

SWEDISH BRAILLE

Braille writing rules

for mathematics
and natural sciences

Second edition

The following titles have been published in the Swedish Braille series:

Phonetics and Braille, by Lillemor Andersson and Catharina Johansson (2005)
Shorthand. Level 1 and 2 (1997)
Shorthand. Level 3 and 4, for notes (1997)
Louis Braille – Creator of a Writing System, by Beatrice Christensen Sköld (Second Edition, 2011)
Braille and its use (second edition, 2010)
Braille Terms (2001)
Editing and Deregistration (1999)
Braille writing rules for mathematics and science (second edition, 2012)
Swedish writing rules for braille (second edition, 2009)
Tactile maps – Guidelines for the production of maps for the visually impaired (2003),
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Previous release:

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Preface to the second edition

Braille's writing rules for mathematics and science are a collection of rules and recommendations for how to write mathematics and other science subjects in Swedish braille.

This second revised edition has been produced by Ulf Aldener, Lillemor Andersson, Stig Becker, Fredrik Larsson, Björn Nyqvist, Anders Sennerö and Björn Westling. The previous edition was published in 1997.

In the new edition, among other things, a new sign for mathematical characters $\ddot{\text{I}}$ (p12456) has been introduced. A list of character-level changes made can be found towards the end of the book.

Changes have been made to make it easier to use math braille. The appearance of the mathematical characters in Braille has been chosen to be easier to remember than before. It is further recommended that greater attention should be given to the layout of the mathematical braille, including that blanks can be used to create better readability in a sequence of characters and that each equation in a system of equations should be written on a new line.

A basic prerequisite for the design of the mathematical braille is to obtain as much agreement with writing rules for other braille as possible. This has in principle been fully successful and can serve as a model for the construction of corresponding writing rules for braille in other countries.

That, for example, $3 \times 4 \text{ m}^2$ is written in the same way in braille in a novel as in a scientific article, we think it is very important for the braille to be readable and accessible.

Johanneshov, August 2012

Björn Westling
Secretary in the Punctskriftsnämnden

Introduction

About this book

Braille's writing rules for mathematics and science are a compilation of rules with associated examples for braille in mathematics and science.

The writing consists of two parts. In nine chapters in the first part, writing rules and different groups of signs and symbols are presented. In the second part, examples are given sorted into four chapters for different areas or subjects.

The writing rules for mathematics and science are based on and are an extension of the writing rules described in *Swedish writing rules for braille*.

The braille writing rules for mathematics and science cover the need for braille characters up to and including high school and in many cases also the university level. Guided by how the braille characters are designed, it is possible to create additional braille characters if necessary in order to fully cover the need for university literature.

Black-print books often have a layout that gives the eye a quick overview of rather complicated connections. Such a layout can be difficult to reproduce in braille and can sometimes be more of a hindrance than a help to the braille reader.

Typical ways of writing in black that are difficult to imitate exactly in braille are, for example, layouts where arrows show a criss-cross flow, the "staircase" that illustrates division calculations, and atomic and molecular structures in chemistry. Such black-letter illustrations should be commented on and can also be supplemented with relief images.

The examples in *the Point script's writing rules for mathematics and science* are essentially authentic and have been chosen to illustrate phenomena that are not always clear from the text. Note that in some cases the examples introduce writing styles and characters that are not covered until later in the book.

Spaces in mathematical braille

In most cases, blanks do not have any meaningful function in mathematical Braille, but can be used to create better readability for longer sequences of characters. In some cases, braille characters must be surrounded by blanks to avoid misunderstandings.

Arithmetic operators

Arithmetic operators (chapter 5) can be written with or without blanks on both sides, as in black writing.

Pillar

Braille characters for various arrows are presented in sections 8.4 and 8.5.

The representations that ordinary arrows (section 8.4) have in braille are meant to graphically mimic the appearance of characters in black. This principle does not apply to most other signs. All Braille characters representing regular arrows must be surrounded by blanks.

Other arrows (section 8.5) are represented in Braille by writing the meaning of the sign in parentheses – in an abbreviated form.

Track

Dashes are presented in section 8.3. Two single plumb lines next to each other should be separated by blanks so as not to be misinterpreted as a double plumb line.

Comparison operators

Comparison operators are presented in section 9.1. It is often convenient and sometimes necessary to let these braille characters be surrounded by blanks.

Theory of quantities and logic

The signs and symbols used in set theory and logic are presented in section 9.2. Even for them, it is often appropriate to surround the corresponding Braille characters with blanks.

From 1

CHARACTERS AND WRITING RULES FOR MATHEMATICS AND NATURAL SCIENCES

1 Special braille characters

1.1 Signs

Signs give the next closest Braille character or characters a special meaning.

The meaning of the sign is nullified by blanks, closing and separating characters or other signs unless otherwise mentioned.

—	Uppercase letter sign. See section 2.1.
—	Signs for multiple uppercase letters in a row. See section 2.1.
—	Sign of multiple consecutive capitalized words. See section 2.1.
"	Sign of a Greek lowercase letter. See section 2.2.
" —	Sign of a Greek capital letter. See section 2.2.
@	Sign for single accented character. See section 2.3. Also signs for plus minus and minus plus.
^	Sign for crossed out character, often with the meaning not/not. See section 2.4.
#	Signs for numbers. See section 3.1.
§	Sign of exponent or superscript. See sections 4.2 and 7.1.
eh	Subscript sign. See section 7.1.

§§	Centered superscript sign. See section 7.1.
will	Centered subscript sign. See section 7.1.
ï	Signs of several mathematical signs. See chapter 9.
~	Signs for some characters which, among other things, occur in a computer context, for example proboscis-a, @. See section 9.6. The sign is also used as a warning sign, see section 1.3.2.

1.2 Blank corners

Blanks and line breaks cancel the meaning of the immediately preceding character unless otherwise stated. When spaces are part of a number sequence, the number character is repeated. In sequences of numbers grouped with blanks, you may not use . to return blanks.

See also the section "Blanks in mathematical Braille" in the introduction to this book.

1.3 Auxiliary characters

1.3.1 Termination and separation characters

The character $\hat{u}$ is used as a separator between a number and the lowercase letters a–j to avoid misinterpretation, see also *Swedish writing rules for braille*, section 5.5 Numbers and letters. Sometimes the character is also used between different lowercase letters to mark the change between straight and italic style. See section 2.3.

The character is also used as a termination character to end complex exponents, indices, root expressions, characters with dashes above them, and underscores that begin with the warning sign ~ . See chapter 7.

Ex. 1.1

4a 5b 7ab

#4ûa<<#5_b<<#7ûab<<<<<<<<<<<

If the number is followed by a capital letter, no separator is needed.

When quotation marks appear before an independent Latin letter in mathematical text, the quotation mark must be followed by $\hat{u}$ to avoid confusion with signs for Greek letters (applies to both lower and uppercase letters).

"and **Termination and delimiter characters after quotation marks, to avoid confusion with the signs for Greek letters.**

Ex. 1.2

He said: "p is about 3.3".

```
_he<said:<"ûp<is<about<<<<< #3,3".<<<<<<<<<<<<<<<<
```

Ex. 1.3

$\ddot{y}$ is approximately 3.14

"p<is<about<#3,14<<<<<<<<<<

When the letter o is combined with comparison operators that include the braille character o , spaces must be used to avoid confusion with the much greater than character. Alternatively, the separator character can be used. The same applies when the letter ö is combined with comparison operators that include the braille character ö - to avoid confusion with the sign for much less than. See also section 9.1.

Ex. 1.4

$$a \circ b > \ddot{y}$$

```
a<#0<0<#00<b<<<<<<<<<<<<<<<<<
```

1.3.2 Warning signs

The warning sign ~ precedes long expressions that need to be kept together. This can apply to complicated exponents, indices, characters with dashes above them, underscores or root expressions. Warning signs end with û.

See examples 7.6 and 7.10.

1.3.3 Continuation characters

If a line break must be made in braille in a sequence of characters that must not be split in black, the continuation character ¨ must be used. The line breaks that are then made in braille should not be interpreted as blanks, therefore, for example, a number character should not be repeated, see example 1.5 below.

Ex. 1.5

**y is approximately
equal to 3.14159265358979323846264338327950288**

`_Pi<is<approximately<equal<to<<<<<
#3,141592653589793238462643ii
38327950288<<<<<<<<<<<<<<<<<`

1.3.4 Auxiliary bracket

Text in a braille edition that is not in the corresponding black print edition must be marked in some way, for example with auxiliary brackets ~(<~).

To reproduce characters that have no representation in braille, you can print the meaning or the character name in parentheses. See section 1.4 and example 12.1.

1.3.5 Fraction adder

Fraction holder, which consists of the beginning of the fraction $\acute{e}$ (and the end of the fraction $\acute{e}$), must be written to make visible the beginning and end of a fraction - when it is required for the mathematical meaning to be conveyed correctly. See also chapter 6.

1.4 Characters that do not have a defined way of writing in braille

When you want to reproduce a character that has no representation in braille, you should write the meaning in plain text or alternatively an intuitive abbreviation in auxiliary brackets. Alternatively, a character can be given a temporary representation.

