

Basic LaTeX

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This resource was adapted from
notes provided by Jerry Marsden

1 Basic Formatting

1.1 Beginning a document

```
\documentclass{article}  
\usepackage{graphicx, amssymb}
```

```
\begin{document}
```

```
\textwidth 6.5 truein  
\oddsidemargin 0 truein  
\evensidemargin -0.50 truein  
\topmargin -.5 truein  
\textheight 8.5in
```

template for changing margin sizes
insert after document opener

```
\title{...}  
\author{...}  
\thanks{...}  
\date{...}  
\maketitle
```

template for title and author

```
\begin{abstract}  
\end{abstract}
```

template for abstract

1.2 Format

<code>\section{</code>	numbered section
<code>\section*{</code>	unnumbered section
<code>\subsection{</code>	numbered subsection
<code>\subsection*{</code>	unnumbered subsection
<code>\begin{center}</code>	centers intermediate text
<code>\end{center}</code>	
<code>\centerline{</code>	centers a line
<code>\hfill</code>	fills line with horizontal space
<code>\begin{flushleft}</code>	places text flush with left margin
<code>\end{flushleft}</code>	
<code>\begin{flushright}</code>	places text flush with right margin
<code>\end{flushright}</code>	
<code>\begin{quotation}</code>	offsets intermediate text by wider margins
<code>\end{quotation}</code>	
<code>\noindent</code>	new paragraph starts without indent
<code>\\</code>	newline
<code>\newpage</code>	starts new page
<code>%</code>	following text on same line is invisible

1.3 Basic Braces and Parentheses

<code>{</code>	open brace
<code>}</code>	closing (end) brace
<code>\/}</code>	end brace for italics
<code>(</code>	open parenthesis
<code>)</code>	end parenthesis
<code>[</code>	open bracket
<code>]</code>	end bracket
<code>\{</code>	left literal braces
<code>\}</code>	right literal braces
<code>“</code>	begin quotation mark
<code>”</code>	end quotation mark
<code><</code>	<code>\langle</code>
<code>></code>	<code>\rangle</code>

1.4 Lists and Tables

<code>\begin{enumerate}</code>	makes a numbered list;
<code>\end{enumerate}</code>	
<code>\begin{itemize}</code>	makes list with bullets;
<code>\end{itemize}</code>	
<code>\begin{description}</code>	makes an unnumbered list;
<code>\end{description}</code>	
<code>\item</code>	produces items for above lists
<code>\item[</code>	for customized items, in enumerate lists
<code>\setcounter{enumi}{</code>	sets counter for enumerate list
<code>\setcounter{. . .}{. . .}</code>	fill in braces (don't leave spaces)
<code>\begin{tabbing}</code>	starts tabbing environment
<code>\end{tabbing}</code>	
<code>\></code>	next tab stop
<code>\begin{tabular}{ c c }</code>	tabular with vertical lines
<code>\end{tabular}</code>	
<code>\hline</code>	horizontal line
<code>&</code>	separates columns in tabular environment

1.5 Labels, References and Bibliography

<code>\footnote{</code>	footnote
<code>\index{</code>	use for index entries
<code>\label{</code>	to label an equation, theorem, etc.
<code>\ref{</code>	to cross reference an equation, theorem, etc.
<code>(\ref{ })</code>	put cursor between { } by hand
<code>\cite{ }</code>	reference a bibitem entry

The following are designed for the author-year style of bibliography that is used after

```
\begin{thebibliography}
```

and before

```
\end{thebibliography}
```

<code>\bibitem[artref] Author [year]</code>	for articles
Title.	
<code>{\it Journal\}/} {\bf 11}, 123-223.</code>	

<code>\bibitem[bookref] Author [year]</code>	for books
<code>{\it Title.\}/} Publisher.</code>	

1.6 Foreign Accents

é	É	<code>\'e</code>	<code>\'E</code>
è	È	<code>\'e</code>	<code>\'E</code>
ä	Ä	<code>\"a</code>	<code>\"A</code>
ö	Ö	<code>\"o</code>	<code>\"O</code>
ü	Ü	<code>\"u</code>	<code>\"U</code>

1.7 Miscellaneous

@	@	at symbol
©	<code>\copyright</code>	copyright
¶	<code>\P</code>	paragraph
§	<code>\S</code>	section
ß	<code>\ss</code>	german ss

1.8 Spaces

<code>\vspace{0.2in}</code>	vertical space 0.2in
<code>\hspace{0.2in}</code>	horizontal space 0.2in
<code>\quad</code>	single character space
<code>\qquad</code>	double space
<code>\,</code>	small space
<code>\:</code>	medium space; only in math mode
<code>\;</code>	thick space; only in math mode
<code>\!</code>	negative space; only in math mode
<code>\! \!</code>	negative double space; only in math mode

