Reference Sheet for a Thesis
with LaTeX2e and KOMA-Script

➥ All examples were tested with pdflatex.
➥ The package mentioned in the headings has to be included (see B.2).
➥ Compile three times after last change (esp. docs with references).

A. LaTeX Basics

A.1. Units
➥ Available units for length and dimensions:

bp	point (typographic)	mm	millimeter	in	inch	em	width of M
px	pixel (1/72in)	cm	centimeter	pc	pica	ex	height of x

➥ Document dependent units z\textwidth, z\linewidth, z\columnwidth, z\textheight with z a percentage value, e.g. 0.55\textwidth means 55% of the actual width of the text.
➥ \baselineskip minimum vertical space between the bottom of two successive lines in a paragraph.
➥ Amounts like \smallskipamount, \medskipamount, \bigskipamount.

A.2. Reserved Characters (see also E.2, cf. H)

\	introduces a command	\textbackslash
{ }	embraces arguments, creates logical parts	\{ \}
[ ]	embraces *optional* arguments	[ ]
%	comments: code after % will be ignored.	\%
&	separates columns in tabular-like environments	\&
#	parameter for own command declarations	\#
$	text style math mode (abbr. for \(...\))	\$
_^	index/exponent only valid in math mode, e.g. a_1^2 see E.2	

B. Preamble (before \begin{document})

B.1. Documentclass (necessary)
Use: \documentclass[*opt,opt,...*]{*class*}
Recommended classes: scrartcl, scrreprt, scrbook, scrlttr2
Non-KOMA-Script classes: beamer, koma-moderncvclassic

Common options with default	Values available (subtotal)
fontsize=11pt	10pt | 12pt (e.g. 12.5pt also valid)
paper=a4, paper=portrait	a3 | a5 | b4 | letter, landscape
parskip=no	half | full
headings=big	small | normal
chapterprefix=false	true
open=right (scrbook)	any (scrartcl, scrreprt) | left
captions=oneline	nooneline
captions=tablebelow,figurebelow	tableabove, figureabove
toc=nolistof	listof | listofnumbered
bibliography=totoc | totocnumbered	nottotoc
twoside=true (scrbook)	false (scrartcl, scrreprt)
twocolumn=false	true
draft=false	true (show overfull boxes)

➥ Options of document class are passed to every loaded package.
➥ Set or change options later in file, e.g. \KOMAoptions{twoside=true}

B.2. Loading Packages
\usepackage[*options*]{*package*}
\PassOptionsToPackage[*options*]{*package*}

B.3. Encoding Settings

```
\usepackage[utf8]{inputenc}    % most IDEs use UTF8
\usepackage[T1]{fontenc}       % most fonts needs T1
```

B.4. Language Settings with babel
Load: \usepackage[ngerman, main=english]{babel}
Use: \selectlanguage{*language*}   \foreignlanguage{*language*}{*text*}

```
\documentclass[italian]{scrbook}           % global option
\usepackage[british,main=italian]{babel}   % package option
\usepackage{csquotes}     % package csquotes knows italian
```
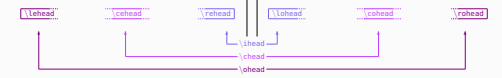
C. Layout

C.1. Changing Page Layout with geometry
➥ Let KOMA-Script know of geometry by option usegeometry=true.

```
\usepackage[left=2cm, right=2, top=3cm, bottom=4cm,
   bindingoffset=1cm, inlcudeheadfoot]{geometry}
```

➥ Auto-completion determines unspecified dimensions (under or over specified as well), here width and height of text (see I.9).
➥ Other options: paper=a4paper, landscape|portrait, includehead, includefoot, includeheadfoot, twocolumn
➥ Changing page layout mid document: \newgeometry{ *opt, opt, ...* }

C.2. Header and Footer of Page (aka running heading)


```
% delete default settings and define your own
\usepackage[automark]{scrlayer-scrpage}
\clearpairofpagestyles
\ohead[]{\headmark} \ofoot[\pagemark]{\pagemark}
```

```
% Variant for a thesis with horizontal rules at head and foot
\usepackage[headsepline=0.005pt:,footsepline=0.005pt:,
   plainfootsepline,automark]{scrlayer-scrpage}
\clearpairofpagestyles
\ohead[]{\headmark} \ofoot[\pagemark]{\pagemark}
\ModifyLayer[addvoffset=-.6ex]{scrheadings.foot.above.line}
\ModifyLayer[addvoffset=-.6ex]{plain.scrheadings.foot.above.line}
\setkomafont{pageheadfoot}{\small}
```

C.3. Linespread with setspace
Load: \usepackage[onehalfspacing]{setspace} for 1.5 line spacing.

D. Document Structure (see also L)

D.1. Start Document
\begin{document} *Complete document contents.* \end{document}

D.2. Title
simple title: \author{*text*} \title{*text*} \date{\today} \maketitle
title page self designed: \begin{titlepage} *text* \end{titlepage}

D.3. Table of Contents, List of Figures (for other List of see E.8 & G)
\tableofcontents   \listoftables   \listoffigures
KOMAoption toc=listof (see B.1) generates entries for TOC.