In this context, using Braille characters that graphically resemble a character in black is not recommended, such images are not always intuitive and can be difficult to interpret.

Ex. 1.6

In the following examples, the characters for female and male respectively have been reproduced in plain text in parentheses.

ÿ ~(hona~) hona

ÿ ~(hane~) hane

ÿ ~(so~)

in other words

ÿ ~(therefore<that~) because

Alternative writing in abbreviated

form: ÿ ~(aå~) ÿ ~(da~)

in other words

because

1.5 Rules for line breaks

The Braille lines should be split where it is natural, for example after plus signs, minus signs, multiplication signs, fractions or before or after comparison operators, for example equal signs.

Plus signs, minus signs, plus minus signs, minus plus signs, equal signs, multiplication signs and division signs should be repeated on the next line to facilitate readability. See examples 6.12 and 6.15. These lines should be written with two spaces indented compared to the first line, also to facilitate readability.

Characters that in braille consist of several braille characters may not be split. Indexes, exponents, and root expressions should also not be shared.

If possible, you should avoid dividing an equation into two lines.

When an equation must be divided, as a rule, you should primarily try to get the left and right terms in each row; the division thus takes place at the equals sign. If such division is not possible or appropriate, the equation should be divided at, for example, the plus sign, the minus sign, or the multiplication sign. However, a number, a capital letter or a short expression should not stand alone in one line.

If possible, a bracketed content should not be shared. Short bracket contents, for example (A – B), must not be shared.

If the line break in braille must take place where the black script is not allowed to change lines, where there is no operator, the continuation character ¶ must be placed at the end of the braille line. In these cases, no indent should be made on the following line either.

Ex. 1.7

$$(ab)^6 = ababababababababab \neq (a+b)(a+b)(a+b)(a+b)(a+b)(a+b)$$

(a\$b)§#6=(a\$b)(a\$b)(a\$b)ïï<< (a\$b)(a\$b)(a\$b)<<<<<<<<<<<<

2 Letters

2.1 Latin letters

Lowercase Latin letters are written without signs. Capital is written with _ before the letter. Multiple capital letters in a row are written with _ before each letter or with __ before the first letter. Uppercase characters are canceled by spaces or other non-letter characters.

Several consecutive capitalized words can be written with ____ before the first capital and the closing character ũ after the last.

To mark lowercase in a long sequence of capitals, either a capitalization can be repeated before the last capital (see example 2.2) or a closing character can be used after the last capital.

Ex. 2.1

kWh

[illegible]

Ex. 2.2

ABCDEFGHIjklm

ABCDEFGH Ijklm<<<<<<<<<<<

Ex. 2.3

$$E[X + Y] = E[X] + E[Y]$$

Eà $X < \$ < Y \leq <$ Eà $X \leq \$ <$ Eà $Y \leq$

2.2 Greek letters

Lowercase Greek letters are written with " before the letter and capital letters with "_" before the letter. The sign only applies to the closest following letter.

Lower case**Capital letters**

a "a

A "_a

alfa

b "b "g

B "_b C "_g

beta

c

gamma

ÿ "d "e

ÿ "_d

delta

e

E "_e

epsilon

z "z "j ÿ "h

Z "_z

zeta

the

ÿ "_j ÿ "_h

and**aunt**

i "i

I "_i K "_k

whom

k "k

kappa

l "l "m

L "_l M "_m

lambda

m

my

n "n

N "_n

the

ÿ "x "o

ÿ "_x xi

The

The "_o

omicron

Pi "p

P "_p P "_r

pi

r "r

ro

p "s

ÿ "_s **sigma** T "_t **tau**

t "t

u

ÿ "_u **ypsilon** ÿ "_f **fi**

ÿ "and "f

h "\

X "_\

spend

p "y

ÿ "_y ÿ "_w

psi

oh "w

omega

Ex. 2.4

$$xyy(x)h(y) \ddot{y} = + \ddot{y}$$

"_dX(Y)<=<y(x<\$<h)<-<y(x)<<<<

Ex. 2.5

1_{the}^t

#1,<"j(t)<<<<<<<<<<<<<<<<<<

Ex. 2.6

$$\omega_h = 2\pi f_h$$

"w<=<#2"p/_T<<<<<<<<<<<<<<

Ex. 2.7

$T_{(A)}^{\mu\nu} = \frac{1}{b} \quad \text{a You } T_b^{\gamma} +$

$$_T("au<\$<"bv)<=<"a_Tu<\$<"b_Tv$$

Ex. 2.8

$\ddot{y}$ = facial science ~~1~~ a

"f<=arctan<#1/a<<<<<<<<<<<<

Ex. 2.9

$$\ddot{y}(0) = \ddot{y}(\tau_0)$$

"f(#0)<=<"f(a)<=<#0<<<<<<<<<<

Ex. 2.10

$$r = \frac{a}{i}$$

```
r<=<"aü"h<<<<<<<<<<<<<<<<
```

Ex. 2.11

$\rho_{ff}(\gamma) = \rho_{sf}$

$$(|y\rangle\langle f|) \leq (|f\rangle\langle y|) \ll \ll \ll \ll \ll \ll \ll$$

2.3 Single highlighted characters

Single highlighted letters and other characters, bold or italic, are preceded by @. When the highlighted letter is uppercase, the order between the signs is as follows: @_. The highlighted character sign applies only to the closest Braille character.

When you want to show that words or paragraphs have a certain font, or in cases where it is important to show how a character is highlighted, the rules for marking different fonts must be used. See *Swedish writing rules for braille*, section 3.4.

Note that italic letters as designations for variables are not normally marked in Braille. If there is a risk of misinterpretation of straight and italic style, separators $\hat{}$ or blanks can be used, see example 2.12.

Ex. 2.12

Determine h so that $\sin hx = \sinh x$

Comment on the example:

Notice that there are two functions in this example: $\sin = \text{sine}$
 $\sinh = \text{sine}$

hyperbolicus

Determine h so that $\sin hx \leq x \leq \sinh x$

Alternative writing in braille: separators instead of spaces.

Determine h so that $|\sin \hat{u} h x| \leq \epsilon$
 $\leq |\sinh \hat{u} x|$

Ex. 2.13

x

[illegible]

Ex. 2.14

$$At = \ddot{y}g$$
[illegible]

Ex. 2.15

$$\ddot{y}_0 = 0$$

```
"l@#0<=<@#0<<<<<<<<<<<<<<<<<
```

Ex. 2.16

$$AX = 0$$
[illegible]

2.4 Strikethrough characters

To mark strikethrough characters (characters with dashes on or through), ^ is used before the braille character.

Ex. 2.17

3/ (crossed out third)

$$^{\#3}(\text{crossed out} \prec \text{third}) \prec \prec \prec \prec \prec$$

Ex. 2.18

$\ddot{y}$ (not equal to, separate from)

$$\neq = (\text{not} \leq \text{with}, \text{different from})$$

Ex. 2.19

b/ (underlined b)

$$^b<(\text{strikeout}<\text{gement}<b)<<<<$$

Ex. 2.20

R/ (crossed out capital r)

$$^{\wedge}_{\text{R}} < (\text{strikeout} < \text{uppercase} < \text{r}) < <$$

Ex. 2.21

IV

[illegible]

For more examples of strikethrough characters, see sections 9.1 and 9.2.

3 Numbers

3.1 Arabic numerals

The meaning of the number character # is canceled by spaces or other braille characters with the exception of commas and periods.

Ex. 3.1

1 2 3 4 35 148

#1<<#2<<#3<<#4<<#35<<#148<<<<

3.1.1 Blanks in sequences of numbers

Blanks in sequences of numbers, for example thousands, are rendered with blanks in the same way as in black writing. This means repeating the number character after each blank character. Note that in black and braille you can separate numbers in a list from a sequence of numbers with extra spaces (extra blanks).

Ex. 3.2

18,305,116 is roughly 18 million.

#18<#305<#116<is<about<#18<
million.<<<<<<<<<<<<<<<<<<<

18,305,116 is an enumeration of three numbers.

#18<<#305<<#116<is<an<enumeration<of<three<numbers.<

3.1.2 Comma and full stop in number sequences

Commas and periods in sequences of numbers are reproduced in the same way as in black writing. The number character is not repeated after a comma or period. In English-language literature, the decimal point may come first.

Ex. 3.3

5,37

[illegible]

Ex. 3.4

3.1415926535...

#3.1415926535...<<<<<<<<<<<

Ex. 3.5

2, 4, 8, 16, ...

#2,<#4,<#8,<#16,<...<<<<<<<<<

Ex. 3.6

Semicolons are used here to clearly separate the x and y value.

(0.4; 2)

 $(\#0,4;\#2) \lll \lll \lll \lll \lll \lll \lll \lll \lll \lll \lll \lll \lll$

Ex. 3.7

$$\ddot{y}_{.5} = \ddot{y}_{0.5}$$

$-0.5 \leq -0.5 < -0.5 < -0.5 < -0.5 < -0.5 < -0.5 < -0.5 < -0.5 < -0.5$

3.2 Roman numerals

Roman numerals are treated as corresponding letters. This applies to both lowercase and uppercase letters.