2 Basic Mathematical Formatting

2.1 Equation Commands

<code>\$</code>	starts and terminates in-text formulas
<code>\[</code> <code>\]</code>	displayed one line formula, not numbered
<code>\begin{equation}</code> <code>\begin{equation}\label{</code> <code>\end{equation}</code>	displayed one line formula, numbered add label
<code>\begin{eqnarray}</code> <code>\begin{eqnarray}\label{</code> <code>\end{eqnarray}</code>	displayed multiline formula, numbered; add label
<code>\begin{eqnarray*}</code> <code>\end{eqnarray*}</code>	displayed multiline formula, not numbered
<code>\begin{array}{ccc}</code> <code>\end{array}</code>	produces matrices (see also §5.3)
<code>&</code> <code>& = &</code>	use between columns for aligning equals in equation arrays
<code>\nonumber</code>	suppresses numbering
<code>\mbox{ }</code>	use before – and + signs in split equations
<code>\quad \mbox{...}\quad</code> <code>\quad \mbox{and}\quad</code>	for text within a formula makes box “and” within a formula
<code>\begin{eqnarray}</code> <code>\lefteqn{ } \nonumber \\\</code> <code>& &</code> <code>\end{eqnarray}</code>	numbered equation split over two lines, for equations with long lefthand sides use “lequs” for the unnumbered version

2.2 Basic Displayed Equations – Examples

`\[`

$$F(b) - F(a) = \int_a^b f(x)dx$$

`\begin{equation}`

$$F(b) - F(a) = \int_a^b f(x)dx \tag{1}$$

\[containing text

$$\sum_{i=1}^n x_i^2 + y_i^2 \geq 0 \quad \text{for all real numbers } x_i \text{ and } y_i$$

\begin{eqnarray*}

$$\begin{array}{rcl} & ^2 & = y + 1 \\ z^2 + 1 & = & u + v \end{array}$$

\begin{eqnarray}

$$\begin{array}{rcl} & ^2 & = y + 1 & (2) \\ z^2 + 1 & = & u + v & (3) \end{array}$$

\begin{eqnarray} \begin{array}{c} \end{array} \quad \text{numbered as a group}

$$\begin{array}{rcl} a & = & b + c \\ d & = & e + f + g \end{array} \tag{4}$$

\begin{eqnarray*} \quad \text{split (with leading minus sign on second line)}

$$\begin{array}{rcl} a & = & b + c + (c + d) \\ & & - e + f \end{array}$$

2.3 Specialized Displayed Equations – Examples

\begin{equation} \begin{array}{l} \end{array} \end{equation}

$$\left. \begin{array}{l} x = y \\ a = b^2 + b + 1 \end{array} \right\} \tag{5}$$

`\begin{equation} \begin{array}{c}`

$$\left. \begin{array}{c} x = y \\ a = b^2 + b + 1 \end{array} \right\} \quad (6)$$

`\begin{equation} \boxed{\}`

$$\boxed{\frac{x^2 + 1}{5} = y} \quad (7)$$

evaluation of expression

$$f\left(\frac{t}{2}\right)\Big|_{t=0}$$

`\begin{eqnarray} \left\{ \right.`

$$\begin{aligned} ax^2 + 2bxy + cy^2 + dx + ey + f \\ = \alpha u + \beta v + \gamma w + \delta \end{aligned} \quad (8)$$

equation array with big brackets on different lines

$$\begin{aligned} \hat{H}_c(\Delta\omega) : &= \int_D \left[\frac{1}{2} \Delta\omega (-\nabla^2)^{-1} \Delta\omega + \Phi(\omega_e + \Delta\omega) - \Phi(\omega_e) \right. \\ &\quad \left. - \Phi'(\omega_e) \Delta\omega \right] dx dy \end{aligned}$$

equation array with big braces on different lines

$$H_0^s(TM) = \left\{ \begin{array}{l} \in H^s(TM) \mid \text{there exists an } H^s\text{-extension} \\ \tilde{X} \in H^s(\tilde{TM}) \text{ with } X \text{ zero on } \tilde{M} \setminus M \end{array} \right\}.$$

2.4 Theorem Like Environments

<code>\newtheorem{cor}</code>	{Corollary}	to make new series of Corollaries
<code>\newtheorem{dfn}</code>	{Definition}	to make new series of Definitions
<code>\newtheorem{lem}</code>	{Lemma}	to make new series of Lemmas
<code>\newtheorem{prop}</code>	{Proposition}	to make new series of Propositions
<code>\newtheorem{thm}</code>	{Theorem}	to make new series of Theorems