D.4. Headings
\part{*title*}   \chapter{*title*}
\section{*title*}   \subsection{*title*}   \subsubsection{*title*}
\paragraph{*title*}   \subparagraph{*title*}

➥ \chapter only valid in documentclass scrbook and scrreprt
➥ Use ∗ variants for headings without numbering, no change in counter and no entry in table of contents.
➥ Use the optional parameter for short titles in headings and table of contents, e.g. \section[*short title*]{*title*}
➥ Use \addpart, \addchap or \addsec for unnumbered headings, but with running heading and entry in table of contents.
   The ∗ variants delete the running heading.
➥ Layout of paragraph and subpargraph similar to other headings:
   \RedeclareSectionCommands[afterskip=1sp]{paragraph,subparagraph}
   \setcounter{secnumdepth}{\subparagraphnumdepth}
   \setcounter{tocdepth}{\subparagraphtocdepth}

D.5. Justification

Environment	Declaration	Other
\begin{center}	\centering	*text* \par\vfill *text*
\begin{flushleft}	\raggedright	*text* \hfill *text*
\begin{flushright}	\raggedleft	\raggedbottom, \flushbottom

D.6. Lists
\begin{itemize} with bullets   \item or \item[*symbol*]
\begin{enumerate} with numbers   \item
\begin{description} with bold words   \item[*word*]
\begin{labeling}[*separator*]{*labelinglabel*} \item[*word*]

```
\begin{enumerate}
   \item First item
   \item Second item\label{it:second} % see References
\end{enumerate}
```

D.7. Enhanced Lists with enumitem
Load: \usepackage{enumitem}
Example (for enumerate):
\setlist[enumerate,1]{label=\Alph*)}
\setlist[enumerate,2]{label=\alph*)}
\setlist[enumerate,3]{label=\roman*)}
\setlist[enumerate,4]{label=\arabic*)}

A) one
  a) one
  b) two
B) two

Example (for legal list):
\newlist{legal}{enumerate}{10}
\setlist[legal]{label*=\arabic*.,noitemsep}
Use: \begin{legal} \item ...\end{legal}

1. one
  1.1. two
    1.1.1. three
    1.1.2. strawberry

D.8. Separate Files
➥ After preamble within the text place:\include{*file*} Text starts and ends on a new page. *file* has to be in the same directory as the master file. Otherwise specify a path: \include{*path/file*}
➥ In preamble place: \includeonly{*file1,file2*} to run only these files.
➥ Use \input{*file*} includes a file without starting/ending on a new page (\includeonly not valid).

E. Text

E.1. Paragraphs (≈ "new idea in content")
Paragraphs are separated by an empty line in the code or by \par.
A \\ produces a new line – use sparingly, seldom needed outside tabulars.
Correct Overfull Box Warnings with more than 4pt (look into log file).

E.2. Text Symbols/Characters (see also A.2)
A lot of diacritic symbols can be typed directly, e.g. è é ê ñ ç

§	\S	_	\textunderscore{}	~	\textasciitilde{}
^	\textasciicircum{}	...	\ldots	|	\textbar

Other symbols need packages, e.g. € \texteuro (textcomp)

E.3. Fonts

Command	Declaration	Effect
\textrm{*text*}	{\rmfamily *text*}	Roman family
\textsf{*text*}	{\sffamily *text*}	Sans serif family
\texttt{*text*}	{\ttfamily *text*}	Typewriter family
\textmd{*text*}	{\mdseries *text*}	Medium series
\textbf{*text*}	{\bfseries *text*}	**Bold series**
\textup{*text*}	{\upshape *text*}	Upright shape
\textit{*text*}	{\itshape *text*}	*Italic shape*
\textsl{*text*}	{\slshape *text*}	*Slanted shape*
\textsc{*text*}	{\scshape *text*}	Small Caps shape
More general commands:		
\emph{*text*}	{\em *text*}	*Emphasized*
\textnormal{*text*}	{\normalfont *text*}	Document font

Example: \setkomafont{section}{\scshape}

E.4. Font Size
Font size is relative to the base font size, specified in the document class.

\tiny	tiny
\scriptsize	scriptsize
\footnotesize	footnotesize
\small	small
\normalsize	normalsize
\large	large

\Large Large
\LARGE LARGE
\huge huge
\Huge Huge

Use: {\small *text*} or {\huge *text*\par} to limit the size change.
Example: \setkomafont{pageheadfoot}{\small}

D.6. Lists — colors etc.

E.5. Colors with xcolor

```
\usepackage{xcolor}
\definecolor{DarkBlue}{RGB}{0, 115, 207}
\colorlet{col_section}{DarkBlue}
\textcolor{red}{text in red} or {\color{red}text}
\colorbox{gray!25}{\color gray faded by 25\%}
```

Predefined colors:
white gray black red green blue cyan magenta yellow
Fade a color with *color*!*value* between 0 and 100
Headings in color: \setkomafont{disposition}{\color{*color*}}

E.6. Footnotes

\footnote{*text*}	Print footnote marker in text and footnote at bottom of page
\footnotemark	Print footnote marker in text (e.g. within tabular or caption)
\footnotetext{*text*}	Print footnote at bottom of page

E.7. References with hyperref (loads url implicitly)

\autocite{*citekey*}	Cite a bibliographic reference (package biblatex)
\label{*marker*}	Set a marker for cross reference, often if the form \label{sec:item} or \label{fig:diag1}
\autoref{*marker*}	Give type name and number of marker
\autopageref{*marker*}	Give abbreviation of "page" and page number of marker
\url{*url*}	Print clickable web page
\href[*options*]{*url*}{*text*}	Print clickable link
\hyperref[*marker*]{*text*}	Print clickable reference