Ex. 3.8

111

[illegible]

Ex. 3.9

1989 = MDCCCCLXXXVIII = MCMLXXXIX

```
#1989<=<__MDCCCCXXXVIII<=<<
<<=<__MCMLXXXIX<<<<<<<<<<<<<
```

Ex. 3.10

The preface covers pages i–xii.

_The preface<comprises<pages<<< i--
xii.<<<<<<<<<<<<<<<<<<

4 Quantities and units

4.1 Some special unit signs

Some units etc. are written in black script with special unit signs (not letters) and therefore also have a special representation in Braille: $\dot{\text{g}}$

o	straight corners
v	minutes, photo
y	second, tum
%	percent
ô %oô ôô	blood alcohol level

Ex. 4.1

$$0^{\circ}\text{C} = +32^{\circ}\text{F} = 273,15\text{K}$$

#0ig C<=<\$#32ig F<=<#273,15 K

Ex. 4.2

29° 15'

#29ig<#15'<<<<<<<<<<<<<<<<<<<

Ex. 4.3

6% of SEK 7.50 = 45 öre

#6<ô<of<#7.50<kr<=<#45<öre<<<

4.2 Other units

Slashes in units are written with /.

In measurements, spaces are usually used between the quantity and the unit in the same way as in black writing.

In units with an exponent, § is used immediately before the exponent. See also section 7.1.

Ex. 4.4

$$1 \text{ l} = 10 \text{ dl} = 100 \text{ cl} = 1000 \text{ ml}$$

```
#1<|<=<#10<d|<=<#100<c|<=<<<<  
<<=<#1000<m|<<<<<<<<<<<<<<
```

Ex. 4.5

$$4.5 \text{ m/s} = 4.5 \cdot 3600/1000 \text{ km/h} = 16.2 \text{ km/h}$$

[illegible]

Ex. 4.6

$$3.9 \text{ MW} = 3.9 \cdot 10^6 \text{ W}$$

#3,9<__MW<=#3,9<ï.<#10§#6<_W

Ex. 4.7

6 m

[illegible]

Ex. 4.8

50 dB

#50<d_B<<<<<<<<<<<<<<<<<<

Ex. 4.9

8 m²

#8<m§#2<<<<<<<<<<<<<<<<<<<

Ex. 4.10

13 kg/dm³

#13<kg/dm³#3<<<<<<<<<<<<<<<<<

5 Arithmetic operators

Arithmetic operators must be written as in black, that is, either with or without blanks on both sides. Regarding line breaks, see section 1.5.

$+$	$\$$	plustuck, additiontuck
$-$	$-$	to me
$\pm$	$@\$-$	plusminuschecking
$\tilde{y}$	$@-\$$	minus plus corners
$\cdot$	$\ddot{i}$	multiplication plug (point)
$\cdot$	$\dot{i}$	multiplication sign (dot in bold)
$\times$	$\ddot{x}$	multiplication sign (cross)
$*$	$*$	multiplication sign (asterisk)
$\ddot{y}$	$\ddot{u}$	division sign (horizontal fractional line)
$/$	$/$	division sign (slash)
$:$	$:$	skalecken (kolon, relationsticken)
$\ddot{y}$	$\sim$	functional composition

Ex. 5.1

 $5 \cdot 12 +$ [illegible]

Ex. 5.2

$$9,990,001 +$$

#9,99\$#0,001<<<<<<<<<<<<<<

Ex. 5.3

$$\frac{1}{2} \quad 1 \quad \frac{2}{+}$$

#1/#2<\$<#1/#2<<<<<<<<<<<<<<<<

Ex. 5.4

and $x = +5$

$y \leq \#5 < \$x < < < < < < < < < < < <$

Ex. 5.5

613 221 $\ddot{y}$

```
#613<-<#221<<<<<<<<<<<<<<<<
```

Ex. 5.6

10,1 3,05 $\ddot{y}$

#10,1-#3,05<<<<<<<<<<<<<<<<

Ex. 5.7

$$\begin{array}{r} 133 \\ 1 \overline{) 44} \end{array}$$

#3#1ü#4<-<#1#3ü#4<<<<<<<<<<<

Ex. 5.8

0,5 3,4 6 7,5 0,02

#0,5<\$<#3,4<\$<#6<-<#7,5<-<<<< <<-
<#0,02<<<<<<<<<<<<<<<<<<<

Ex. 5.9

$$a \pm 2 \pi i$$

"a@\$-#2"p<<<<<<<<<<<<<<<<<<

Ex. 5.10

15 · 13

#15<ï.<#13<<<<<<<<<<<<<<<<<<

Ex. 5.11

4.5 1.4 $\ddot{y}$

#4.5İ.#1.4<<<<<<<<<<<<<<<<<<

Ex. 5.12

$$2ab \cdot 2ab \cdot 2ab$$

#2ûab<ï.<#2ûab<ï.<#2ûab<<<<<

Ex. 5.13

$$r \nmid s \mid n^i =$$

@r<@i.<@n<=<@s<@i.<@n<<<<<<<<

Ex. 5.14

LET C=A*B

```
_LET< _C= _A*_B<<<<<<<<<<<<<<<<
```

Ex. 5.15

 24×36

#24<ïx<#36<<<<<<<<<<<<<<<<<<<

Ex. 5.16

$$\begin{array}{r} 231 \\ \hline 7 \end{array}$$
[illegible]

Ex. 5.17

$$\frac{0,64}{0,08}$$

#0,64ü#0,08<<<<<<<<<<<<<<<<

Ex. 5.18

0, 2 / 0,004

#0,2/#0,004<<<<<<<<<<<<<<<<

Ex. 5.19

The drawing was on a scale of 1:100.

```
_The drawing<was<in<scale<<<<<<  
#1:#100.<<<<<<<<<<<<<<<<<<
```

Ex. 5.20

The ratio between the sides of the triangle is 2:3:4.

The ratio between the sides of the angel is $2:3:4$.

6 Fraud

6.1 Numbers and variables in fractional form

/	/	slanted fractional line
-	U	horizontal dash
It is(		the beginning of the fraction (part of the fractional unit)
It is)		fraction ending (part of fractional unit)

Fraction connectors, the beginning of a fraction é (respectively the end of a fraction é), must be written to make the beginning and end of a fraction visible.

Fraction adders are needed to translate the two-dimensional writing style of fractions into the linear writing style of Braille and are used when the numerator and/or denominator contains more than one number, variable or constant. This also applies to fractions in connection with basic functions, of the type $\ln$, $\lg$, $\tan$, $\sin$ and $\cos$, as well as sum Σ and product Π (see examples 6.7 and 6.8).

Ex. 6.1

$$\frac{x}{2} = 9$$

xü#2<=<#9<<<<<<<<<<<<<<<<<

Ex. 6.2

$$\frac{5}{5} 1 =$$

#5/#5<=<#1<<<<<<<<<<<<<<<<<<<

Comment on the above two examples:

Note that the blanks are only there to increase readability.

Ex. 6.3

$$\begin{array}{r} 319413 \\ - + \equiv + \equiv - \\ 43121212 \end{array} \quad _ \quad _$$

#3#4<\$<#1#3=<<<<<<<<<<<
<<=<#9#12<\$<#4#12=<#13#12

Ex. 6.4

$$\begin{array}{r} x + 1 \\ \hline (x - 1) \end{array}$$

$(x\#1)\ddot{u}(x-\#1)<<<<<<<<<<<<<$

Ex. 6.5

$$\begin{array}{r} x + 1 \\ \hline x \quad 1 \end{array}$$

é(x\$#1üx-#1é)<<<<<<<<<<<<<

Ex. 6.6

$$^2 \frac{a \ a}{b \ b} \ ^2$$

$$\#2é(aübé) \leq é(\#2\hat{u}aübé) < < < < <$$

Commentary on the

example: Fraction summaries are used in both the left-hand and right-hand links to more clearly show the appearance of both fractions.

Ex. 6.7

$$\frac{\lg x}{10} = 0,1 \lg x$$

$$\text{is}(\lg \langle x \rangle \# a_j) \leq \#j, a \leq \lg \langle x \rangle \ll \ll \ll$$

Ex. 6.8

$$\lg \frac{x}{10} = y \lg 1$$

$$\lg(x \cdot 10^e) \leq \lg x + e$$

6.2 Fractions in mixed form

In mixed fractions, integers do not need to be separated by blanks, but the fractions can be written immediately after the integer. The number sign is repeated in both numerator and denominator.

Ex. 6.9

$$\frac{13532131211444442}{y= \frac{1}{1}}$$

#3#1#4<-<#1#3#4<=<<<<<<<<<<
 <<=<#2#5#4<-<#1#3#4<=<< <<<<
 <<=<#1#2#4<=<#1#1#2<<<<<<<<

Ex. 6.10

$$3\frac{1}{4} \div 1\frac{3}{4} = 2\frac{5}{4} \div 1\frac{3}{4} = 1\frac{2}{4} = 1\frac{1}{2}$$

In black writing, it is not a recommended way of writing to use slashes in fractions written in mixed form (whole numbers and fractions).