<code>\begin{cor}</code>	to begin a Corollary
<code>\end{cor}</code>	to end a Corollary
<code>\begin{dfn}</code>	
<code>\end{dfn}</code>	
<code>\begin{lem}</code>	
<code>\end{lem}</code>	
<code>\begin{prop}</code>	
<code>\end{prop}</code>	
<code>\begin{thm}</code>	
<code>\begin{thm}[Gauss' Theorem]</code>	to begin a Theorem with title
<code>\end{thm}</code>	

Example

Remarks

Proof

Solution

<code>\noindent{\large \bf Example\,}</code>
<code>\noindent{\large \bf Remarks\,}</code>
<code>\noindent{\bf Proof\,}</code>
<code>\noindent{\bf Solution\,}</code>

2.5 End of Proofs, etc.

◆	<code>\quad \blacklozenge</code>	
◆	<code>\quad \$\blacklozenge\$</code>	
■	<code>\quad \blacksquare</code>	end proof
□	<code>\quad \square</code>	empty square
▽	<code>\quad \bigtriangledown</code>	empty triangle down
▼	<code>\quad \blacktriangledown</code>	black triangle down

3 Alphabets and Fonts

3.1 Greek Letters

α	<code>\alpha</code>		
β	<code>\beta</code>		
γ	<code>\gamma</code>	Γ	<code>\Gamma</code>
δ	<code>\delta</code>	Δ	<code>\Delta</code>
ϵ	<code>\epsilon</code>		
ε	<code>\varepsilon</code>		
ζ	<code>\zeta</code>		
η	<code>\eta</code>		
θ	<code>\theta</code>	Θ	<code>\Theta</code>
ϑ	<code>\vartheta</code>		
ι	<code>\iota</code>		
κ	<code>\kappa</code>		
λ	<code>\lambda</code>	Λ	<code>\Lambda</code>
μ	<code>\mu</code>		
ν	<code>\nu</code>		
π	<code>\pi</code>	Π	<code>\Pi</code>
ϖ	<code>\varpi</code>		
ρ	<code>\rho</code>		
ϱ	<code>\varrho</code>		
σ	<code>\sigma</code>	Σ	<code>\Sigma</code>
ς	<code>\varsigma</code>		
τ	<code>\tau</code>		
υ	<code>\upsilon</code>	Υ	<code>\Upsilon</code>
ϕ	<code>\phi</code>	Φ	<code>\Phi</code>
φ	<code>\varphi</code>		
χ	<code>\chi</code>		
ψ	<code>\psi</code>	Ψ	<code>\Psi</code>
ω	<code>\omega</code>	Ω	<code>\Omega</code>

3.2 Italics, Bold, etc.

<i>example</i>	<code>{\it</code>	<i>italic</i> type, “eit” to finish
example	<code>{\rm</code>	roman type
example	<code>{\bf</code>	boldface type
EXAMPLE	<code>{\sc</code>	SMALL CAPS type
example	<code>{\sf</code>	sans serif type
<i>example</i>	<code>{\sl</code>	<i>slanted</i> type
example	<code>{\tt</code>	typewriter type
<i>example</i>	<code>{\em</code>	<i>emphasized</i> type
ξ	<code>\mbox{\boldmath\$. . . \$}</code>	
\mathcal{A}	<code>{\cal</code>	only in math mode, only cap.letters
\mathbf{g}	<code>\mathbf</code>	only in math mode
\mathbb{R}	<code>{\mathbb</code>	only in math mode

3.3 Boldface Letters

	<code>{\bf</code>	
0 – 10	<code>{\bf 0} – {\bf 10}</code>	
a – d	<code>{\bf a} – {\bf d}</code>	
e	<code>{\bf e}</code>	(because of the word “be”)
f	<code>{\bf f}</code>	(because of the command “bf”)
g – x	<code>{\bf g} – {\bf x}</code>	
y	<code>{\bf y}</code>	(because of the word “by”)
z	<code>{\bf z}</code>	
A – Z	<code>{\bf A} – {\bf Z}</code>	
e₁	<code>{\bf e}_1</code>	

3.4 Boldmath Symbols

	<code>\mbox{\boldmath\$. . \$}</code>
ω	<code>\mbox{\boldmath\$\omega\$}</code>
ξ	<code>\mbox{\boldmath\$\xi\$}</code>

3.5 Calligraphic Letters

	<code>{\cal</code>	only in math mode, cap. letters
A – Z	<code>{\cal A} – {\cal Z}</code>	

3.6 German (Fraktur) Letters

	<code>\mathfrak. . .</code>	only in math mode
b	<code>\mathfrak b</code>	german b,
g	<code>\mathfrak g</code>	german g,
h	<code>\mathfrak h</code>	german h,
k	<code>\mathfrak k</code>	german k,
p	<code>\mathfrak p</code>	german p,
t	<code>\mathfrak t</code>	german t,
A	<code>\mathfrak A</code>	german A,
G	<code>\mathfrak G</code>	german G,
H	<code>\mathfrak H</code>	german H,
K	<code>\mathfrak K</code>	german K,
T	<code>\mathfrak T</code>	german T,
X	<code>\mathfrak X</code>	german X,