Style: \urlstyle{*xx*} with *xx* a style like "tt", "rm", "sf" or "same".
Names for autoref (package babel):
   \renewcaptionname{*language*}{*typenameautorefname*}{*text*},
   e.g. \renewcaptionname{english}{\subsectionautorefname}{section}

E.8. Acronyms with acro

```
\usepackage{acro,hyperref,longtable,tabu} %next 5 to praeambel
\acsetup{list-style=longtabu,list-heading=addchap}
\DeclareAcroListStyle{longtabu}{table}{table=longtabu,
   table-spec=@{}>{\bfseries}lX@{}}
\DeclareAcronym{ecm}{short=EM,long=Electro Machining}
...
\ac{EM} or \Ac{EM} for capitalized first letter
\printacronyms
```

F. Figures & Tables (floating environments)

F.1. Figures with graphicx
Load: \usepackage{graphicx}
Use: \includegraphics[*opt*]{*file*} (png, jpg, pdf)

With 'figure' the environment to place a graphic is meant. The figure caption is printed where the caption command is placed in the input. Extra vertical space is controlled by the KOMAoption captions (see B.1).
Use: \begin{figure}[*pos*] ..\caption{..}\label{fig:x} \end{figure}
Parameter: *pos* is a suggestion for placing, it can be ignored by TeX. Possible values are combinations of t (top), h (here), b (bottom), ! (try harder), p (separate page).
Hint: Define a path to the graphic files (no blanks in folder names; no special characters in file names) \graphicspath{ {*folder*/}{*folder*/}... }

```
\graphicspath{ {img/} } %subfolder for images; set in preambel
\begin{figure}\centering
   \includegraphics[width=.8\columnwidth]{pic.jpg}
   \caption[Short title]{Long title}\label{fig:ff}
\end{figure}
```

➥ Numbering throughout the whole document (scrbook) with package chngcntr: \counterwithout{figure}{chapter} (same for table)
➥ Figure name: \renewcaptionname{*language*}{\figurename}{*text*}
   \renewcaptionname{*language*}{\figureautorefname}{*text*}

F.2. Subfigures with subcaption

Load: `\usepackage{subcaption}`
Use: `\begin{subfigure}[pos]{width}` ... `\end{subfigure}`

```
\begin{figure}[ht] \centering
  \begin{subfigure}[t]{0.5\textwidth}
  \centering \includegraphics[height=1.2in]{figure-a}
  \caption{Subcaption 1}\label{fig:SubFig1}\end{subfigure}
  \begin{subfigure}[t]{0.5\textwidth}
  \centering \includegraphics[height=1.2in]{figure-b}
  \caption{Subcaption 2}\label{fig:SubFig2}\end{subfigure}
  \caption{Caption of complete figure}\label{fig:Fig1}
\end{figure}
```

F.3. Tables width aligned material

With 'table' the environment to place aligned material is meant. The table caption is printed where the caption command is placed in the input. For positioning options see F.1.

```
\KOMAoptions{captions=tableabove} % move to praeambel
\begin{table}[htbp] \centering
  \caption{Table caption}\label{tab:exp}
  \begin{tabular}{@{}ll@{}}
  \emph{Name} & \emph{Desc.}\\ \hline
  tikz2pdf    & Python script\\
  LaTable     & visual table editor
  \end{tabular}
\end{table}
```

Use: `\begin{tabular}[c b t]{@{} l r c | p{unit}}`
Column separation: `@{\hspace{unit}}` or `\setlength{\tabcolsep}{unit}`
Row separation: `\\[unit]` or `\renewcommand{\arraystretch}{unit}`
Partial lines: `\cline{2-3}` instead of `\hline`
Additional packages: array, longtable, booktabs, tabu,
 xcolor with option table, tabularx, tabulary

F.4. Colored Table

```
\usepackage[table]{xcolor} % move to praeambel
\rowcolors{1}{}{lightblue} % {start row}{odd-row}{even-row}
\begin{tabular}{clr} ... \end{tabular}
```

F.5. Suppress Floating with float

For a thesis most students want to control the placing of figures and tables themselves. One way is more control with placeins. Another way is to avoid the environments figure and table using `\captionof`. Quick and dirty is an additional positioning parameter using float:
Load: `\usepackage{float,scrhack}`
Use: `\begin{figure}[H]`, `\begin{table}[H]`

F.6. Source Code Listings with listings

Load: `\usepackage{listings}`
Options: `\lstset{ basicstyle=\ttfamily\small, language=Python, numbers=left, keywordstyle=\color{blue}\bfseries }`
 See option literate for Umlauts (literate={ä}{{\"a}}1)
Languages: C, C++, Java, Matlab, Python, HTML, XML, . . .
Use: Environment: `\begin{lstlisting}` code `\end{lstlisting}`
    In line: `\lstinline+code+` (same start- and end char)
    File: `\lstinputlisting{filename}`

```
1  # Python selection
2  secret=42
3  guess=int(input('Enter number: '))
4  if guess==secret:
5      print ("You won!")
6  elif guess>secret:
7      print ("No, secret number bigger.")
8  else:
9      print ("No, secret number is smaller.")
```

