Basic LaTeX

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1 Basic Formatting

1.1 Beginning a document

```
\documentstyle{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

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

1.3 Basic Braces and Parentheses

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

1.4 Lists and Tables

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

1.5 Labels, References and Bibliography

\footnote{	footnote
\index{	use for index entries
\label{	to label an equation, theorem, etc.
\ref{	to cross reference an equation, theorem, etc.
(\ref{ })	put cursor between { } by hand
\cite{ }	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}

\bibitem[artref] Author [year] Title. {\it Journal\/} {\bf 11}, 123–223.	for articles
\bibitem[bookref] Author [year] {\it Title.\/} Publisher.	for books

1.6 Foreign Accents

é	\'{e}	\'{E}
è	\`{e}	\`{E}
ä	\"{a}	\"{A}
ö	\"{o}	\"{O}
ü	\"{u}	\"{U}

1.7 Miscellaneous

@	@	at symbol
©	\copyright	copyright
¶	\P	paragraph
§	\S	section
ß	\ss	german ss

1.8 Spaces

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

2 Basic Mathematical Formatting

2.1 Equation Commands

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

2.2 Basic Displayed Equations – Examples

\[

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

beqex \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*}

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

\begin{eqnarray}

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

\begin{eqnarray} \begin{array}{c} numbered as a group

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

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

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

2.3 Specialized Displayed Equations – Examples

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

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

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

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

\begin{equation} \fbox{

$$\boxed{\frac{x^2+1}{5} = y} \tag{7}$$

evaluation of expression

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

\begin{eqnarray}\lefteqn{ }

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

equation array with big brackets on different lines

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

equation array with big braces on different lines

$$\begin{aligned} H_0^s(TM) \quad = \quad & \left\{ \in H^s(TM) \,\middle|\, \text{there exists an } H^s\text{-extension} \right. \\ & \left. \tilde{X} \in H^s(\tilde{T}M) \text{ with } X \text{ zero on } \tilde{M}\backslash M \right\}. \end{aligned}$$

2.4 Theorem Like Environments

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

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

Example	\noindent{\large \bf Example\,}
Remarks	\noindent{\large \bf Remarks\,}
Proof	\noindent{\bf Proof\,}
Solution	\noindent{\bf Solution\,}

2.5 End of Proofs, etc.

⧫	\quad \blacklozenge	
⧫	\quad $\blacklozenge$	
■	\quad \blacksquare	end proof
■	\quad $\blacksquare$	dollar end proof
□	\quad \square	empty square
□	\quad $\square$	dollar empty square
▽	\quad \bigtriangledown	empty triangle down
▽	\quad $\bigtriangledown$	dollar empty triangle down
▼	\quad \blacktriangledown	black triangle down
▼	\quad $\blacktriangledown$	dollar black triangle down

3 Alphabets and Fonts

3.1 Greek Letters

All greek letters are available as sub- and superscripts by preceding the codes below with "l" or "h". For example, "lxa" is "_\alpha" and "hxa" is "^\alpha". They are also available enclosed by $, for example "dxa" produces "$\alpha $".