3.7 Open Letters

	<code>{\mathbb</code>	only in math mode
\mathbb{C}	<code>{\mathbb C}</code>	\$
\mathbb{I}	<code>{\mathbb I}</code>	
\mathbb{R}	<code>{\mathbb R}</code>	
\mathbb{R}^1	<code>{\mathbb R}^1</code>	
\mathbb{R}^2	<code>{\mathbb R}^2</code>	
\mathbb{R}^3	<code>{\mathbb R}^3</code>	
\mathbb{R}^m	<code>{\mathbb R}^m</code>	
\mathbb{R}^n	<code>{\mathbb R}^n</code>	
\mathbb{T}	<code>{\mathbb T}</code>	
\mathbb{Z}	<code>{\mathbb Z}</code>	

4 Basic Mathematical Operations and Symbols

4.1 Universal Operations

	$\frac{\ }{\ }$	for general fractions
$\sqrt{\ }$	$\sqrt{\ }$	universal square root
	$\overset{\ }{\ }$	superscript universal
	$\underset{\ }{\ }$	subscript universal
$\lim_{\ } \vec{a}$	$\lim_{\ } \vec{a}$	limit universal
\bar{a}	$\overline{\ }$	
\bar{a}	$\bar{\ }$	
\check{a}	$\check{\ }$	
\dot{a}	$\dot{\ }$	
\ddot{a}	$\ddot{\ }$	
\hat{a}	$\hat{\ }$	
\tilde{a}	$\tilde{\ }$	
$\{ \}$	$\{ \mid \}$	in-line set
$\{ \}$	$\left\{ \left. \right \right\}$	sized set for large displays
	$\{\displaystyle\}$	for larger math mode formulas

4.2 Single Symbols included in \$ Signs

$a - z$	$\$a\$ - \$z\$$	(except: “doo” for \$o\$)
$A - Z$	$\$A\$ - \$Z\$$	
$1 - 10$	$\$1\$ - \$10\$$	
$\mathbf{a} - \mathbf{z}$	$\$\{\bf a\}\$ - \{\bf z\}\$$	
$\mathbf{A} - \mathbf{Z}$	$\$\{\bf A\}\$ - \{\bf Z\}\$$	
$\mathbf{0} - \mathbf{10}$	$\$\{\bf 0\}\$ - \{\bf 10\}\$$	

4.3 Roots

$\sqrt{2}$	$\sqrt{2}$	
$\sqrt{\pi}$	$\sqrt{\pi}$	
$\sqrt[3]{2}$	$\sqrt[3]{2}$	cube root over 2
$\sqrt[n]{2}$	$\sqrt[n]{2}$	n -root over 2

4.4 Specific Fractions

$$\frac{1}{2} \quad \backslash\text{frac}\{1\}\{2\}$$

$$\frac{1}{3} \quad \backslash\text{frac}\{1\}\{3\}$$

$$\frac{1}{4} \quad \backslash\text{frac}\{1\}\{4\}$$

$$\frac{d}{dt} \quad \backslash\text{frac}\{d\}\{dt\}$$

$$\frac{du}{dt} \quad \backslash\text{frac}\{du\}\{dt\}$$

$$\frac{dx}{dt} \quad \backslash\text{frac}\{dx\}\{dt\}$$

$$\frac{dy}{dt} \quad \backslash\text{frac}\{dy\}\{dt\}$$

$$\frac{dz}{dt} \quad \backslash\text{frac}\{dz\}\{dt\}$$

$$\frac{\partial}{\partial x} \quad \backslash\text{frac}\{\backslash\text{partial}\}\{\backslash\text{partial } x\}$$

$$\frac{\partial}{\partial y} \quad \backslash\text{frac}\{\backslash\text{partial}\}\{\backslash\text{partial } y\}$$

$$\frac{\partial z}{\partial x} \quad \backslash\text{frac}\{\backslash\text{partial } z\}\{\backslash\text{partial } x\}$$

$$\frac{\partial^2}{\partial x \partial y} \quad \backslash\text{frac}\{\backslash\text{partial}^2\}\{\backslash\text{partial } x \backslash\text{partial } y\}$$

$$\frac{\partial^3}{\partial x \partial y \partial z} \quad \backslash\text{frac}\{\backslash\text{partial}^3\}\{\backslash\text{partial } x \backslash\text{partial } y \backslash\text{partial } z\}$$