F.7. Boxes and Rules

Normal: `\parbox[pos][height][contentpos]{width}{text}` or
`\begin{minipage}[pos][height][contentpos]{width}text\end{minipage}`
Lift Text: `\raisebox{lift}[height][depth]{text}`
Framed Box: `\fbox{text}` or `\framebox[width][pos]{text}`
Colored Box (xcolor): `\colorbox{backgroundcolor}{text}`
Framed colored Box: `\fcolorbox{bordercolor}{backgroundcolor}{text}`
Resize (graphicx): `\scalebox{10}{Giant}`
Lengths: `\setlength{\fboxsep}{unit}`, `\setlength{\fboxrule}{unit}`

G. Bibliography with `biblatex` & External Processor `biber`

G.1. Entry types

@article	@book	@inbook
@collection	@incollection	@manual
@misc	@online	@patent
@phdthesis	@proceedings	@periodical
@report	@techreport	@thesis

G.2. Entry Fields (example see L)

author	title	journal	year	volume
editor	publisher	institution	school	series
pages	organization	number	note	key

G.3. Styles

alphabetic	authoryear	authortitle	numeric	mla	verbose
chem-acs	phys	nature	science	ieee	apa

See https://de.sharelatex.com/learn/Biblatex_bibliography_styles

G.4. Example

```
% in preambel
\usepackage[autostyle=true]{csquotes} % Load
\usepackage[backend=biber,style=nature,language=british]
  {biblatex} % Load
\addbibresource{mybibliographyfile.bib} % Define
% anywhere within the document
\autocite{citekey} % Use
\printbibliography % Print
```

KOMAoption bibliography (see B.1) generates entry for TOC.

G.5. External Processor

IDEs like TEXstudio include the external processor, select biber as bibliography tool for 'build' in preferences, otherwise run biber explicitly.

H. Math

H.1. Math mode (Standard LATEX)

Textstyle: `\(x^2 + 4\)` ⇝ $x^2 + 4$ as part of the text.
Displaystyle: `\[ x^2 + 4 \]` ⇝ separat line, centered
Equation: `\begin{equation}` ... `\end{equation}\label{name}`

$$\lambda := \lim_{x_1 \to \infty} \int_{x_0}^{x_1} \frac{f\left(\frac{t}{2}\right)}{\sqrt[n]{t^2 + \sin^2(t)}}\, dt \overset{!}{\le} 1 \qquad (1)$$

➡ Use ∗ variant for unnumbered equation (without label).
➡ Package option for equation position: fleqn fixed indent from the left margin instead of centered.
➡ Options for positions of equation number: leqno or reqno.

H.2. Important Symbols in Math

+	+	−	-	±	\pm	∓	\mp
<	<	≤	\le	≪	\ll	·	\cdot
>	>	≥	\ge	≫	\gg	×	\times
=	=	≠	\ne	≡	\equiv	≈	\approx
|	|	⊥	\perp	|	\mid	‖	\parallel
f′	f'	∇	\nabla	Δ	\Delta	∂	\partial
∈	\in	∀	\forall	∃	\exists	∄	\nexists
∩	\cap	∪	\cup	∉	\notin	∖	\setminus
ℓ	\ell	∠	\angle	○	\circ	∅	\emptyset
∨	\lor	∧	\land	¬	\lnot	∅	\varnothing
⊤	\top	⊥	\bot	∞	\infty	∝	\propto

H.3. Math Functions (upright typeface)

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

For other functions use (package amsmath): `\operatorname{name}`, e.g. `\operatorname{arcsinh}` (see also J.2).

H.4. More Math Functions

∑	\sum	∏	\prod	∐	\coprod
∫	\int	∬	\iint	∭	\iiint	∮	\oint
$\vec a$	\vec{a}	$\dot a$	\dot{a}	$\ddot a$	\ddot{a}	$\hat a$	\hat{a}

H.5. Fonts and Sizes in Math Mode (some from AMSMath)

`\mathrm{}, \mathit{}, \mathbf{}, \mathsf{}, \mathtt{}, \boldmath{}`
`\mathbb{}` e.g. $\mathbb{AZ}$, `\mathcal{}` e.g. $\mathcal{AZ}$, `\mathfrak{}` e.g. $\mathfrak{AZ}$
`\displaystyle, \scriptstyle, \scriptscriptstyle, \textstyle`
`\boldsymbol{}`

H.6. Often used Math Expressions

x^{n+1}	x^{n+1}	
$\frac{a+b}{2}$	\frac{a+b}{2}	
$x_1,\ldots,x_n$	x_1, \ldots, x_n	
E_{kin}	E_{\mathrm{kin}}	
$\sqrt[n]{a^2+b^2}$	\sqrt[n]{a^2+b^2}	
$x_1 + \cdots + x_n$	x_1 + \cdots + x_n	

$\left(a + \frac{1}{2} \right)^2$ — `\left( a + \frac{1}{2} \right)^2`

$\sum_{i=1}^{N}$ — `\sum_{i=1}^{N}` $\prod_{i=1}^{N}$ — `\prod_{i=1}^{N}`

$\lim_{a \to \infty}$ — `\lim_{a \rightarrow \infty}`

$\int_a^b x^2\, dx$ — `\int_a^b x^2\; \mathrm{d}x`

$\left. \frac{\mathrm{d}f}{\mathrm{d}x} \right|_{x_0}$ — `\left. \frac{\mathrm{d}f}{\mathrm{d}x} \right|_{x_0}`

$\vec{F}_{\perp}$ $\vec{F}_{\parallel}$ — `\myvec{F}_{\perp}^1   \myvec{F}_{\parallel}^1`