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

3.2 Italics, Bold, etc.

For the universal blank bricks, use "...u" (universal). To complete it, after typing the entry, use "eb" and "eit". [Note about "bi": If you do your papers in 12pt, modify the definition of \tenbi at the beginning.]

example	{\it	*italic* type, "eit" to finish
example	{\rm	roman type
example	{\bf	**boldface** type
EXAMPLE	{\sc	SMALL CAPS type
example	{\sf	sans serif type

example	{\sl	*slanted* type
`example`	{\tt	`typewriter` type
example	{\em	*emphasized* type
$\boldsymbol{\xi}$	\mbox{\boldmath$...$}	
$\mathcal{A}$	{\cal	only in math mode, only cap.letters
$\mathfrak{g}$	\mathfrac	only in math mode
$\mathbb{R}$	{\mathbb	only in math mode

3.3 Boldface Letters

	{\bf	
0 – 10	{\bf 0} – {\bf 10}	
a – d	{\bf a} – {\bf d}	
e	{\bf e}	(because of the word "be")
f	{\bf f}	(because of the command "bf")
g – x	{\bf g} – {\bf x}	
y	{\bf y}	(because of the word "by")
z	{\bf z}	
A – Z	{\bf A} – {\bf Z}	
$\mathbf{e}_1$	{\bf e}_1	

3.4 Boldmath Symbols

	\mbox{\boldmath$...$}
$\boldsymbol{\omega}$	\mbox{\boldmath$\omega$}
$\boldsymbol{\xi}$	\mbox{\boldmath$\xi$}

3.5 Calligraphic Letters

	{\cal	only in math mode, cap. letters
$\mathcal{A}$ – $\mathcal{Z}$	{\cal A} –{\cal Z}	

3.6 German (Fraktur) Letters

	\mathfrak...	only in math mode
$\mathfrak{b}$	\mathfrak b	german b,
$\mathfrak{g}$	\mathfrak g	german g,
$\mathfrak{h}$	\mathfrak h	german h,
$\mathfrak{k}$	\mathfrak k	german k,
$\mathfrak{p}$	\mathfrak p	german p,
$\mathfrak{t}$	\mathfrak t	german t,

$\mathfrak{A}$	\mathfrak A	german A,
$\mathfrak{G}$	\mathfrak G	german G,
$\mathfrak{H}$	\mathfrak H	german H,
$\mathfrak{K}$	\mathfrak K	german K,
$\mathfrak{T}$	\mathfrak T	german T,
$\mathfrak{X}$	\mathfrak X	german X,

3.7 Open Letters

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

4 Basic Mathematical Operations and Symbols

4.1 Universal Operations

	\frac{ }{}	for general fractions
$\sqrt{}$	\sqrt{	universal square root
	$\hat{}$	superscript universal
	_{	subscript universal
lim	\lim_{	limit universal
$\vec{a}$	\vec{	
$\overline{a}$	\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

$\frac{1}{2}$ \frac{1}{2}

$\frac{1}{3}$ \frac{1}{3}

$\frac{1}{4}$ \frac{1}{4}

$\frac{d}{dt}$ \frac{d}{dt}

$\frac{du}{dt}$ \frac{du}{dt}

$\frac{dx}{dt}$ \frac{dx}{dt}

$\frac{dy}{dt}$ \frac{dy}{dt}

$\frac{dz}{dt}$ \frac{dz}{dt}

$\frac{\partial}{\partial x}$ \frac{\partial}{\partial x}

$\frac{\partial}{\partial y}$ \frac{\partial}{\partial y}

$\frac{\partial z}{\partial x}$ \frac{\partial z}{\partial x}

$\frac{\partial^2}{\partial x \partial y}$ \frac{\partial^2}{\partial x \partial y}

$\frac{\partial^3}{\partial x \partial y \partial z}$ \frac{\partial^3}{\partial x \partial y \partial z}

4.5 Superscripts

All letters, capital letters and numbers from 0 to 10 are available as superscripts, by preceding the desired letter or number with "h". E.g. "ha" gives ^a, "hca" gives "^A", "h1" gives "^1". Exceptions, to avoid conflict with words and the universal macro, are "hee" for superscript e, "huu" for superscript u.

^{		high universal
^{a} – ^{z}	^a – ^z	(except: "hee" for ^{e}, "huu" for ^{u})
^{A} – ^{Z}	^A – ^Z	
^{0} – ^{10}	^0 – ^{10}	
^{2}	^2	to avoid typing the number
^{3}	^3	to avoid typing the number
x^2, y^2, z^2	x^2, y^2, z^2	

$^{-1}$	^{-1}
$\hat{ij}$	\hat{ij}
$\hat{ijk}$	\hat{ijk}
$\hat{jk}$	\hat{jk}
†	^\dagger
$^{\perp}$	^\perp