4.5 Superscripts

$\hat{\{}$		high universal
$a - z$	$\hat{a} - \hat{z}$	(except: “hee” for e , “huu” for u)
$A - Z$	$\hat{A} - \hat{Z}$	
$0 - 10$	$\hat{0} - \hat{\{10\}}$	
2	$\hat{2}$	to avoid typing the number
3	$\hat{3}$	to avoid typing the number
x^2, y^2, z^2	$x^{\hat{2}}, y^{\hat{2}}, z^{\hat{2}}$	
-1	$\hat{\{-1\}}$	
ij	$\hat{\{ij\}}$	
ijk	$\hat{\{ijk\}}$	
jk	$\hat{\{jk\}}$	

†	<code>^\dagger</code>
⊥	<code>^\perp</code>
'	<code>^\prime</code>
*	<code>^\ast</code>
*	<code>^\star</code>

4.6 Subscripts

<code>-{</code>		low universal
<code>a - z</code>	<code>._a - ._z</code>	(except: “luu” for <i>u</i>)
<code>A - Z</code>	<code>._A - ._Z</code>	
<code>0 - 10</code>	<code>._0 - ._{10}</code>	
<code>ij</code>	<code>._{ij}</code>	
<code>ijk</code>	<code>._{ijk}</code>	
<code>jk</code>	<code>._{jk}</code>	
<code>y_n</code>	<code>y._n</code>	
<code>z_n</code>	<code>z._n</code>	
*	<code>._\ast</code>	
*	<code>._\star</code>	

4.7 Overcharacters

\bar{p}	<code>\bar{p}</code>
$\bar{\alpha}$	<code>\bar{\alpha}</code>
\dot{p}	<code>\dot{p}</code>
\ddot{p}	<code>\ddot{p}</code>
\overline{p}	<code>\overline{p}</code>
\hat{p}	<code>\hat{p}</code>
\vec{a}	<code>\vec{a}</code>
\xrightarrow{PP}	<code>\stackrel{\textstyle\longrightarrow}{\rm PP}</code>
\xrightarrow{PQ}	<code>\stackrel{\textstyle\longrightarrow}{\rm PQ};</code>

4.8 Binary Operations and Relations

$+$	<code>+</code>	plus
$-$	<code>-</code>	minus
\pm	<code>\pm</code>	plus-minus
\mp	<code>\mp</code>	minus-plus
\div	<code>\div</code>	divide
\circ	<code>\circ</code>	composite
\bullet	<code>\bullet</code>	bullet
\oplus	<code>\oplus</code>	direct sum
\ominus	<code>\ominus</code>	direct difference
\times	<code>\times</code>	times
\otimes	<code>\otimes</code>	tensor product
\circledast	<code>\circledast</code>	semi direct product
\wedge	<code>\wedge</code>	wedge product
$=$		equals
$= 0$		equals zero
\geq	<code>\geq</code>	greater than or equal
\leq	<code>\leq</code>	less than equal
\neq	<code>\neq</code>	not equal
\cong	<code>\cong</code>	isomorphic
\equiv	<code>\equiv</code>	equivalent
\ll	<code>\ll</code>	much less than
\gg	<code>\gg</code>	much greater than
\approx	<code>\approx</code>	approximately

4.9 Sized Parentheses

(<code>\left(</code>	The “left” and “right” commands
)	<code>\right)</code>	effect the size of the braces.
[<code>\left[</code>	They always have to appear in pairs!
]	<code>\right]</code>	Invisible braces are made with <code>\left.</code> and <code>\right.</code>
{	<code>\left\{</code>	
}	<code>\right\}</code>	
<	<code>\left\langle</code>	
<<	<code>\left\langle\!\!\left\langle</code>	
>	<code>\right\rangle</code>	
>>	<code>\right\rangle\!\!\right\rangle</code>	
	<code>\left.</code>	
	<code>\right.</code>	

4.10 Single Mathematical Symbols

\aleph	<code>\aleph</code>	aleph
\hbar	<code>\hbar</code>	Planck’s constant
\prime	<code>\prime</code>	prime, use “hpr” for superscript
\flat	<code>\flat</code>	flat sign, “hfl” for superscript
\sharp	<code>\sharp</code>	sharp sign, “hsh” for superscript
\heartsuit	<code>\heartsuit</code>	sweetheart
\propto	<code>\propto</code>	proportional to
$\ $	<code>\ </code>	
\pounds	<code>\pounds</code>	Lie derivative
\pitchfork	<code>\pitchfork</code>	transversal
ℓ	<code>\ell</code>	script l
$\ $	<code>\ </code>	norm
∇	<code>\nabla</code>	nabla
∂	<code>\partial</code>	partial derivative
∞	<code>\infty</code>	infinity
\wp	<code>\wp</code>	Weierstrass p -function
\Re	<code>\Re</code>	real part alternate
\Im	<code>\Im</code>	imaginary part alternate
\sphericalangle	<code>\angle</code>	angle

