 point size  
*Note:* Many other fonts, which need to be declared like `cmss10`, are available

#### (iii) Horizontal spacing:

`\_`  
`~` (i.e. a tilde)  
`\thinspace`  
`\negthinspace`  
`\enskip`  
`\quad`  
`\qqquad`  
`\hskip2.2cm`

Produces a single space (like between these words)  
Produces a single space at which a line break cannot occur (a 'tie')  
Produces a space of this much (Equivalent to `\_`, in mathematics mode)  
Produces thismuch space (Equivalent to `\!` in mathematics mode)  
Produces a 0.5em space—this much (1.0em = 10 pt in `\rm` font)  
Produces a 1.0em space—this much  
Two 'quads'—this much  
Produces a 2.2 cm horizontal space

(iv) Vertical spacing:

`\smallskip`  
`\medskip`  
`\bigskip`  
`\vskip12mm`

Insert a little *extra* vertical space (about 3pt) between paragraphs. This much       
Two 'smallskips'. This much       
Two 'medskips'. This much       
Insert an extra vertical space of 12mm between paragraphs

(v) Local control:

`\par`  
`\noindent`  
`\centerline{Heading}`  
`\leftline{Heading}`  
`\rightline{Heading}`  
`\line{...}`  
`\item{(a)}`  
`\itemitem{(i)}`  
`\hfil\break`  
`\vfil\eject`  
`\nobreak`  
`\smallbreak`  
`\medbreak`  
`\bigbreak`  
`\goodbreak`  
`\filbreak`  
`\leftskip=-2mm`  
`\rightskip=5pt`  
`\narrower`  
`\obeylines`  
`\raggedright`  
`\parshape`  
`\settabs`  
`\frenchspacing`  
`\nonfrenchspacing`  
`\bye`

Start a new paragraph (A double carriage return can also be used)  
Don't indent this new paragraph  
Centre 'Heading' on a new line and starts a new paragraph  
Put 'Heading' at left end of a new line and starts a new paragraph  
Put 'Heading' at right end of a new line and starts a new paragraph  
Spread ... to fill a whole line and start a new paragraph—see page 72  
Start a 'paragraph' labelled '(a)' in which every line is indented—used for itemized lists  
Start a 'paragraph' labelled '(i)' in which every line is doubly-indented—used for itemized lists within lists  
Start a new line (but not a new paragraph)  
Start a new page and a new paragraph  
Inhibit line or page break  
Suitable place for a page break—insert a 'smallskip' if no break  
Suitable place for a page break—insert a 'medskip' if no break  
Suitable place for a page break—insert a 'bigskip' if no break  
Start a new paragraph and encourage a page break here  
See page 111  
Causes the left end of all the lines of a paragraph to be indented by -2mm  
Causes the right end of all the lines of a paragraph to be indented by 5 points  
Causes all lines of a paragraph to be indented at the left and right ends  
Causes a carriage return to start a new line ("poetry mode")  
Right margin justification turned off  
Controls the shape of a paragraph—see page 101  
Presets tab stops across page—see page 231  
Make all between-word spaces the same regardless of punctuation  
Turn off frenchspacing (the default)  
The usual way to end a T<sub>E</sub>X file (`\bye`  $\equiv$  `\vfill\ejct\end`)

(vi) Printing reserved symbols:

`\#`  
`\%`  
`\$`

Produces a # (# is used in defining macros)  
Produces a % (% is the comment character)  
Produces a \$ (\$ controls maths mode)