When it does occur, blanks are written in braille in the same way as black writing:

#3<#1/#4<-<#1<#3/#4<=<<<<<<<< <<=<#2<#5/
 #4<-<#1<#3/#4<=<<<< <<=<#1<#2/#4<=<#1<#1/
 #2<<<<<<

6.3 Complicated fractions

In black writing, it is easy to see what belongs to the numerator and denominator, for example by placing an equal sign in the middle of a main fractional line. What belongs to the numerator and denominator in Braille is not as easy to perceive, because it is written linearly, and must in many cases be marked with fractional conjunctions.

When the numerator and/or the denominator contains more than one number, variable or constant, the fraction must be surrounded by fraction separators. Fraction holders may also be needed in fractions with main fractional lines, see section 6.4.

A text-only fraction setup is treated in the same way as complicated fractions. (See example 6.14.)

Ex. 6.11

$$\frac{137}{2}$$

é(#13<ï.<#7ü#2é)<<<<<<<<<<<

Ex. 6.12

$$\frac{55 \text{ (18) } 2 \text{ (63)}}{(3) (7)}$$

é(#55\$(-#18)<i.<#2-(-#63)<ü<< <<ü<(-#3)-(-#7)é)<<<<<<< <<<<<

Ex. 6.13

$$\frac{n(n-1)\dots(n-k+1)}{k!}$$

$$e(n(n-1) \dots (n-k+1) k!) \ll$$

Ex. 6.14

$$W_{\text{eff}} = \frac{\text{Number of outcomes in } A}{\text{Total number of outcomes}}$$

$$P(A) = \frac{\text{Number of outcomes that come in } A}{\text{Total number of outcomes}}$$

Ex. 6.15

$$b_0 + \frac{a_1}{b_1 + \frac{a_2}{b_2 + \dots \frac{a_n}{b_n}}}$$

$$b\#0<\$<\acute{(a\#1\ddot{u}b\#1<\$<\acute{(a\#2\ddot{u} <<\ddot{u}b\#2<\$<...<\$<a\#n\ddot{u}b\#n\acute{e})\acute{e}<<$$

7 Exponents, roots and indices

7.1 Upper and lower indices

To show that a main character has a superscript, § is used.

To show that a main character has a subscript, ê is used.

Lower index is written before upper index. Indexes to the left of the main character are written before and indexes to the right of the main character are written after it. See examples 7.11–7.13.

Centered indices are written after the main character and before any right-aligned indices. Note that this is different from how diacritics are written. For letters with diacritical marks, see *Swedish writing rules for braille*, section 4.1.

Normally, you do not indicate in braille that indexes are right-aligned or centered, but sometimes you still need to mark that certain indexes are written directly above/below main characters. One such example is when both centered and right-aligned indexes occur in the same context. In these cases, the following index signs must be used (see also example 12.11 and example 12.16): êê directly below

(centered lower index)

§§ directly above (centered superscript)

An index begins with an index sign and ends after the next nearest number, constant, variable or symbol. For all other (longer) indexes, you start with the warning sign ~ before the index sign and end the index with û.

To avoid confusion when a main character with a right-aligned index is followed by a main character with a left-aligned index, blanks are used alternatively û as separators to separate them and facilitate interpretation. See example 7.31.

If an index is directly above or directly below several main characters, warning characters must be written before and termination characters after the main characters (see examples 7.21–7.23).

Here are some builds that use the above rules:

$\overline{\S\S}$ - dash (directly above the main character) $\sim \S\S$:

tilde (directly above the main character)

$\wedge \S\S!$ top value (ceiling) (directly above the main character) $\hat{=}$ -

$_$ dash (directly below the main character) $\grave{=}$

bottom value (tick) (directly below the main character)

$\grave{\grave{=}}$ double dash (directly below main character)

$\S\S:o$ vektorpil

--- $\S\S$ - vector

Example 7.24 below provides an overview of the applications of the rules for writing indexes.

Ex. 7.1

$$(2)^{\frac{5}{2}} = 15$$

$(\#2\S\#5)\S\#3<=<\#2\S\#15<<<<<<<<<<$

Ex. 7.2

$$x^2y^3\ddot{y}$$

$x\S\#2y<\grave{i}.<x\S\#3y\S\#2<<<<<<<<<<<<$

Ex. 7.3

$$f\ddot{y}^{(2\ 1)m}$$

$f\S(\#2m-\#1)<<<<<<<<<<<<<<<<<<<<<<$

Ex. 7.4

$$10\ddot{y}^{12}$$

$\#10\S-\#12<<<<<<<<<<<<<<<<<<<<<<$

Ex. 7.5

$$\text{With } n = \left(\frac{j n r e}{i} \right) = e^{n \ln r i}$$

zſn<=<(re~ſi"hu)ſn<=<<<<<<<<< <=<rſne~ſin"hu<<<<<<<<<
<<<

Ex. 7.6

It is $\frac{\pi}{2} + \frac{(\frac{\pi}{2})^2}{2} \ln 2$

$$e \sim \mathfrak{S} - ("p \ddot{u} \# 2 \$ \# 2 n" p) < \$ < i l n \# 2 \hat{u} < < <$$

Ex. 7.7

$2^{2^{ny-1}}$

#2§#2~§n-#1 and<<<<<<<<<<<<<

Ex. 7.8

$${}^a\log x + {}^a\log y = {}^a\log xy$$

$$\S \log \langle x \rangle \leq \S \log \langle y \rangle \leq \S \log \langle xy \rangle$$

Ex. 7.9

$$x^2/4aybz_{ce} \quad 2/4 \quad 2/4$$

e~\$-x\$#2/#4ûa-y\$#2/#4ûb-<<<< <-z\$#2/#4ûcû<<<<<<<<<<<
<

Ex. 7.10

$$x x x 1 2, \dots, m$$

$$x_{e\#1}, x_{e\#2}, \dots, x_{e\#m-1} \lll$$

Ex. 7.11

$${}_{92}^{238}\text{U}$$

ê#92§#238_U<<<<<<<<<<<<<<

Ex. 7.12

$$\text{SO}_4^{2-}$$

_SOê#4~§#2-and<<<<<<<<<<<<

Ex. 7.13

$${}^1_1\text{H}^+ \quad {}^1_1\text{H}$$

ê#1§#1_He#1§\$<<<<<<<<<<<<<

Ex. 7.14

$$\lim_{n \rightarrow \infty} a_n \text{ exists } \Leftrightarrow \lim_{n \rightarrow \infty} |a_n - a_m| = 0$$

lim-êên:o#éû<aên<existerar<<< <<ö=o<lim-êêm:o#éû<ïï<<<<<<<
<<-êên:o#éû<|aêm-aên |<=<#0<<<

Ex. 7.15

$$a^{\bar{y}b}$$

[illegible]

Ex. 7.16

$$\overline{ab}$$

[illegible]

Ex. 7.17

$y \bar{y}$

y§§:<=<y<<<<<<<<<<<<<<<<<<<

Ex. 7.18

$$V = V_{-}$$

this=<=<this-<<<<<<<<<<<<<

Comment on the example:

Note that $\hat{u}$ is used as a separator to separate the number 5 from the letter c (see also example 1.1).

Ex. 7.28

$$\sqrt{\frac{a}{2}} = \frac{\ddot{y} \sqrt{a}}{\ddot{y} \sqrt{2}}$$

$\sim \hat{1} \# 2 = \hat{(1 \# 2)} < < < < < < < < <$

Ex. 7.29

$$r = \frac{a}{4} \sqrt{\frac{50 \pm 5}{5}}$$

r<=<aü#4îé(#50\$#22î#5<ü<#5é)<

Comment on the example:

Note that the blanks are only here to increase readability.

Ex. 7.30

$$s_a = \sqrt{\ddot{y}_{bc}^2 + 1 + \ddot{y}_a^2 + \ddot{y}_b^2 + \ddot{y}_c^2}$$

$$s\hat{e}a\leq<\sim\hat{i}bc\grave{a}\#1<-<(a\ddot{u}b\$c)\S\#2\grave{u}\hat{u}<$$

Ex. 7.31

$$\sqrt[3]{27} = 3$$

§#3î#27<=<#3<<<<<<<<<<<<<<<

Ex. 7.32

$$\sqrt[n]{a} \sqrt[m]{a} = \sqrt[mn]{a^{mn + mn}}$$

$$\S n^{\hat{a}} \hat{\S} m^{\hat{a}} \leq \sim \S m n^{\hat{a}} \sim \S m \S n^{\hat{a}} \ll \ll$$

Comment on the example:

Note that $\hat{u}$ is used as a delimiter so that m is not interpreted as a superscript to a_i the first root expression.

8 Brackets, dashes and arrows

8.1 Parentheses

(	left parenthesis
)	right parenthesis
[	left square bracket
]	right square bracket
{	left brace, left curly brace
}	right brace, right curly brace
<	left angle bracket
>	right angle bracket
(~	left auxiliary parenthesis
~)	right auxiliary bracket

Ex. 8.1

$(a, b) \leq (c, d) \llllllllllllllllllllll$

Ex. 8.2

$s(s(s((0))) \llllllllllllllllllllll$

Ex. 8.3

$D = \frac{\ddot{y} \ddot{p} \ddot{y}^3}{\ddot{y} \ddot{y}^2 \ddot{y}} + \frac{q}{2}$

$_D \leq (p\ddot{u}\#3)\S\#3 < \$ < (q\ddot{u}\#2)\S\#2 < <$

Ex. 8.4

$$S = \{0, 1\}$$

_S<=<_à#0,<#1_ù<<<<<<<<<<<<

Ex. 8.5

$$[(4\ 4) \pm (4\ 3)] [4\ 4] = 4^+ \oplus 3^+ \oplus 1 \quad x =$$

à(#4x\$#4)<-(#4x\$#3)ù<=<<<<<< <=<à#4x\$#4-#4x-
#3ù<=<<<<<< <<< <=<#1<<<<<<<<<<<<<<<<<<<

Ex. 8.6

$$\langle a \rangle a = -$$

(a) $\leq \alpha$

8.2 Parentheses over multiple lines

Brackets covering several lines in black (single-sided and double-sided) in Braille consist of a parenthesis at the beginning and always end with û.