$\vec{a}^{\top}$ $A^{\dagger}$ A^* — `\myvec{a}^{\top}^1   A^{\dagger}   \boldmath{A}^{*}`

$\overset{!}{<}$ $\underset{def}{=}$ — `\stackrel{!}{<}   \stackrel{\mathrm{def}}{=}`

$\overset{above}{mid}$ $\underset{below}{mid}$ — `\overset{above}{mid}   \underset{below}{mid}`

[1] `\newcommand{\myvec}[1]{\ensuremath{\underline{\boldsymbol{#1}}}}`

H.7. Math with amsmath (replacing standard Environments)

equation	equation*	One line, one equation
multline	multline*	One unaligned multiple-line equation, one number
gather	gather*	Several equations without alignment
align	align*	Several equations with multiple alignments
alignat	alignat*	Multiple alignments, choose spacing between cols
flalign	flalign*	Several equations: horizontally spread form of align
cases		Alignment for cases
split		A simple alignment within a multiple-line equation
aligned		A "mini-page" with multiple alignments
gathered		A "mini-page" with unaligned equations

➡ The content is automatically placed in math mode.
➡ Use `\intertext{text}` to set text within an amsmath environment
➡ Length parameter to influence vertical spacing within any amsmath environment: `\jot` (e.g. `\addtolength{\jot}{1ex}`)
➡ Add singular vertical space for a line via `\\[<amount>]` (see A.1)
➡ Use the spreadlines environment from the mathtools package
➡ Length parameters (with standard values) to influence vertical white space around displayed math formulas: `\abovedisplayskip=12pt`, `\belowdisplayskip=12pt`, `\abovedisplayshortskip=0pt`, `\belowdisplayshortskip=7pt`

H.7.1. AMSMath align

```
\begin{align}
y &= d\\
y &= cx+d\nonumber\\
y &= bx^{2}+cx+d \label{eq:key}
\end{align}
```

$$y = d \qquad (1)$$
$$y = cx + d$$
$$y = bx^2 + cx + d \qquad (2)$$

```
\begin{align*}
y     &= d     & z &= 1\\
y(x)  &= cx+d  & z &= x+1\\
y_{12} &= bx^2+cx & z &= x^2+x+1
\end{align*}
```

$$y = d \qquad z = 1$$
$$y(x) = cx + d \qquad z = x + 1$$
$$y_{12} = bx^2 + cx \qquad z = x^2 + x + 1$$

H.7.2. AMSMath alignat

```
\begin{alignat}{3} % 2x3-1 '&' are neccessary
i_{11} &=0.25    & i_{12} &=i_{21}    & i_{13} &=i_{23}\\
i_{21} &=\frac{1}{3}i_{11} & i_{22} &=0.5i_{12} & i_{23} &=i_{31}\\
i_{31} &=0.33i_{22} \quad  & i_{32} &=0.15i_{32} \quad
                   & i_{33} &=i_{11}
\end{alignat}
```

$$i_{11} = 0.25 \qquad i_{12} = i_{21} \qquad i_{13} = i_{23} \qquad (1)$$
$$i_{21} = \frac{1}{3}i_{11} \qquad i_{22} = 0.5i_{12} \qquad i_{23} = i_{31} \qquad (2)$$
$$i_{31} = 0.33i_{22} \qquad i_{32} = 0.15i_{32} \qquad i_{33} = i_{11} \qquad (3)$$

H.7.3. AMSMath flalign

```
\begin{flalign*}
i_{11} & = 0.25    & i_{12} & =i_{21}    & i_{13} & =i_{23}\\
i_{21} & =\frac{1}{3}i_{11} & i_{22} & =0.5i_{12}
& i_{23} & =i_{31}\cdot\sqrt{5}\\
i_{31} & =0.33i_{22} & i_{32} & =0.15i_{32} & i_{33} & =i_{11}
\end{flalign*}
```

$$i_{11} = 0.25 \qquad i_{12} = i_{21} \qquad i_{13} = i_{23} \qquad (1)$$
$$i_{21} = \frac{1}{3}i_{11} \qquad i_{22} = 0.5i_{12} \qquad i_{23} = i_{31}\cdot\sqrt{5} \quad (2)$$
$$i_{31} = 0.33i_{22} \qquad i_{32} = 0.15i_{32} \qquad i_{33} = i_{11} \qquad (3)$$

H.7.4. AMSMath gather

```
\begin{gather}
D(a,r) \equiv \{z \in \mathbf{C} \colon |z-a| < r \}   \notag\\
\operatorname{seg} (a,r) \equiv \{ z \in \mathbf{C}
\colon \Im z < \Im a, \ |z-a| < r \}\\
C (E, \theta, r) \equiv \bigcup_{e\in E} c (e, \theta, r)
\end{gather}
```

$$D(a,r) \equiv \{z \in \mathbb{C} : |z - a| < r\}$$
$$\operatorname{seg}(a,r) \equiv \{z \in \mathbb{C} : \Im z < \Im a, \ |z - a| < r\} \qquad (1)$$
$$C(E,\theta,r) \equiv \bigcup_{e \in E} c(e,\theta,r) \qquad (2)$$