- |                              |                                                                            |
|------------------------------|----------------------------------------------------------------------------|
| <code>\&amp;</code>          | Produces a & (& is used for alignment)                                     |
| <code>\_</code>              | Produces a _ (_ is used for subscripting)                                  |
| <code> \${\}\$</code>        | Produces a { (Mathematics mode is necessary) ( { is used for grouping)     |
| <code> \$\}\$</code>         | Produces a } (Mathematics mode is necessary) ( } is used for grouping)     |
| <code> \$\backslash\$</code> | Produces a \ (Mathematics mode is necessary) (\ begins a control sequence) |
- (vii) Other (text) features:
- |                                        |                                                                                            |
|----------------------------------------|--------------------------------------------------------------------------------------------|
| <code>\underbar{important}</code>      | Produces <u>important</u> (Note underlining is seldom, if ever, used in good type-setting) |
| <code>\footnote</code>                 | Insert a footnote—see page 116                                                             |
| <code>\topinsert... \endinsert</code>  | Insert ... at top of first available page                                                  |
| <code>\midinsert... \endinsert</code>  | Insert ... here or as soon as practicable                                                  |
| <code>\pageinsert... \endinsert</code> | Insert ... to fill all of the next page                                                    |
| <code>\llap</code>                     | Overwrite on the left—see page 82                                                          |
| <code>\rlap</code>                     | Overwrite on the right—see page 82                                                         |
| <code>\hyphenation</code>              | Indicates allowable hyphenation—see page 28                                                |
- (viii) Special symbols, etc:
- |                          |                                                                   |
|--------------------------|-------------------------------------------------------------------|
| <code>\TeX</code>        | Produces $\TeX$ in the current font                               |
| <code>\dots</code>       | Produces an ellipsis ...                                          |
| <code>\dag</code>        | Produces †                                                        |
| <code>\ddag</code>       | Produces ‡                                                        |
| <code>\copyright</code>  | Produces ©                                                        |
| <code>\S</code>          | Produces §                                                        |
| <code>\P</code>          | Produces ¶                                                        |
| <code>{\it\}\$}</code>   | Produces $\mathcal{L}$                                            |
| <code>{\it\&amp;}</code> | Produces $\mathcal{E}$                                            |
| <code>-</code>           | Produces - (a hyphen), as in note-book                            |
| <code>--</code>          | Produces - (an en-dash), as in pages 5–12                         |
| <code>---</code>         | Produces — (an em-dash), ie. an ordinary dash used in punctuation |
| <code>\$-\$</code>       | Produces - (a minus sign)                                         |
| <code>‘‘</code>          | Produces “                                                        |
| <code>’’</code>          | Produces ”                                                        |
| <code>\vrule</code>      | See page 221                                                      |
| <code>\hrule</code>      | See page 221                                                      |
- (ix) Accents and some foreign letters:  
 See page 52—the possibilities are: à é ô ü ÿ ñ ð q ĩ š ĵ û k ç ħ æ Œ å Å ø Ø

## B. MATHEMATICS MODE

### (i) Fonts:

<code>\mit</code>	Switch to computer modern maths italics ( <code>cmmi10</code> )—the default font for most variable names
<code>\bmit</code>	Switch to computer modern bold maths italics ( <code>cmmib10</code> )
<code>\rm</code>	Switch to computer modern roman—the default font for uppercase Greek letters
<code>\it</code>	Switch to computer modern italics ( <code>cmti10</code> )
<code>\bf</code>	Switch to computer modern bold roman ( <code>cmb10</code> )
<code>\cal</code>	For uppercase letters in <i>CALLIGRAPHIC</i> style ( <code>cmsy10</code> )
<code>\displaystyle</code>	Force display style—see page 140
<code>\textstyle</code>	Force text style—see page 140
<code>\scriptstyle</code>	Force subscript/superscript size
<code>\scriptscriptstyle</code>	Force subsubscript/supersuperscript size

### (ii) Horizontal spacing:

<code>\quad</code>	Insert a standard between-word space
<code>\quad</code>	Produces a 1.0em space—this much
<code>\quad</code>	Two 'quads'—this much
<code>\hspace{2mm}</code>	Produces a 2mm horizontal space
<code>\,</code>	Produces a thinspace—this much (1/6 of a 'quad')
<code>\&gt;</code>	Produces a medium space—this much (2/9 of a 'quad')
<code>\;</code>	Produces a thick space—this much (5/18 of a 'quad')
<code>\!</code>	Produces a negative thin space—this much (−1/6 of a 'quad')
<code>\mskip9mu</code>	Insert 9 mu of space (18 mu = 1.0 em ≈ 10 pt)
<code>\mathsurround=1pt</code>	Insert an additional 1 pt of space before and after every formula