For example, a single-sided left parenthesis, which is used in equation systems, begins with $\ulcorner$ and ends with $\urcorner$. A single-sided right parenthesis begins with $\urcorner$ and ends with $\urcorner$.

Note that double-sided parentheses in Braille begin with both parentheses and end with $\hat{u}$ (even though the right parenthesis in Braille ends the expression and is on the right).

(		single-sided left parenthesis over several lines
i(and		
i)		one-sided right parenthesis over several lines
)		
and		

()	ï(i) and	double-sided parenthesis over several lines
[	ïà and	single-sided left square bracket across multiple lines
]	ïù û	single-sided right square bracket over multiple lines
[]	ïàïù and	double-sided square brackets over multiple lines
{	ï_à û	single-sided left brace (single-sided left angle bracket) across multiple lines
}	ï_ù and	single-sided right bracket (single-sided right angle bracket) over multiple lines
{ }	ï_àï_ù and	double-sided brace (double-sided brace) over multiple lines
⌈	ï_(and	single-sided left angle bracket across multiple lines
⌋	ï_) and	single-sided right angle bracket over multiple lines
⌈ ⌋	ï_(ï_) and	double-sided angle bracket over multiple lines

For all the above characters, they must be written alone on a line, the same applies to the associated closing character. The lines covered by a parenthesis over several lines must be indented by two characters compared to the line with the parenthesis.

Ex. 8.7

$$\ddot{x} + y = 3 \quad (1)$$

$$\ddot{y}_{2 \times 3 \times 8} \quad (2)$$

```
i_à<<<<<<<<<<<<<<<<<< (#1)<x<$<y<=#3<<<<<<<
<<<<<< (#2)<#2x<$<#3y<=#8<<<<<<<<< û<<<<<<<<<<<<
<<<<<<<<<<<<
```

Each new equation in a system of equations must be written on a new line. When an equation does not fit on a line in braille, the line is changed according to the rules for line breaks. See example 10.5.

Some differences between solving systems of equations in black and in braille: • In braille, the

numbers of the equations are written before the respective equation, in black they are usually written after.

- The equations in braille are written in the left margin on a new line, while other calculations and intermediate terms are written with two

spaces indented. • Before each system of equations, $i \rightarrow$ is written on a separate line.

The braille character means "left brace across multiple lines". •

After each

system of equations, the closing sign $\hat{u}$ is written on a separate line.

It indicates here that the scope of the left bracket, that is, the system of equations, is terminated.

Ex. 8.8

WE§ÿ

$$F_{N\#WbNm} = \ddot{y}$$

Sm 10

Comment on the example:

Note that here a setup similar to an equation system is used but with right brackets over several lines.

```
i_ù<<<<<<<<<<<<<<<<<<<<<
_W<=<_F<i.<s<<<<<<<<<<<< <<<<
_f<=<#0<_N<<<<<<<<<<<<<<< s<=<#10<m<<<<<<<<<<<
<<<<<<<<< û<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
_W<=<#0<_Nm<<<< <<<<<<<<<<<<<<<
```

Ex. 8.9

$$A = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$
[illegible]

8.3 Route

//

slash

11

plumb line, divisor, set builder, "such that", left and right absolute sum, determinant

 $\| \cdot \|$ and

double-sided plumb line over several lines

$$/ \mid \wedge \mid$$

no more dividers

II II

double plumb line; standard

$\backslash \sim /$	backslash, backslash, backslash, difference (for quantities)
$- \vdots,$	ankle stretch (ankle binding)
$\ddot{y} =;$	double dash (double bond)
$\ddot{y} \text{he}$	triple dash (triple bond)

The braille characters for double-sided plumb over multiple lines are written on their own line at the beginning of the expression. This always ends with û, likewise on its own line. See e.g. 8.12 below. For comparison with parentheses over multiple lines, which are written according to the same principles, see section 8.2.

For single dashes, double dashes and triple dashes, see also section 12.2.

Ex. 8.10

$A = \{x \mid x \text{ is even}\}$

_A<=_àx<i_t<@_N<|x<is<<<<<
<<even ù<<<<<<<<<<<<<<<<<

Ex. 8.11

AIB

A~/ B<<<<<<<<<<<<<<<<<<<

Ex. 8.12

$$A = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{pmatrix}$$

Comment on the example:

Double-sided plumb line over several lines is written according to the same principles as parentheses over several lines, see section 8.2.

$$|i + =| + \sqrt{25 \ 4 \ 29 \ 5 \ 2}$$
 $|x|y|$ $|x| < |y|$
$$|xy\ddot{y}\ddot{y}\ddot{y}| \quad || \quad | \quad | \quad ||$$
$$|x-y| \leq |x| + |y|$$
$$\frac{\|y\|}{\|y\|_{\text{and}}} = 0.495$$
$$|y| \leq 0.495$$

8.4 Common arrows

Spaces must be used before and after the following characters.

$\rightarrow$	$\rightarrow$	simple right arrow
$\leftarrow$	$\leftarrow$	single left arrow
$\leftrightarrow$	$\leftrightarrow$	simple bidirectional arrow
$\xrightarrow{\hspace{1cm}}$	$\xrightarrow{\hspace{1cm}}$	simple right arrow above simple left arrow
$\xleftarrow{\hspace{1cm}}$	$\xleftarrow{\hspace{1cm}}$	simple left arrow above simple right arrow
$\Rightarrow$	$\Rightarrow$	double right arrow (implies, entails)
$\Leftarrow$	$\Leftarrow$	double left arrow (required for
$\Leftrightarrow$	$\Leftrightarrow$	double bidirectional arrow (equivalent to
$\mapsto$	$\mapsto$	right arrow with cross bar ("function arrow")

Ex. 8.17

$A + B \rightarrow AB$

$A \rightarrow B \rightarrow A \rightarrow B \rightarrow \dots$

Ex. 8.18

1 mole of NaCl $\rightarrow$ 1 mole of Cl

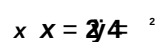
$\#1 \text{ mole of } \text{NaCl} \rightarrow \#1 \text{ mole of } \text{Cl}$

Ex. 8.19

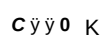
__Coê#3~§#2-û<\$<_Hê#2_O<:oö:<
 <<__HCOê#3§-<\$<__OH§-<<<<<<<<

Comment on the example:

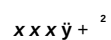
Here, for the sake of readability, it is appropriate to surround the plus signs with blanks, the chemical designations stand out better.

Ex. 8.20

x<=#2<=o<x§#2<=#4<<<<<<<<<

Ex. 8.21

_C<ö=o<"k<==<#0<<<<<<<<<<<<

Ex. 8.22

x<|:o<x§#2<\$<x<<<<<<<<<<<<<<

8.5 Other arrows

The following arrows are reproduced (in auxiliary brackets) with abbreviations of the character names. Capital pi arrow means here that the arrow is double.

r ~ (nopil~)

northeast arrow (points northeast)

t ~ (nvpil~)

northwest arrow (points
northwest)

ÿ ~ (svpil~)

southwest arrow (points southwest)

ts ~ (sopil~)

southeast arrow (points southeast)

$\ddot{y} \sim (\text{noise} \sim)$

arrow up

 $\ddot{y} \sim (\text{many} \sim)$

down arrow

 $\ddot{y} \sim (\text{vharpun} \sim)$ **left-handed harpoon** $\ddot{y} \sim (\text{hharpun} \sim)$ **right-handed harpoon** $\ddot{y} \sim (\text{vhharpun} \sim)$ **left-handed harpoon above
right-handed harpoon** $\ddot{y} \sim (\text{hvharpoon} \sim)$ **right-handed harpoon
above left-handed harpoon** $\ddot{y} \sim (\text{depicted} \sim \text{on} \sim)$ **single curved right arrow
(pictured in)****Alternative card form:** $\sim (\text{avb} \sim)$ $\ddot{y} \sim (\text{u_pil} \sim)$ **double uppåtriktad pill** $\ddot{y} \sim (\text{n_arrow} \sim)$ **double nedåtriktad pill****Ex. 8.23** $P\ddot{Q}\ddot{Q}\ddot{P}$ $_P < \sim (\text{upil} \sim) < _Q < \ddot{o} = o < _Q < < < < < < <$ $< < \sim (\text{upil} \sim) < _P < < < < < < < < < < < < <$ **Ex. 8.24** $A + HO \underset{2}{HA} + OH \ddot{y}$ $_A \S < \$ < _H \hat{e} \# 2 _O < \sim (\text{hvharpoon} \sim) < <$ $< < _HA < \$ < _OH \S < < < < < < < < < < < < <$

9 Other operators and characters

9.1 Comparison operators

The operators listed here include far from all the characters that appear in black script, so there is a need to be able to construct your own characters. See section 1.4 for how to handle characters and symbols that have no representation in Braille.