$^{\prime}$	^\prime
*	^\ast
*	^\star

4.6 Subscripts

All letters, capital letters and numbers from 0 to 10 are available as subscripts, preceding with "l". E.g. "la" gives "_a", "lca" gives "_A", "l1" gives "_1".

$_{\{}$		low universal
$_{a - z}$	_a – _z	(except: "luu" for $_u$)
$_{A - Z}$	_A – _Z	
$_{0 - 10}$	_0 – _{10}	
$_{ij}$	_{ij}	
$_{ijk}$	_{ijk}	
$_{jk}$	_{jk}	
y_n	y_n	
z_n	z_n	
$_{*}$	_\ast	
$_{\star}$	_\star	

4.7 Overcharacters

$\bar{p}$	\bar{p}
$\bar{\alpha}$	\bar{\alpha}
$\dot{p}$	\dot{p}
$\ddot{p}$	\ddot{p}
$\overline{p}$	\overline{p}
$\hat{p}$	\hat{p}
$\vec{a}$	\vec{a}
$\overrightarrow{\mathrm{PP}}$	\stackrel{\textstyle\longrightarrow}{\rm PP}
$\overrightarrow{\mathrm{PQ}}$	\stackrel{\textstyle\longrightarrow}{\rm PQ};

4.8 Binary Operations and Relations

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

4.9 Sized Parentheses

(	\left(	The "left" and "right" commands
)	\right)	effect the size of the braces.
[	\left[	They always have to appear in pairs!
]	\right]	Invisible braces are made with \left. and \right.
{	\left\{	
}	\right\}	
⟨	\left\langle	
⟪	\left\langle \! \left\langle	
⟩	\right\rangle	
⟫	\right\rangle \! \right\rangle	
	\left.	
	\right.	

4.10 Single Mathematical Symbols

ℵ	\aleph	aleph
ℏ	\hbar	Planck's constant
′	\prime	prime, use "hpr" for superscript
♭	\flat	flat sign, "hfl" for superscript
♯	\sharp	sharp sign, "hsh" for superscript
♡	\heartsuit	sweetheart
∝	\propto	proportional to
‖	\ |	
£	\pounds	Lie derivative
⫛	\pitchfork	transversal
ℓ	\ell	script l
‖	\\|	norm
∇	\nabla	nabla
∂	\partial	partial derivative
∞	\infty	infinity
℘	\wp	Weierstrass p-function
ℜ	\Re	real part alternate
ℑ	\Im	imaginary part alternate
∠	\angle	angle

4.11 Set Theoretic Symbols

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

4.12 Arrows and Dots

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

4.13 Trig Functions

$\cos$	\cos	
$\cosh$	\cosh	hyperbolic cosine
$\cos^2$	\cos^2	cosine squared
$\cos\theta$	\cos \theta	cosine of theta
$\cos\phi$	\cos \phi	cosine of phi
$\sin$	\sin	
$\sinh$	\sinh	hyperbolic sine
$\sin^2$	\sin^2	sine squared
$\sin\theta$	\sin \theta	sine of theta
$\sin\phi$	\sin \phi	sine of phi
sech	{\rm sech}\,	hyperbolic sech
$\tan$	\tan	
$\tanh$	\tanh	hyperbolic tangent

4.14 Log-like Symbols

$\exp$	\exp	exponential
$\log$	\log	logarithm
$\ln$	\ln	natural logarithm
$\sup$	\sup	supremum
$\inf$	\inf	infimum
$\max$	\max	maximum
$\min$	\min	minimum
$\lim$	\lim	limit universal
$\liminf$	\liminf	limit inferior
$\limsup$	\limsup	limit superior
$\det$	\det	determinant
$\ker$	\ker	kernel
$\dim$	\dim	dimension
$\arg$	\arg	argument
$\gcd$	\gcd	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
$L_A{}^\mu$	L_A{}^\mu	staggered, variation 1
$v^A{}_\nu$	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^*_qQ	T^{\ast}_{q} Q	
div	{\rm div}\,	divergence
Aut(	{\rm Aut}(	automorphism universal
Diff(	{\rm Diff}(	diffeomorphism universal
Im(	{\rm Im}(	real part universal
Im(z)	{\rm Im}(z)	real part of z
Re(	{\rm Re}(	real part universal
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”
$\iint$	\int \!\!\! \int	double integral
$\iiint$	\int \!\!\!\int \!\!\!\int	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	$\sum$	(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)
$\lim_{(x,y)\to(0,0)}$	(displayed)	$\lim_{(x,y)\to(0,0)}$	(in-text)
$\lim_{a\to\infty}$	(displayed)	$\lim_{a\to\infty}$	(in-text)
$\lim_{x\to x_0}$	(displayed)	$\lim_{x\to x_0}$	(in-text)

5.3 Sample Matrices

$$\left(\begin{array}{c} x_1 \\ x_2 \\ x_3 \end{array} \right)$$