### (iii) Vertical spacing

<code>\openup1\jot</code>	Insert an extra 1jot (= 3 pt) of vertical space between displayed lines—see page 194
<code>\abovedisplayskip</code>	Controls the amount of space above displayed maths—see page 189
<code>\belowdisplayskip</code>	Controls the amount of space below displayed maths—see page 189

### (iv) Greek letters—page 434

$\alpha$	<code>\alpha</code>	$\zeta$	<code>\zeta</code>	$\lambda$	<code>\lambda</code>	$\varpi$	<code>\varpi</code>	$\upsilon$	<code>\upsilon</code>
$\beta$	<code>\beta</code>	$\eta$	<code>\eta</code>	$\mu$	<code>\mu</code>	$\rho$	<code>\rho</code>	$\phi$	<code>\phi</code>
$\gamma$	<code>\gamma</code>	$\theta$	<code>\theta</code>	$\nu$	<code>\nu</code>	$\varrho$	<code>\varrho</code>	$\varphi$	<code>\varphi</code>
$\delta$	<code>\delta</code>	$\vartheta$	<code>\vartheta</code>	$\xi$	<code>\xi</code>	$\sigma$	<code>\sigma</code>	$\chi$	<code>\chi</code>
$\epsilon$	<code>\epsilon</code>	$\iota$	<code>\iota</code>	$\omicron$	<code>\omicron</code>	$\varsigma$	<code>\varsigma</code>	$\psi$	<code>\psi</code>
$\varepsilon$	<code>\varepsilon</code>	$\kappa$	<code>\kappa</code>	$\pi$	<code>\pi</code>	$\tau$	<code>\tau</code>	$\omega$	<code>\omega</code>

$\Gamma$	<code>\Gamma</code>	$\Lambda$	<code>\Lambda</code>	$\Pi$	<code>\Pi</code>	$\Upsilon$	<code>\Upsilon</code>	$\Psi$	<code>\Psi</code>
$\Delta$	<code>\Delta</code>	$\Xi$	<code>\Xi</code>	$\Sigma$	<code>\Sigma</code>	$\Phi$	<code>\Phi</code>	$\Omega$	<code>\Omega</code>
$\Theta$	<code>\Theta</code>								

(v) Relations

$\leq$	<code>\le</code>	$\vdash$	<code>\vdash</code>	$\ni$	<code>\ni</code>	$\sim$	<code>\sim</code>	$\propto$	<code>\propto</code>
$\ll$	<code>\ll</code>	$\geq$	<code>\ge</code>	$\dashv$	<code>\dashv</code>	$\simeq$	<code>\simeq</code>	$\models$	<code>\models</code>
$\subset$	<code>\subset</code>	$\gg$	<code>\gg</code>	$\mid$	<code>\mid</code>	$\asymp$	<code>\asymp</code>	$\doteq$	<code>\doteq</code>
$\subseteq$	<code>\subseteq</code>	$\supset$	<code>\supset</code>	$\parallel$	<code>\parallel</code>	$\approx$	<code>\approx</code>	$\perp$	<code>\perp</code>
$\in$	<code>\in</code>	$\supseteq$	<code>\supseteq</code>	$\equiv$	<code>\equiv</code>	$\cong$	<code>\cong</code>	$\neq$	<code>\neq</code>

plus others—see page 436

Many can be negated by prefixing with `\not` (eg. `\not\le` yields  $\not\leq$ )

(vi) Binary operations

$\pm$	<code>\pm</code>	$\cdot$	<code>\cdot</code>	$*$	<code>\star</code>	$\bullet$	<code>\bullet</code>	$\cup$	<code>\cup</code>
$\mp$	<code>\mp</code>	$\times$	<code>\times</code>	$\diamond$	<code>\diamond</code>	$\div$	<code>\div</code>	$\vee$	<code>\vee</code> or <code>\lor</code>
$\setminus$	<code>\setminus</code>	$*$	<code>\ast</code>	$\circ$	<code>\circ</code>	$\cap$	<code>\cap</code>	$\wedge$	<code>\wedge</code> or <code>\land</code>