It is often convenient to surround the comparison operators with blanks to make the Braille text clearer. It is also sometimes necessary, see section "Blanks in mathematical braille" in the book's introduction.

=	=	equal to (equal sign)
≠	≠	not equal to, separate from
¬	¬	the negation of
≡	≡	identical to
≢	≢	not identical to
∝ (or) ∼, ∝		proportional to, uniform with
∄		not uniform with
≈	≈	uniform or equal to ∝
≁		not uniform or equal to ∝
≅		congruent with
≇		not congruent
≈	≈	with ∝ approximately equal to
>	>	greater than (greater than sign)
≥	≥	no bigger than
≤	≤	greater than or equal to
≧	≧	not greater than or equal to

$347 + =$

Ex. 9.2

$$5 \ 3 \ 8 \ 15 \ 8 \ 23 \ \ddot{y} + = + =$$

Ex. 9.3

5 3 23 y

Ex. 9.4

$$\neg \neg \ddot{y}P P$$

9 OTHER OPERATORS AND CHARACTERS

Ex. 9.5

P Q $\ddot{y}$

[illegible]

Ex. 9.6

$$\frac{ee\ddot{y}}{a} \quad \frac{a}{a} \quad 0$$

"eâüa<~::~"<"eâüaê#0<<<<<<<

Ex. 9.7

$$P_i > 3$$

"p#o#3<<<<<<<<<<<<<<<<<<<

Ex. 9.8

 $a \ b \ \ddot{y}$

a#0=b<<<<<<<<<<<<<<<<<<<

Ex. 9.9

 $xy\ddot{y}/$ $x^{#0} = \langle y < < < < < < < < < < < < < <$

Ex. 9.10

 $0.5 < y < b$

#0<#ö<b<#ö=<#5<<<<<<<<<<<<<

Ex. 9.11

$TT\ddot{y}$ _C

[illegible]

$\setminus \sim /$	difference (also backslash, backslash, backslash)
$\dot{\cup}$	union
$\dot{\bar{\cup}}$	average
$\dot{\cap}$	and
$\dot{\cup} \dot{\cap} \dot{\cup}$	or
$\sim(\text{xor}\sim)$	XOR sign
$\dot{\sim}(\text{nor}\sim)$	NOR sign
$\dot{\sim}(\text{nand}\sim)$	NAND sign
$\dot{\vdash}$	assertion
$\dot{\vdash}^*$	mirrored assertion
$\dot{\infty}$	the infinity
$\dot{\mathbb{Q}}$	all quanta
$\dot{\mathbb{K}}$	complement
$\dot{\mathbb{E}}$	quanta of existence
$\dot{=}$	implies, entails (double right-pointing arrow)
$\dot{=}$	necessary for (double left-pointing arrow)
$\dot{=}$	equivalent to (double double-pointing arrow)
$\dot{-}$	circle with minus
$\dot{+}$	circle with plus

Ex. 9.13

$$\frac{P \dot{\cup} Q}{\dot{\cup} Q}$$

$$\dot{\in}(\dot{P} < \dot{O} < \dot{Q} < \dot{\cup} < \dot{\sim}(\dot{a} \dot{\cap} \dot{\sim}) < \dot{Q} \dot{\in}) < < < < <$$

Ex. 9.14

$$\frac{(\ddot{y}(x))^P x}{\ddot{y}^P(a)}$$

[illegible]

Ex. 9.15

$$P_x \ddot{y}_x$$

 $(\ddot{i}_{ex})_P(x) \lll \lll \lll \lll \lll \lll \lll \lll \lll \lll$

Ex. 9.16

a A ÿ

a<i_t<_A<<<<<<<<<<<<<<<<<<<

Ex. 9.17

$A B C A B A C) () ($

$$\begin{aligned} & _A<\textit{\textless}__B<\textit{\textless}__C)<=<<<<<<<<<< \\ & <<=<(_A<\textit{\textless}__B)<\textit{\textless}__A<\textit{\textless}__C)< \end{aligned}$$

Ex. 9.18

$$A B \ddot{y}$$

A<ï ö< B<<<<<<<<<<<<<<<<<<

Ex. 9.19

BAAB ÿ ÿ ÿ

$$_B \leq _A \leq 0 \leq _A \leq _B \leq \leq \leq$$

Ex. 9.20

$\ddot{y} \ddot{y} B$

^a0<ï ö< B<<<<<<<<<<<<<<<<<<

Ex. 9.21

] 999 , [(unlimited range)

ù-#é,<#èà<(unlimited<inter-<
embankment)<<<<<<<<<<<<<<<<<<<

Ex. 9.22

$$\ddot{y}_A G A = \backslash$$

ï k A<=< G~/ A<<<<<<<<<<<<

Ex. 9.23

$$A \cap B = A \cap (B \cap B)$$
[illegible]

9.3 Geometric signs

In the Braille representation of all geometric characters, the sign $\dot{\cdot}$ is used followed by a letter.

See also section 10.5.

ŷ	in	normal to, perpendicular to
ŷ	id	diameter
•	ic	circle
ŷ	īt	triangle
ŷ	iv	angle
ŷ	ik	square
	ir	rectangle

Ex. 9.24

ÿ ÿ ÿ **DO CAB**

it< DAE<~:<it< CAB<<<<<<<<<

Ex. 9.26

$$\frac{d}{dx} r r^{\gamma\gamma} = r r^{\gamma\gamma}$$

$\text{d}\ddot{u}d(x) < r'' \leq r''' < < < < < < < < <$

Ex. 9.27

$$a \vee r = \ddot{y} \ddot{y} \ddot{y}$$

a<=<\\$.v<=<\\$;r<<<<<<<<<<<<<<

Ex. 9.28

$$n = \frac{r \, v t}{r \, v t}$$

[illegible]

Ex. 9.29

$\ddot{y} \tau \ddot{y} f g \ddot{y} g g f$

$$\ddot{r}_n(fg) = \ddot{r}_n g < \$ < g \ddot{r}_n f < < < < < < <$$

Ex. 9.30

$$\int_a^b \ddot{y} f(x) dx$$

 $\int_a^b f(x) dx \ll$

Ex. 9.31

$$\oint_C \mathbf{y} f(z) dz = 0$$

ïèê_C<f(z)dz<=<#0<<<<<<<<<<<

Ex. 9.32

ÿÿ^ršd 3 Pi

èèê@_S<@r<ï.<d@_S<=<#3"p<<<<

9.5 Other signs

ÿ "_s summa corners

"p
 product corners

! ! faculty sign

um module

ÿ ÿ~a alef

B **i~b** **but**

d i~d **the valley**

third **ï~g gimel ÿ ï.c circle**

with dot $\ddot{y}$ **ixc** **circle with cross**

Ex. 9.33

$$\ddot{\mathbf{y}}^n \mathbf{x}_i$$

"_s~êi=#1û§n<xei<<<<<<<<<<<

Ex. 9.34

$$\ddot{y} = \begin{matrix} n \\ \vdots \\ k=1 \end{matrix} \begin{matrix} x_1 & x_2 & \dots & x_n \end{matrix}$$

"_p~êk=#1û\$ñ<xêk=<=xê#1xê#2<< <<...<xên<<<<<<<<<<<<<<<<<<

Ex. 9.35

$$\lim_{n \rightarrow \infty} \frac{1}{n} \sum_{k=1}^n \dot{y}_k = a_k p$$

lim-ên<:o<#éû<"_p~êk=#1û§n<<<
<<(#1<\$<aêk)<=<p<<<<<<<<<<<

Ex. 9.36

$n \neq n$ (1)...2 1

$$n! \leq n(n-1) \dots 2 \cdot 1$$

Ex. 9.37

$$\frac{n!}{k_1! k_2! \dots k_r!}$$

$$e(n! \leq k_1! \leq k_2! \leq \dots \leq k_r!) \leq$$

Ex. 9.38

PFQF $\ddot{y} \ddot{y} \ddot{y}$

P < i m < F < ö = 0 < Q < i m < F < < < < < < <

9.6 Characters in a computer context

See also chapter 13.

Some signs that appear in a computer context:

"	quotation marks (variants of quotation marks, e.g. straight quotation marks, have the same appearance in braille)
~·	independent tilde (also uniform with)
~?	detached grave accent
~*	detached acute accent
~-	independent underscore

^	~!	standalone circumflex
#	~#	number sign, "square"
@	~to	proboscis-a, at-sign
<	#he	less than (less than sign) (see also section 9.1)
>	#O	greater than (greater than sign) (see also section 9.1)
\	~/	backslash, backslash, backslash (see also section 9.2)

Note that character strings (with quotation marks or apostrophes around them) should not be split on two lines. It may, if the expression is long, nevertheless become necessary in Braille and in such cases the continuation character ¶ is placed at the end of the Braille line to draw the reader's attention to the fact that the expression continues on the next line. This also applies to comments in program code.