```
\left( \begin{array}{c} x_1 \\ x_2 \\ x_3 \end{array} \right)
```

$$\left[\begin{array}{c} x \\ y \end{array} \right]$$

```
\left[ \begin{array}{c} x \\ y \end{array} \right]
```

$$\left(\begin{array}{cc} a & b \\ c & d \end{array} \right)$$

```
\left( \begin{array}{cc} a & b \\ c & d \end{array} \right)
```

$$\left[\begin{array}{cc} a & b \\ c & d \end{array} \right]$$

```
\left[ \begin{array}{cc} a & b \\ c & d \end{array} \right]
```

$$\left[\begin{array}{cc} 1 & 0 \\ 0 & 1 \end{array} \right]$$

```
\left[ \begin{array}{cc} 1 & 0 \\ 0 & 1 \end{array} \right]
```

$$\left[\begin{array}{cc} 0 & 1 \\ -1 & 0 \end{array} \right]$$

```
\left[ \begin{array}{cc} 0 & 1 \\ - 1 & 0 \end{array} \right]
```

$$\left(\begin{array}{ccc} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{array} \right)$$

```
\left( \begin{array}{ccc} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{array} \right)
```

$$\left| \begin{array}{ccc} a & b & c \\ d & e & f \\ g & h & i \end{array} \right|$$

```
\left| \begin{array}{ccc} a & b & c \\ d & e & f \\ g & h & i \end{array} \right|
```

$$\left(\begin{array}{ccc} a & b & c \\ d & e & f \\ g & h & i \end{array} \right)$$

```
\left( \begin{array}{ccc} a & b & c \\ d & e & f \\ g & h & i \end{array} \right)
```

$$\left[\begin{array}{ccc} a & b & c \\ d & e & f \\ g & h & i \end{array} \right]$$

```
\left[ \begin{array}{ccc} a & b & c \\ d & e & f \\ g & h & i \end{array} \right]
```

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)

$$\text{Partials exist and are continuous} \implies \text{Differentiable} \underset{\text{Definition of derivative}}{\implies} \text{Partials exist}$$

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

Box 2.1.1 Summary of Important Formulas for §2.1

Velocity

$V = \dfrac{\partial \phi}{\partial t}$	$V^a = \dfrac{\partial \phi^a}{\partial t}$
$v_t = V_t \circ \phi_t^{-1}$	$v_t^a = V_t^a \circ \phi_t^{-1}$

Covariant Derivative

$\mathbf{D}v \cdot w = \nabla_w v$	$(\nabla_w v)^a = \dfrac{\partial v^a}{\partial x^b} w^b + \gamma^a_{bc} w^b v^c$

tabular example 3 (3 columns without a frame)

Classical Tensor Analysis		*Tensor Analysis on Manifolds*
$\{x^a\}$	Coordinates	$\{x^a\}$
$e_a = \dfrac{\partial z^i}{\partial x^a} \vec{i}_i$	coordinate basis vectors	$\dfrac{\partial}{\partial x^a} = e_a$
$\left.\begin{array}{l} \bar{e}_a = \dfrac{\partial x^b}{\partial \bar{x}^a} e_b \\ \bar{e}^a = \dfrac{\partial \bar{x}^a}{\partial \bar{x}^b} e^b \end{array}\right\}$	change of coordinates	$\left\{\begin{array}{l} \dfrac{\partial}{\partial \bar{x}^a} = \dfrac{\partial x^b}{\partial \bar{x}^a} \dfrac{\partial}{\partial x^b} \\ d\bar{x}^a = \dfrac{\partial \bar{x}^a}{\partial x^b} dx^b \end{array}\right.$

tabular example 4 (2 columns with lines)

Classical Mechanics	**Quantum Mechanics**
immersed Lagrangian manifold $\Lambda \to (T^*Q, \Omega)$	element of $L^2(Q)$ or $\mathcal{D}'(Q)$
$\Lambda =$ 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 $\Lambda \to (T^*Q, \Omega)$	element of $L^2(Q)$ or $\mathcal{D}'(Q)$
$\Lambda =$ 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}
```