plus others—see page 436

(vii) Arrows

$\leftarrow$	<code>\leftarrow</code> or <code>\gets</code>	$\rightarrow$	<code>\rightarrow</code> or <code>\to</code>	$\leftrightarrow$	<code>\leftrightarrow</code>	$\uparrow$	<code>\uparrow</code>	$\updownarrow$	<code>\updownarrow</code>
$\Leftarrow$	<code>\Leftarrow</code>	$\Rightarrow$	<code>\Rightarrow</code>	$\Leftrightarrow$	<code>\Leftrightarrow</code>	$\Uparrow$	<code>\Uparrow</code>	$\Updownarrow$	<code>\Updownarrow</code>
$\longleftarrow$	<code>\longleftarrow</code>	$\longrightarrow$	<code>\longrightarrow</code>	$\longleftrightarrow$	<code>\longleftrightarrow</code>	$\downarrow$	<code>\downarrow</code>	$\mapsto$	<code>\mapsto</code>
$\Longleftarrow$	<code>\Longleftarrow</code>	$\Longrightarrow$	<code>\Longrightarrow</code>	$\Longleftrightarrow$	<code>\Longleftrightarrow</code>	$\Downarrow$	<code>\Downarrow</code>	$\longmapsto$	<code>\longmapsto</code>

plus others—see page 437

(viii) Operators

$\sum$	<code>\sum</code>	$\prod$	<code>\prod</code>	$\int$	<code>\int</code>	$\bigcap$	<code>\bigcap</code>	$\bigvee$	<code>\bigvee</code>
		$\coprod$	<code>\coprod</code>	$\oint$	<code>\oint</code>	$\bigcup$	<code>\bigcup</code>	$\bigwedge$	<code>\bigwedge</code>

plus others—see page 435

(ix) Miscellaneous symbols

$\aleph$	<code>\aleph</code>	$\ell$	<code>\ell</code>	$\infty$	<code>\infty</code>	$\surd$	<code>\surd</code>	$\backslash$	<code>\backslash</code>
$\hbar$	<code>\hbar</code>	$\Re$	<code>\Re</code>	$'$	<code>'</code> or <code>\prime</code>	$\parallel$	<code>\parallel</code>	$\forall$	<code>\forall</code>
$\imath$	<code>\imath</code>	$\Im$	<code>\Im</code>	$\emptyset$	<code>\emptyset</code>	$\angle$	<code>\angle</code>	$\exists$	<code>\exists</code>
$\jmath$	<code>\jmath</code>	$\partial$	<code>\partial</code>	$\nabla$	<code>\nabla</code>	$\triangle$	<code>\triangle</code>	$\neg$	<code>\neg</code>

plus others—see page 435

(x) Brackets, etc

<code>\{</code>	Produces {
<code>\}</code>	Produces }
<code>\langle</code>	Produces (
<code>\rangle</code>	Produces )
<code>[\[</code>	Produces [
<code>(\((</code>	Produces ((
<code>\langle\!\langle</code>	Produces ⟨⟨
<code>\lfloor</code>	Produces [
<code>\rfloor</code>	Produces ]
<code>\lceil</code>	Produces [
<code>\rceil</code>	Produces ]
<code>\left( ... \right)</code>	Produces (...) with '(' and ')' enlarged as appropriate
<code>\big \Big \bigg \Bigg</code>	Enlarge the slash or backslash following—see page 147
<code>\bigl ...</code>	Enlarge the left bracket following—see page 147
<code>\bigr ...</code>	Enlarge the right bracket following—see page 147
<code>\bigm ...</code>	Enlarge the   or    following—see page 147

(xi) Standard functions—page 162

Common mathematical functions like 'sin' are always set in roman type. To ensure this in mathematics mode use the following control sequences:

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

Subscripts and superscripts will become limits when attached to `\det`, `\gcd`, `\inf`, `\lim`, `\liminf`, `\limsup`, `\max`, `\min`, `\Pr`, `\sup` in display style (eg.  $\max_{1 \leq n \leq m} \log_2 P_n$  as a displayed equation)