Notice that in braille it is clear where the blanks are, in black, however, it can be difficult to see depending on the font. Blanks are therefore sometimes marked in black with a crossed out b or a character similar to a horizontal/lower square bracket. In Braille you can use ^b respectively ~.

Of 2

**SAMPLE COLLECTION,
SUBJECT-wise ARRANGEMENT**

Ex. 10.5**Comment on the example:****Equations are separated from running text with blank lines before text lines. See also example 8.7.**

$$x^2 - y^2 = \quad (1)$$

$$4x^2 - 9y^2 = \quad (2)$$

$$8x^2 - 9y^2 = \quad (3)$$

4 gives

$$y^2 = x^2 - 4 \quad (4)$$

(4) inserted in 2 and 3 gives

$$4x^2 - 9(x^2 - 4) = \quad \text{With } -8 \quad (5)$$

$$3x^2 - 36 = x^2 \quad (6)$$

$$2x^2 = 36 \quad (7)$$

$$x^2 = 18 \quad (8)$$

$$x = \pm \sqrt{18} \quad (9)$$

$$y^2 = x^2 - 4 \quad (10)$$

(9) + (10) gives

$$y^2 = 18 - 4 = 14 \quad (11)$$

$$y = \pm \sqrt{14}$$

$$\text{of } 19$$

$$\text{of } 4$$

z 4 inserted in 4 gives

$$y^2 = x^2 - 4$$

$$y = \pm \sqrt{x^2 - 4}$$

$$x = \pm \sqrt{y^2 + 4}$$

$$x = \pm \sqrt{y^2 + 4}$$

x 0.5 inserted in 4 gives

$$\text{and } 2 \quad (12)$$

$$(\text{and } 2$$

Response:

$$x = \pm \sqrt{y^2 + 4}$$

$$y = \pm \sqrt{x^2 - 4}$$

$$y = \pm \sqrt{x^2 - 4}$$

[illegible][illegible]

(#1)<ger<<<<<<<<<<<<<<<<<

(#4)<y=#2x\$#3<<<<<<<<<<<<<<

[illegible]

(#4) < inserted < in < (#2) < and < (#3) < <

```
<<ger<<<<<<<<<<<<<<<<<<<<<<<<< i_à<<<<<<<<<<<<<<<<<
```

$$\lllll (5) < 4x - 5(2x^3)z = -8 \lllll (6) < 8x - 3(2x^3)$$
[illegible][illegible][illegible]

#8<<<< << (#8)<#8x-#6x-#9\$#6z=#14<<<<<<

[illegible][illegible]

ï à<<<<<<<<<<<<<<<<<<< (#9)<-#6x\$z=#7<<<<<<<<

[illegible][illegible]

(#9)\$#3i.(#10)<ger<<<<<<<<<< (#11)<#6x\$z\$#6x\$#18z=#7\$#69<

[illegible][illegible]

Ex. 10.7

$$\binom{n}{0} a^n b^0 + \binom{n}{1} a^{n-1} b^1 + \binom{n}{2} a^{n-2} b^2 + \dots + \binom{n}{n-1} a^1 b^{n-1} + \binom{n}{n} a^0 b^n$$

(a\$ b)\$\S n = a\S n \$n \u0021! a \sim \S n - \#1 \hat{u} b \\$ < < \\$ \acute{e}(n(n - \#1) \u0022! \acute{e}) a \sim \S n - \#2 \hat{u} b \\$ \#2 \\$ \\$ \acute{e}(n(n - \#1)(n - \#2) \u0023! \acute{e}) \ddot{i} < < < < < a \sim \S n - \#3 \hat{u} b \\$ \#3 \\$ \dots \\$ b \S n < < < < < < < <

Comment on the example:

To avoid using multiple continuation characters, lines 2–4 have not been indented.

Ex. 10.8

$$D_n^n = \sum_{k=0}^n \binom{n}{k} \frac{(1)^k}{k!} \quad \text{it is } \dots$$

_D \hat{e} n < = < n ! < " _ s \sim \hat{e} k = \#0 \hat{u} \S n \ddot{i} < < < < < (- \#1) \S k \ddot{u} k ! < \sim : - < n ! \acute{e} \S - \#1 < < < < < < < <

10.2 Analysis**10.2.1 Some function types****Ex. 10.9**

$$2^2 \cdot 2^2 = 2^4$$

\#2 \S \#3 < = < \#2 < \ddot{i} . < \#2 < \ddot{i} . < \#2 < < < < < < <

Ex. 10.10

$$2^{-3} = \frac{1}{2^3} = \frac{1}{8}$$

\#2 \S - \#3 < = < \#1 \u0022 \#2 \S \#3 < = < \#1 \u0022 \#8 < < < <

Ex. 10.11

$x \cdot f(x)$ eller $f(x, y)$

$x < 0 \leq f(x)$ eller $x < 0 \leq y, \dots, y \leq f(x)$

Ex. 10.12

$y \bar{x} x^2 y y \quad 0 \ddot{y} \ddot{y} = \ddot{y} 0 \quad \sqrt{\quad}$

$y \leq x \leq 2, x \leq 0 \leq 0 \leq x \leq \dots$

$\leq \hat{y}, y \leq 0 \leq 0 \leq \dots$

Ex. 10.13

$y \bar{a} x^{\frac{1}{2}} c a \quad \ddot{y} 0$

$y \leq a x \leq 2 \leq b x \leq c, a \leq 0 \leq \dots$

Ex. 10.14

$e^x = \frac{2x(x)}{R(x)} = \frac{x^n}{n!} = \frac{x^{n+1}}{(n+1)!} \quad \dots$

$e \leq x \leq 1 \leq x \leq 1 \leq x \leq 2 \leq \dots \leq x \leq n \leq \dots \leq R(x),$

$\leq \dots \leq R(x) \leq \dots \leq (x \leq n \leq 1 \leq \dots \leq \dots \leq n \leq 1)!$

$\leq e \leq \dots \leq h \leq \dots \leq \dots \leq 0 \leq \dots \leq h \leq \dots \leq 1, x \leq t \leq R.$

Comment on the example:

In this case, a fraction separator is used because the line breaks in the middle of the fraction, but it would not have been necessary for the mathematical interpretation of the fraction. An alternative would have been not to indent lines 2–4 and to use continuation characters

10.2.2 Ranges and Limits

Ex. 10.15

 $f_X(A)$ then y, y

f(x)<:o<_A<dâ<x<:o<a<<<<<<<<

Ex. 10.16

х~~а~~х~~а~~х~~а~~х~~а~~х~~а~~х $\ddot{y}$ $\ddot{y}$

$x \leq a, x \leq a, x \leq a, \dots$
 $\dots x \leq a \dots$

Ex. 10.17

$$| \check{y} \rangle \in f x A \quad e$$

|f(x)<-<_A|<#ö<"e<<<<<<<<<<<

Ex. 10.18

$$\lim_{x \rightarrow \infty} \frac{1}{x} = 0$$

$$\lim_{x \rightarrow 0} \frac{1}{x} = \infty$$

Ex. 10.19

$\frac{a+b}{2}$ is the half-open interval between a and b $\dot{y} <$

[illegible]

Ex. 10.20

$$\lim_{x \rightarrow 2} x^2 = 4$$

$$\lim_{x \rightarrow 0} \frac{x^2}{x^2 + 4} = \frac{0}{0} = \frac{0}{4} = 0$$

Ex. 10.21

$$\lim_{x \rightarrow \infty} \frac{x^3 + 2x + 1}{x^3 + 2}$$

$\lim_{x \rightarrow \infty} \frac{x^3 + 2x + 1}{x^3 + 2} = 1$

Ex. 10.22

$$f(x) = \frac{1}{x^2}, \quad x > 0$$

$f(x) = \frac{1}{x^2}$ is a decreasing function on the interval $(0, \infty)$.

Ex. 10.23

$$f(x) = \frac{1}{x^2}, \quad x > 0$$

$f(x) = \frac{1}{x^2}$ is a decreasing function on the interval $(0, \infty)$.

Ex. 10.24

$$f(x) = \frac{1}{1 + x^2}, \quad x > 0$$

$f(x) = \frac{1}{1 + x^2}$ is a decreasing function on the interval $(0, \infty)$.