4.11 Set Theoretic Symbols

\Rightarrow	<code>\Rightarrow</code>	implies
\Leftarrow	<code>\Leftarrow</code>	implied by
\Leftrightarrow	<code>\Leftrightarrow</code>	equivalent to
\emptyset	<code>\varnothing</code>	empty set
\emptyset	<code>\emptyset</code>	empty set alternate
\in	<code>\in</code>	element of
\notin	<code>\notin</code>	not an element of
\setminus	<code>\setminus</code>	set difference
\subset	<code>\subset</code>	subset
\subseteq	<code>\subseteq</code>	subset or equals
\supset	<code>\supset</code>	superset
\supseteq	<code>\supseteq</code>	superset or equals
\cap	<code>\cap</code>	intersection
\bigcap	<code>\bigcap</code>	big intersection
\cup	<code>\cup</code>	union
\bigcup	<code>\bigcup</code>	big union
\mid	<code>\mid</code>	vertical bar, with spacing
\exists	<code>\exists</code>	there exists
\forall	<code>\forall</code>	for all

4.12 Arrows and Dots

\mapsto	<code>\mapsto</code>	arrow with tail
\rightarrow	<code>\rightarrow</code>	rightarrow
\longrightarrow	<code>\longrightarrow</code>	longrightarrow
\leftrightarrow	<code>\leftrightarrow</code>	leftrightarrow
\leftarrow	<code>\leftarrow</code>	leftarrow
\uparrow	<code>\uparrow</code>	uparrow
\upharpoonright	<code>\upharpoonright</code>	upharpoonright
\nearrow	<code>\nearrow</code>	slanted up right
\searrow	<code>\searrow</code>	slanted down right
\cdot	<code>\cdot</code>	centered dot
\cdots	<code>\cdots</code>	centered dots
\ddots	<code>\ddots</code>	diagonal dots
\dots	<code>\ldots</code>	lower dots
\vdots	<code>\vdots</code>	vertical dots

4.13 Trig Functions

<code>cos</code>	<code>\cos</code>	
<code>cosh</code>	<code>\cosh</code>	hyperbolic cosine
<code>cos²</code>	<code>\cos²</code>	cosine squared
<code>cos θ</code>	<code>\cos \theta</code>	cosine of theta
<code>cos ϕ</code>	<code>\cos \phi</code>	cosine of phi
<code>sin</code>	<code>\sin</code>	
<code>sinh</code>	<code>\sinh</code>	hyperbolic sine
<code>sin²</code>	<code>\sin²</code>	sine squared
<code>sin θ</code>	<code>\sin \theta</code>	sine of theta
<code>sin ϕ</code>	<code>\sin \phi</code>	sine of phi
<code>sech</code>	<code>{\rm sech}</code>	hyperbolic sech
<code>tan</code>	<code>\tan</code>	
<code>tanh</code>	<code>\tanh</code>	hyperbolic tangent

4.14 Log-like Symbols

<code>exp</code>	<code>\exp</code>	exponential
<code>log</code>	<code>\log</code>	logarithm
<code>ln</code>	<code>\ln</code>	natural logarithm
<code>sup</code>	<code>\sup</code>	supremum
<code>inf</code>	<code>\inf</code>	infimum
<code>max</code>	<code>\max</code>	maximum
<code>min</code>	<code>\min</code>	minimum
<code>lim</code>	<code>\lim</code>	limit universal
<code>lim inf</code>	<code>\liminf</code>	limit inferior
<code>lim sup</code>	<code>\limsup</code>	limit superior
<code>det</code>	<code>\det</code>	determinant
<code>ker</code>	<code>\ker</code>	kernel
<code>dim</code>	<code>\dim</code>	dimension
<code>arg</code>	<code>\arg</code>	argument
<code>gcd</code>	<code>\gcd</code>	greatest common divisor