H.7.5. AMSMath matrix

```
\begin{matrix}   a & b \\ c & d \end{matrix}
\begin{pmatrix} a & b \\ c & d \end{pmatrix}
\begin{bmatrix} a & b \\ c & d \end{bmatrix}
\begin{Bmatrix} a & b \\ c & d \end{Bmatrix}
\begin{vmatrix} a & b \\ c & d \end{vmatrix}
\begin{Vmatrix} a & b \\ c & d \end{Vmatrix}
```

$$\begin{matrix} a & b \\ c & d \end{matrix} \quad \begin{pmatrix} a & b \\ c & d \end{pmatrix} \quad \begin{bmatrix} a & b \\ c & d \end{bmatrix} \quad \begin{Bmatrix} a & b \\ c & d \end{Bmatrix} \quad \begin{vmatrix} a & b \\ c & d \end{vmatrix} \quad \begin{Vmatrix} a & b \\ c & d \end{Vmatrix}$$

Dots: `\dots` or `\ldots` lower dots, `\cdots` vertically centered dots, `\vdots` vertical dots, `\ddots` diagonal dots, `\hdotsfor[cols]{dotspace}` multicolumn dots.

H.8. AMSMath cases

```
\[ f(n) = \begin{cases}   n/2 & \quad \text{if $n$ is even}\\
  -(n+1)/2  & \quad \text{if $n$ is odd}\\   \end{cases}  \]
```

$$f(n) = \begin{cases} n/2 & \text{if } n \text{ is even} \\ -(n+1)/2 & \text{if } n \text{ is odd} \end{cases}$$

H.9. Arrows

↦	\mapsto	⇝	\leadsto
→	\rightarrow	⇒	\Rightarrow
⟶	\longrightarrow	⟹	\Longrightarrow
←	\leftarrow	⇐	\Leftarrow
⟵	\longleftarrow	⟸	\Longleftarrow
↑	\uparrow	⇑	\Uparrow
↓	\downarrow	⇓	\Downarrow
⟵	\leftarrow	⟸	\Leftarrow
⇇	\leftleftarrows	⇉	\rightrightarrows
⇆	\leftrightarrows	⇄	\rightleftarrows
⇋	\leftrightharpoons	⇌	\rightleftharpoons

H.10. Delimiters

(.)	(.)	[.]	[.]	⌊.⌋	\lfloor.\rfloor
|.|	|.|	{.}	\{.\}	⌈.⌉	\lceil.\rceil
‖.‖	\\|.\\|	|.|	\vert.\vert	⟨.⟩	\langle.\rangle

➡ Use \left *expr* \right to stretch delimiters to the height of *expr*
➡ A missing delimiter can be added with ., e.g. \left.
➡ For manual sizing use \big, \Big, \bigg, e.g. \Big\| \Big\lceil

H.11. Physical Units with `siunitx`

Load: \usepackage[sticky-per=true, per-mode=reciprocal]{siunitx}
Options: \sisetup{output-decimal-marker={,}, per-mode=symbol}
Use: \num{*number*}, \si{*unit*}, \SI{*number*}{*unit*}, \ang{*deg;min;sec*}

$7\,123\,456.7 \times 10^1$	\num{7123456.7e1}
$4°32'10''$	\ang{4;32;10}
$[g] = \mathrm{m\,s^{-2}}$	[g] = \si{\meter\per\second\squared}
$E = 1.3\,\frac{kV}{mm}$	E = \SI{1.3}{\kilo\volt\per\milli\meter}

SI units like \degreeCelsius, \henry; prefixes like \kilo, \exa.

I. Typographic Issues

I.1. Hyphen and Dashes (for Minus see H.2)

Name	Source	Example	Use
hyphen	-	X-ray, in- and output	Connecting words
en-dash	--	1–5, Paris–Rome	Range or Toward
en-dash	--	Paris − except Rome	European dash
em-dash	---	Paris—except Rome	American dash

I.2. Quotation Marks with `csquotes`

Load: \usepackage[autostyle=true]{csquotes}
Use: \enquote{*text*} and \foreignquote{*language*}{*text*}
available are all languages loaded with babel, nesting is possible;
* variants provide inner nesting style.
Exmp: "Some 'english'." / „Ein Deutscher Text" / « parler français »

I.3. Font Combinations

Rule: Use serif fonts for long body text and sans-serif for headings.
Hint: Load fonts with combined math fonts.
Example packages: mathptmx (Times), mathpazzo (Palatino), mathpple
(Palatino text, Euler math), mathtime (Times text, Belleek math).
Hint: Add \KOMAoptions{DIV=last} after loading a font package.

I.4. Numbers and Dates

Numbers	Style	Use
old-style	1234567890	text, dates
lining	1234567890	math

British	American	European
27/06/17	06/27/17	27.6.2017
27 June, 2017	June 27, 2017	27. Juni 2017

International notation (ISO 8601): yyyy-mm-dd: 2017-06-27

I.5. Spacing horizontally

Avoid spacing with fixed units like \hspace{0.5cm} use \quad or \qquad
instead (see also A.1). **Spacing in math is almost always right!**

Math		Math/Text		Math/Text		Math/Text	
a b	ab	a\\!b	ab	a\\;b	$a\,b$	a\quad b	$a \quad b$
a\\>b	$a\,b$	a\\,b	$a\,b$	a\\ b	$a\ b$	a\qquad b	$a \qquad b$

\hspace{*length*}; * variant \hspace*{*length*} space even at line start
Use with care: \hphantom{*text*}

I.6. Spacing vertically

➡ Vertical space is only effective between paragraphs (see E.1).
➡ Avoid spacing with fixed units like \vspace{0.5cm} use rubber length
like \smallskip, \medskip or \bigskip instead (see also A.1)
➡ \vspace{*length*}; * variant \vspace*{*length*} space even at page start
➡ \\[*unit*] (see A.1)
➡ Use with care: \vphantom{*text*}

I.7. Preventing Breaks

➡ Protected space between words: ~
➡ Prevent line breaking within text: \mbox{text}
➡ Prevent page breaks: \nopagebreak[*num*], *num* between 1 and 4
➡ Cheat a bit on page size: \enlargethispage{*unit*} (see A.1)

I.8. Penalties

Penalties are the main values that TeX tries to minimise when line or
page breaks are calculated.