(xii) Accents

See page 135—the possibilities are:  $\hat{a}$   $\hat{a}\hat{b}$   $\check{a}$   $\check{a}\check{b}$   $\tilde{a}$   $\acute{a}$   $\grave{a}$   $\grave{a}$   $\ddot{a}$   $\breve{a}$   $\bar{a}$   $\vec{a}$  (and others can be constructed)

(xiii) Local control for displayed mathematics

<code>\eqalign{...}</code>	Allows alignment of one or more equations over several lines—see page 190
<code>\eqalignno{...}</code>	Allows alignment together with RHS equation numbering—see page 192
<code>\leqalignno{...}</code>	Allows alignment together with LHS equation numbering—see page 192
<code>\displaylines{...}</code>	Display equations over several lines as you want but without alignment—see page 194
<code>\cases{...}</code>	Display an equation containing choices spanned by a brace—see page 175

(xiv) Features

<code>x_1^{-2}</code>	Produces $x_1^{-2}$
<code>{x+y\over 2a}</code>	Produces $\frac{x+y}{2a}$ —see page 139
<code>\sqrt{b-a}</code>	Produces $\sqrt{b-a}$
<code>\matrix\pmatrix\bordermatrix</code>	Produce arrays—see page 176
<code>\overbrace{x+y}</code>	Produces $\overbrace{x+y}$ —see page 176
<code>\underbrace{x+y}</code>	Produces $\underbrace{x+y}$ —see page 176
<code>\overline{x+y}</code>	Produces $\overline{x+y}$
<code>\underline{x+y}</code>	Produces $\underline{x+y}$
<code>\root n+1\of{a+b}</code>	Produces $\sqrt[n+1]{a+b}$
<code>{n\choose k}</code>	Produces $\binom{n}{k}$
<code>\bmod</code>	Inserts 'mod' as a binary operation (eg. $m\bmod n$ produces $m \bmod n$ )
<code>\pmod</code>	Inserts 'mod' in parentheses (eg. $m\pmod n$ produces $m \pmod n$ )
<code>\eqno</code>	Equation numbering on RHS—see page 187
<code>\leqno</code>	Equation numbering on LHS—see page 187
<code>\*</code>	Discretionary multiplication sign—see page 173
<code>\allowbreak</code>	Line break within text mathematics permitted here—see page 174

### C. ALLOWABLE UNITS OF MEASUREMENT

in	inch	(1 in = 72.27 pt)
cm	centimetre	(2.54 cm = 1 in, 1 cm = 28.45 pt)
mm	millimetre	(10 mm = 1cm, 25.4 mm = 1in, 1 mm = 2.845 pt)
pc	pica	(1 pc = 12 pt, 6.023 pc = 1 in, 2.371 pc = 1 cm)
cc	cicero	(1 cc = 12 dd, 1 cc = 12.84 pt, 5.628 cc = 1 in, 2.216 cc = 1 cm)
dd	didôt point	(1157 dd = 1238 pt, 67.54 dd = 1 in, 26.59 dd = 1 cm)
bp	big point	(72 bp = 1 in, 28.35 bp = 1 cm)
pt	point	(1 pt = 0.01384 in, 1 pt = 0.03515 cm)
sp	scaled point	(65536 sp = 1 pt, 4736287 sp = 1 in, 1864690 sp = 1 cm)

### D. MACROS—page 199

```
\def\nl{\hfil\break}      \nl will now be interpreted as \hfil\break, ie. start a new line
\def\left{                \left will now be interpreted as \left(
\def\der#1{{d#1\over dx}} \der y will now be interpreted as {dy\over dx} and produce  $\frac{dy}{dx}$  in maths mode
\input macros             Reads in the file macros.tex from the current directory or \inputs directory
Note: A definition nested inside braces, or within $ symbols, does not apply outside those braces or outside that mathematics.
```

### E. SOME DEFAULTS OF PLAIN T<sub>E</sub>X

```
\hsize = 16.51cm (6.5in)      \vsize = 22.61cm (8.9in)
\hoffset = 0pt                \voffset = 0pt
\parindent = 20pt (7.0mm)     \parskip = 0pt plus 1pt
\baselineskip = 12pt (4.2mm)  \topskip = 10pt
\pageno = 1                    \tolerance = 200
```