4.15 Combinations of Mathematical Symbols

-1	-1	minus one
$\ \mathbf{u}\ $	$\ \{\bf u}\ $	
$ a $	$ a $	absolute value;
A^i_a	$A^i_{;a}$	staggered, high and low
L_A^μ	$L_A^{\{\}\mu}$	staggered, variation 1
v^A_ν	$v^A_{\{\}\nu}$	staggered, variation 2
\mathfrak{g}^*	\mathfrak{g}^{\ast}	german g star;
\mathfrak{g}^*	\mathfrak{g}^{\ast}	
$\mathfrak{so}(3)$	$\mathfrak{so}(3)$	
$so(3)$	$so(3)$	
$SO(3)$	$SO(3)$	
T^*Q	$T^{\ast}Q$	
T_q^*Q	$T^{\ast}_{\{q\}}Q$	
div	$\{\rm div\}$	divergence
$\operatorname{Aut}()$	$\{\rm Aut}\()$	automorphism universal
$\operatorname{Diff}()$	$\{\rm Diff}\()$	diffeomorphism universal
$\operatorname{Im}()$	$\{\rm Im}\()$	real part universal
$\operatorname{Im}(z)$	$\{\rm Im}\}(z)$	real part of z
$\operatorname{Re}()$	$\{\rm Re}\()$	real part universal
$\operatorname{Re}(z)$	$\{\rm Re}\}(z)$	real part of z
(0)		
$(0, 0)$		
$(0, 0, 0)$		
(a_1, a_2, a_3)		
(x, y)		
(x, y, z)		
$x^2 + y^2$		
$dx dy$		
$dx dy dz$		
dy/dt	dy/dt	
dx/dt	dx/dt	
dz/dt	dz/dt	
$\partial z/\partial y$	$\partial z/\partial y$	
$\mathbf{a} + \mathbf{b}$	$\{\bf a}\} + \{\bf b}\}$	
$\mathbf{a} \times \mathbf{b}$	$\{\bf a}\} \times \{\bf b}\}$	
$(\mathbf{a} \times \mathbf{b})$	$(\{\bf a}\} \times \{\bf b}\})$	

5 Integrals, Sums, Products and Matrices

5.1 Integrals

\int `\int` integral universal; add limits with “hu” and “lu”

\iint `\iint` double integral

\iiint `\iiint` triple integral

\oint `\oint` contour integral

\int_0^1 `\int^1_0`

\int_a^b `\int^b_a`

\int_D `\int_D`

$\int_{\mathbb{R}^3}$ `\int_{\{\mathbb{R}\}^3}`

$\int_{-\infty}^{\infty}$ `\int^{\infty}_{-\infty}`

$\int_0^{2\pi}$ `\int^{2\pi}_0`

5.2 Sums, Limits, etc.

\sum \sum Σ (in-text)

$\sum_{i=1}^n$ (displayed) $\sum_{i=1}^n$ (in-text)

$\prod_{i=1}^n$ (displayed) $\prod_{i=1}^n$ (in-text)

$\bigcup_{i=1}^n$ (displayed) $\bigcup_{i=1}^n$ (in-text)

$\bigcap_{i=1}^n$ (displayed) $\bigcap_{i=1}^n$ (in-text)

$\lim_{(x,y)\rightarrow(0,0)}$ (displayed) $\lim_{(x,y)\rightarrow(0,0)}$ (in-text)

$\lim_{a\rightarrow\infty}$ (displayed) $\lim_{a\rightarrow\infty}$ (in-text)

$\lim_{x\rightarrow x_0}$ (displayed) $\lim_{x\rightarrow x_0}$ (in-text)

5.3 Sample Matrices

$\begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}$	<code>\left(\begin{array}{c} x_1 \\ x_2 \\ x_3 \end{array} \right)</code>
$\begin{bmatrix} x \\ y \end{bmatrix}$	<code>\left[\begin{array}{c} x \\ y \end{array} \right]</code>
$\begin{pmatrix} a & b \\ c & d \end{pmatrix}$	<code>\left(\begin{array}{cc} a & b \\ c & d \end{array} \right)</code>
$\begin{bmatrix} a & b \\ c & d \end{bmatrix}$	<code>\left[\begin{array}{cc} a & b \\ c & d \end{array} \right]</code>
$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$	<code>\left[\begin{array}{cc} 1 & 0 \\ 0 & 1 \end{array} \right]</code>
$\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$	<code>\left[\begin{array}{cc} 0 & 1 \\ -1 & 0 \end{array} \right]</code>
$\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$	<code>\left(\begin{array}{ccc} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{array} \right)</code>
$\begin{vmatrix} a & b & c \\ d & e & f \\ g & h & i \end{vmatrix}$	<code>\left \begin{array}{ccc} a & b & c \\ d & e & f \\ g & h & i \end{array} \right </code>
$\begin{pmatrix} a & b & c \\ d & e & f \\ g & h & i \end{pmatrix}$	<code>\left(\begin{array}{ccc} a & b & c \\ d & e & f \\ g & h & i \end{array} \right)</code>
$\begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}$	<code>\left[\begin{array}{ccc} a & b & c \\ d & e & f \\ g & h & i \end{array} \right]</code>