\linepenalty=10	page break within a paragraph
\hyphenpenalty=50	line break at an automatic hyphen
\binoppenalty=700	line break at a binary operator
\relpenalty=500	line break at a relation
\clubpenalty=150	page break after first line of paragraph
\widowpenalty=150	page break before last line of paragraph
\brokenpenalty=100	page break after a hyphenated line
\tolerance=200	acceptable badness of lines after hyphenation

I.9. Page Layout

① 1in + \hoffset ② 1in + \voffset ③ \oddsidemargin
④ \topmargin ⑤ \headheight ⑥ \headsep
⑦ \textheight ⑧ \textwidth ⑨ \marginparwidth
⑩ \marginparwidth ⑪ \footskip
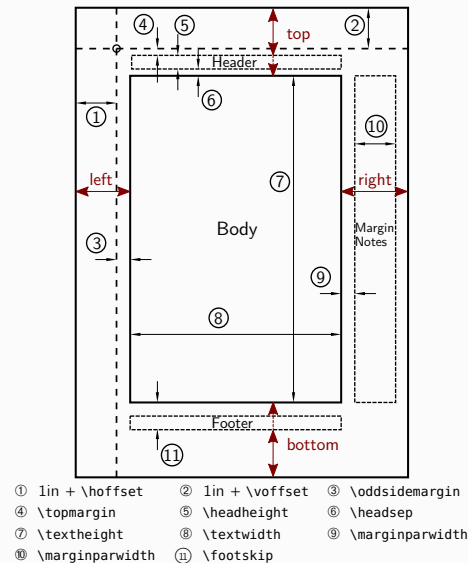
Hint: This image with the current values of the specific document can be
generated by loading the package `layout` and the command \layout.

J. Own Commands and Environments

J.1. Own Commands in General

➡ \newcommand doesn't work if the command is already defined: so it's a
completely new definition.
➡ \renewcommand works only if the command is already defined: it's a
redefinition.
➡ \providecommand works like \newcommand, but if the command is
already defined, the (re)definition is ignored.
➡ \AtBeginDocument{*commands*} can be helpful.

J.2. Own Commands

Define:	\newcommand{*cmdname*}{*commands*}
Exmp:	\newcommand{\mytext}{Some text which I need very often.}
Exmp:	\newcommand{\diff}{\mathop{}\\!\mathrm{\vphantom{ d}}
Params:	#1 ... #9
Define:	\newcommand[*paramsquantity*]{*cmdname*}{cmds #1 ...}
Redefine:	\renewcommand[*paramsquantity*]{*cmdname*}{*commands*}
Copy:	with letltxmacro: \LetLtxMacro{*cmdcpyname*}{*cmdname*}
Define:	\DeclareMathOperator{*name*}{*commands*}
Exmp:	\DeclareMathOperator{\dirac}{\ensuremath{\delta}}
Exmp:	\DeclareMathOperator{\acrsinh}{arcsinh}

J.3. Own Environments

Define:	\newenvironment{*envname*}{*cmds begin*}{*cmds end*}
Params:	#1 ... #9
Define:	\newenvironment{*envname*}[*paramsquantity*]{*cmds begin #1* ...}{*cmds end #2* ...}
Exmp:	\newenvironment{colorpar}[1]{\color{#1}}{\normalcolor}
Use:	\begin{colorpar}{violet} *text* \end{colorpar}

J.4. Some important Variables

Counters: page, section, figure, equation; to get the formatted content
of a counter add \the, e.g. \thepage
Lengths: \textwidth, \linewidth, \columnwidth, \parindent, \parskip
Change: \setlength, \addtolength

J.5. Helpfull other Commands for defining own Commands

➡ \ensuremath, e.g. $\tx=...$ defines \tx. by
\newcommand{\tx}{\ensuremath{\tilde{x}}}
➡ Look for \Declare... in package documentations.
➡ Packages: etoolbox, xparse, xkeyval, calc; see also tocbasic.

K. Useful Weblinks and Summary of Packages

For all packages a documentation can be found with:
texdoc *package name* (or in the Help menu in IDEs)
The documentation for KOMA-Script can be found with
texdoc scguien or texdoc scrguide (German)

acro	Acronyms, Glossary
amsmath,amssymb	Math extended, Math symbols extended
babel	Language depend issues
biblatex	Bibliography
booktabs	Rules in tabular
csquotes	Quotations esp. in bibliography
enumitem	Lists extended
float	Suppress floating, needs scrhack
fontenc,inputenc	Font encoding, input encoding
geometry	Page layout, e.g. size
graphicx	Graphics
hyperref	Hyperlinks
listings	Source code listings, needs scrhack sometimes
longtable	Tables longer than a page
microtype	Optical margin alignment
multicols	Multiple columns extended
pdfpages	Including PDF pages
scrlayer-scrpage	Page layout, e.g. headings, watermarking
setspace	Control line spread, needs scrhack sometimes
scrhack	Avoid warnings from float, listings, setspace
subcaption	Multiple figures with multiple captions
textcomp	Text symbols extended
tabularx | tabulary	Tabular extended
upgreek	Upright greek symbols
wrapfig | floatflt	Graphic surrounded by text
xcolor	Color

L. A Sample Document (output on next page)

```
% thesis.tex
\documentclass[fontsize=12pt,paper=a4,open=any,parskip=half,
twoside=false,toc=listof,toc=bibliography,fleqn,leqno,
captions=nooneline,captions=tableabove,british]{scrbook}
\usepackage[utf8]{inputenc} % load early
\usepackage[T1]{fontenc}    % load early
\usepackage[ngerman,main=british]{babel}
\usepackage[autostyle=true]{csquotes}
\usepackage{graphicx, booktabs, float, scrhack}
\usepackage{amsmath, amssymb}
\usepackage{scrlayer-scrpage}
\usepackage[backend=biber,style=verbose,sortcase=false,
language=british]{biblatex}
\addbibresource{thesis.bib}
\PassOptionsToPackage{hyphens}{url}
\usepackage{hidelinks}{hyperref} % load late
\setkomafont{disposition}{\sffamily\color{gray!70}}
\begin{document}
\frontmatter % only if you need page numbering roman
\titlehead{\hfill\includegraphics[width=2cm]{logo}}
\title{My Title} \subtitle{My Subtitle} \author{N.\,N.} \date{}
\maketitle
\tableofcontents \listoffigures \listoftables

\mainmatter % page numbering arabic, starting by 1 again
\chapter[Intro]{Introduction}\label{sec:intro}
\section{Technical introduction}\label{sec:tecintro}
\subsection*{Heading without number}
Some text in \textbf{bold}, some more text.
Some text in \emph{emph}, more text.
And now some text in German language
\foreignlanguage{ngerman}{Hier kommt eine Formel:} \(2+2=5\)

A new paragraph, viz. a new idea, a new thought.

\subsection{Heading lower level}\label{sec:headingLL}
More text \emph{emphasized} text.\autocite{WC:2017}
\begin{table}[htp]
\caption{Table caption}\label{tab:table}
  \begin{tabular}{l@{\qquad}cr} \toprule
    Head    & Head & Head \\ \midrule
    Data    & first  & Row \\
    Data    & second & Row \\ \bottomrule
  \end{tabular}
\end{table}

\chapter{Method}\label{sec:ana}
Some text, see \autoref{tab:table} for aligned material.

L'Hôpital's rule:
\begin{equation}
\lim_{x\to 0}{\frac{e^x-1}{2x}}
\overset{\left[\frac{0}{0}\right]}{\underset{\mathrm{H}}{=}}
\lim_{x\to 0}{\frac{e^x}{2}}={\frac{1}{2}}
\end{equation}\label{eq:lhopital}
\newpage
More text. A \enquote*{quote} and a \foreignquote{ngerman}{Zitat}.

\appendix % headings numbered with letters
\chapter{Appendix}\label{sec:app}
\begin{figure}[H]
\KOMAoptions{captions=centeredbeside}
\begin{captionbeside}%
[Example of a caption centeredbeside]%
{Example of a caption beside the figure}
[o]    % position left/right/inner/outer
[\linewidth]  % width of figure+caption
[0.0in]       % offset from left side
\framebox[\begin{minipage}[t][3cm][c]{0.5\textwidth}
  {\begin{center} A BOX\end{center}}\end{minipage}}
\end{captionbeside}\label{fig:cbeside}\end{figure}
\printbibliography
\end{document}
```

```
# thesis.bib
@misc{ WC:2017,
    author = {Wikipedia},
    title = {{TeX}---Wikipedia{,} The Free Encyclopedia},
    note = {\url{https://en.wikipedia.org/wiki/TeX},
    last referenced 24-June-2017}
}
```

My Title

My Subtitle

N. N.

Contents

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List of Figures

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List of Tables

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1. Introduction

1.1. Technical introduction

Heading without number

Some text in **bold**, some more text. Some text in *emph*, more text. And now some text in German language Hier kommt eine Formel: $2 + 2 = 5$

A new paragraph, viz. a new idea, a new thought.

1.1.1. Heading lower level

More text *emphasized* text.[1]

Table 1.1.: Table caption

Head	Head	Head
Data	first	Row
Data	second	Row

---
[1] Wikipedia. *TeX—Wikipedia, The Free Encyclopedia*. https://en.wikipedia.org/wiki/TeX, last referenced 24-June-2017.

1

2. Method

Some text, see Table 1.1 for aligned material.

L'Hôpital's rule:

$$(2.1) \quad \lim_{x\to0}\frac{e^x-1}{2x} \overset{[\frac{0}{0}]}{=} \lim_{x\to0}\frac{e^x}{2} = \frac{1}{2}$$

2

More text. A "quote" and a „Zitat".

3

A. Appendix

A BOX

Figure A.1.: Example of a caption beside the figure

4

Bibliography

Wikipedia. *TeX—Wikipedia, The Free Encyclopedia*. https://en.wikipedia.org/wiki/TeX, last referenced 24-June-2017.

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