6 Boxes, Tabbing and Tabular Environment Samples

6.1 Boxes

Note: text

framed box, edit its size

type header
text

framed box, edit its size

type header
text

double framed box, edit its size

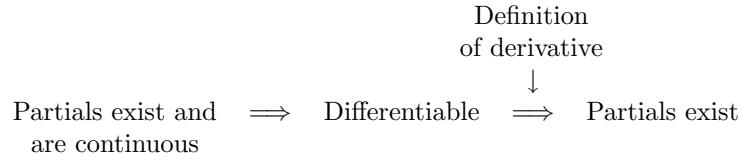
6.2 Tabbing

tabbing example 1

items	for	row	one
items	for	row	two

6.3 Tabular

tabular example 1 (5 columns)



tabular example 2 (2 columns within a fbox-parbox)

Box 2.1.1 Summary of Important Formulas for §2.1	
<i>Velocity</i>	
$V = \frac{\partial \phi}{\partial t}$	$V^a = \frac{\partial \phi^a}{\partial t}$
$v_t = V_t \circ \phi_t^{-1}$	$v_t^a = V_t^a \circ \phi_t^{-1}$
<i>Covariant Derivative</i>	
$Dv \cdot w = \nabla_w v$	$(\nabla_w v)^a = \frac{\partial v^a}{\partial x^b} w^b + \gamma_{bc}^a w^b v^c$

tabular example 3 (3 columns without a frame)

<i>Classical Tensor Analysis</i>		<i>Tensor Analysis on Manifolds</i>
$\{x^a\}$	Coordinates	$\{x^a\}$
$e_a = \frac{\partial z^i}{\partial x^a} \hat{i}_i$	coordinate basis vectors	$\frac{\partial}{\partial x^a} = e_a$
$ \left. \begin{aligned} \bar{e}_a &= \frac{\partial x^b}{\partial \bar{x}^a} e_b \\ \bar{e}^a &= \frac{\partial \bar{x}^a}{\partial x^b} e^b \end{aligned} \right\} $	change of coordinates	$ \left\{ \begin{aligned} \frac{\partial}{\partial \bar{x}^a} &= \frac{\partial x^b}{\partial \bar{x}^a} \frac{\partial}{\partial x^b} \\ d\bar{x}^a &= \frac{\partial \bar{x}^a}{\partial x^b} dx^b \end{aligned} \right. $

tabular example 4 (2 columns with lines)

Classical Mechanics	Quantum Mechanics
immersed Lagrangian manifold $\Lambda \rightarrow (T^*Q, \Omega)$	element of $L^2(Q)$ or $\mathcal{D}'(Q)$
$\Lambda = \text{graph of } \mathbf{d}S$	$\psi = \exp(iS/\hbar)$
T^*Q	Hilbertspace
Lagrangian manifold $\Omega \subset (T^*Q, \Omega_Q) \times (T^*R, -\Omega_R)$	(possibly unbounded) $L^2(R)$ to $L^2(Q)$
composition of canonical relations	composition of operators

tabular example 5 (same as tabex4, but within a framed box)

Classical Mechanics	Quantum Mechanics
immersed Lagrangian manifold $\Lambda \rightarrow (T^*Q, \Omega)$	element of $L^2(Q)$ or $\mathcal{D}'(Q)$
$\Lambda = \text{graph of } \mathbf{d}S$	$\psi = \exp(iS/\hbar)$
T^*Q	Hilbertspace
Lagrangian manifold $\Omega \subset (T^*Q, \Omega_Q) \times (T^*R, -\Omega_R)$	(possibly unbounded) $L^2(R)$ to $L^2(Q)$
composition of canonical relations	composition of operators

tabular example 6 (3 columns with lines)

Case	Conditions	Connection
Unconstrained	$\mathcal{D}_q = T_qQ$	$\mathcal{A}^{\text{sym}}(\dot{q}) = \mathbb{I}^{-1}J(\dot{q})$
Purely Kinematic	$\mathcal{D}_q \cap T_q(\text{Orb}(q)) = \{0\}$	$\mathcal{A}^{\text{kin}}(\dot{q}) = 0$
Horizontal symmetries	$\mathcal{D}_q \cap T_q(\text{Orb}(q))_G = T_q(\text{Orb}(q))_H$	$\mathcal{A}^{\text{sym}}(\dot{q}) + \mathcal{A}^{\text{kin}}(\dot{q}) = \mathbb{I}^{-1}J_H(\dot{q})$
General principal bundle case	$\mathcal{D}_q + T_q(\text{Orb}(q)) = T_qQ$	$\mathcal{A}^{\text{sym}}(\dot{q}) + \mathcal{A}^{\text{kin}}(\dot{q}) = \mathbb{I}^{-1}J^{\text{nhc}}(\dot{q})$

7 Pictures

You must include the line

```
\usepackage{graphicx}
```

at the beginning of your document in order to use these commands.

```
\begin{figure}  
\vspace{2in}  
\hspace*{.4in}  
\includegraphics{myfigure.eps}  
\caption{}  
\end{figure}
```