10.2.3 Derivator**Ex. 10.25**

$$a \vee r = \ddot{y} \ddot{y}$$

$a \vee r = \ddot{y} \ddot{y}$

Ex. 10.26

$$\frac{y''}{dx^2}$$

$\frac{y''}{dx^2}$

Ex. 10.27

$$\lim_{h \rightarrow 0} \frac{h f(x+h) - f(x)}{h}$$

$$\lim_{h \rightarrow 0} \frac{h f(x+h) - f(x)}{h} = f'(x)$$

Ex. 10.28

$$f(x) = \sum_{k=0}^{\infty} \frac{f^{(k)}(0)}{k!} x^k + R_n$$

$$f(x) = \sum_{k=0}^{\infty} \frac{f^{(k)}(0)}{k!} x^k + R_n$$

Ex. 10.29

$$R_n = \frac{f^{(n)}(\xi)}{n!} x^n \quad \text{for some } \xi \in [0, x]$$

$$R_n = \frac{f^{(n)}(\xi)}{n!} x^n \quad \text{for some } \xi \in [0, x]$$

Ex. 10.30

$$f(x) = \sum_{k=0}^{\infty} \frac{f^{(k)}(0)}{k!} x^k + R_n$$

$$f(x) = \sum_{k=0}^{\infty} \frac{f^{(k)}(0)}{k!} x^k + R_n$$

10.2.4 Integral

Ex. 10.31

$$\ddot{y} \left(x^2 \dot{x}^2 + 4 \right) = + \ddot{y} x^3 \dot{x}^4 - 3 \frac{\ddot{y} \dot{y}}{\dot{y}^2} \dot{y}^2$$

èê#2§#3<(x§#2<\$<#3x<-<#4)dx<= <<=àx§#3ü#3<\$<#3é(x§#2ü#2é)<-
 <<-<#4xùê#2§#3<<<<<<<<<<<<<

Comment on the example:

Fractions $\acute{e}(<\acute{e})$ are used to show that the number 3 is not in the numerator. Also note that without the fraction adder, it will have the same mathematical meaning.

Ex. 10.32

$$\oint_C P dx + Q dy = \iint_D \left(\frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y} \right) dx dy$$

$$\iint_{\mathcal{D}} \left(\frac{\partial}{\partial x} \left(\frac{\partial \phi}{\partial x} \right) + \frac{\partial}{\partial y} \left(\frac{\partial \phi}{\partial y} \right) \right) dx dy = \int_{\partial \mathcal{D}} \left(\frac{\partial \phi}{\partial n} \right) ds$$

10.2.5 Differential equations

Ex. 10.33

$$\ddot{y} = y f(x) dx + C$$

$$y \leq \int_a^b f(x) dx \leq C$$

Ex. 10.34

$$y \text{ ay by } R \text{ x} + + = ()$$

$$y'' < a y' < b y \leq R(x) < < < < <$$

10.2.6 Exponential and logarithmic functions

Ex. 10.35

$$\lg \frac{x}{10} = \lg x - 1$$

$$\lg(x \cdot 10^k) = \lg x + k$$

Ex. 10.36

$$a^x a^y = a^{x+y}$$

$$a^{\lg x} = x^{\lg a}$$

Ex. 10.37

$$0,4^x > \frac{x+3}{2}$$

$$\lg(x \cdot 10^k) = \lg x + k$$

Ex. 10.38

$$\ln x = \frac{1}{x} \frac{dt}{t}$$

$$\ln x = \frac{1}{x} \frac{dt}{t}$$

10.2.7 Limit values, sequences and series

Ex. 10.39

$$a_1 = 1 \text{ and } a_{n+1} = \frac{1}{a_n} \text{ the sequence } 1, 2, \frac{1}{2}, 3, \frac{1}{3}, \dots$$

$$a_1 = 1, a_2 = 2, a_3 = \frac{1}{2}, a_4 = 3, a_5 = \frac{1}{3}, a_6 = 4, a_7 = \frac{1}{4}, a_8 = 5, a_9 = \frac{1}{5}, \dots$$

Ex. 10.40

$$\lim_{n \rightarrow \infty} \frac{2 \cdot 3^n}{5^n + 1} = 2$$

$\lim_{n \rightarrow \infty} \frac{2 \cdot 3^n}{5^n + 1} = 2$

Ex. 10.41

$$\lim_{n \rightarrow \infty} s_n = \lim_{n \rightarrow \infty} (a_1 + a_2 + \dots + a_n)$$

$\lim_{n \rightarrow \infty} s_n = \lim_{n \rightarrow \infty} (a_1 + a_2 + \dots + a_n)$

$\lim_{n \rightarrow \infty} s_n = \lim_{n \rightarrow \infty} (a_1 + a_2 + \dots + a_n)$

Ex. 10.42

$$s_n = \frac{1}{2} \left(\frac{1}{n} + \frac{1}{n+1} + \dots + \frac{1}{2n} \right)$$

$s_n = \frac{1}{2} \left(\frac{1}{n} + \frac{1}{n+1} + \dots + \frac{1}{2n} \right)$

Ex. 10.43

$$\{a_n\}_{n=1}^{\infty}$$

$\{a_n\}_{n=1}^{\infty}$

Ex. 10.44

$$\lim_{n \rightarrow \infty} \frac{a_n}{n} = 0$$

$\lim_{n \rightarrow \infty} \frac{a_n}{n} = 0$

10.3 Complex numbers

Ex. 10.45

$$\sqrt{y} = 1 \cdot i, i^2 = -1$$

i = the imaginary unit

$$\hat{1} = i, i^2 = -1 \quad i = \text{the imaginary unit}$$

Ex. 10.46

$$|z| = |x + iy| = \sqrt{x^2 + y^2}$$

$$|z| = \sqrt{x^2 + y^2} \quad |z| = \sqrt{x^2 + y^2}$$

Ex. 10.47

$$z = r(\cos \theta + i \sin \theta), \quad r = |z|$$

$$z = r(\cos \theta + i \sin \theta), \quad r = |z|$$

Ex. 10.48

$$z^n = r^n (\cos n\theta + i \sin n\theta) = r^n (\cos n\theta + i \sin n\theta)$$

$$z^n = r^n (\cos n\theta + i \sin n\theta) = r^n (\cos n\theta + i \sin n\theta)$$

Ex. 10.49

$$(2)^i e = i i \log(2) = \frac{\pi}{2} \log(2)$$

$$(2)^i e = i i \log(2) = \frac{\pi}{2} \log(2)$$

Ex. 10.50

$$\cos y = \cos y + \sin y$$

$$\cos = \frac{\cos}{2}$$

$$\sin = \frac{\sin}{2i}$$

$e^{-iy} = \cos y - i \sin y$
 $e^{iy} = \cos y + i \sin y$
 $e^{-iy} + e^{iy} = 2 \cos y$
 $e^{-iy} - e^{iy} = -2i \sin y$

10.4 Quantity theory and logic**Ex. 10.51**

$$P(\emptyset) = 0$$

$$P(\emptyset) = 0$$

Ex. 10.52

$$A \cap B = \emptyset$$

$$A \cap B = \emptyset$$

Ex. 10.53

$$a \in A$$

$$a \in A$$

Ex. 10.54

$$A \cap B = \emptyset$$

$$A \cap B = \emptyset$$

Ex. 10.55

 $\{2,4,6\} \neq \{ \} \quad 0,2,4,6,\dots$ _à#2,<#4,<#6_ù<i_ö=<_à#0,<#2, <<#4,<#6,<..._ù<<<<<<<<<<
<

Ex. 10.56

$$BA \ddot{y}, A A \ddot{y}, \emptyset \ddot{y} \mathbf{B}, 0 \ddot{y} \mathbf{B}$$

```
_B<i_ö=<_A,<_A<i_ö=<_A,<<<<<
<^o<i_ö<_B,<#0<^i_t<_B<<<<<
```

Ex. 10.57

$$A = \{ x \in \mathbb{N} \mid x \text{ is even} \}$$

```
_A<=<_àx<i_t<@_N<|<x<is<<<<<<  
<<even_ù<<<<<<<<<<<<<<<<<<
```

Ex. 10.58

$PQ \cap PQ = \emptyset$

_P<~(many~)<_Q<ö=0<<<<<<<<<
<<:\$(<_P<ië<_Q)<<<<<<<<<<<<

Ex. 10.59

$$(\ddot{y} \ddot{y})(x \wedge x B) \quad x \ddot{y} \ddot{y}$$
$$(\ddot{i}_{ax})(x \leq \ddot{i}_t \leq _A \leq 0 \leq x \leq \ddot{i}_t \leq _B) <$$

Ex. 10.60

$$\ddot{y}_0 = c(Q)$$

$\tilde{I} \sim a\epsilon^{\#0} < c(_Q) < < < < < < < < < <$

Ex. 10.61

$$P(A_1 \cap A_2 \cap \dots \cap A_n) = P(A_1)P(A_2) \cdot \dots \cdot P(A_n)$$

$$P(A_1 \cap A_2 \cap \dots \cap A_n) \leq P(A_1) \leq P(A_2) \leq \dots \leq P(A_n)$$

Ex. 10.62

$$\{(x, y) : 5 \leq x^2 + y^2 \leq 10\}$$

$$\frac{d}{dx} (x^2 + y^2) = 2x + 2y \frac{dy}{dx}$$

10.5 Geometry**Ex. 10.63**

$$AN : NB = AP : PH = 1 : 1 \quad NP \parallel BE \quad NP \parallel AC \quad NP \parallel NL$$

$$\begin{aligned} AN &= NB \\ AP &= PH \\ NP &\parallel BE \\ NP &\parallel AC \\ NP &\parallel NL \end{aligned}$$

Ex. 10.64

$$\angle ABC = \angle BCA$$

$$\angle abc = \angle bca$$

Ex. 10.65

$$\text{Parallelogram } ABCD \quad a^2 + b^2 = c^2 + d^2$$

$$\text{Parallelogram: } a^2 + b^2 = c^2 + d^2$$

Ex. 10.66

Area of a parallelogram $A = \frac{ab \sin \theta}{2}$

Area of a parallelogram $A = \frac{ab \sin \theta}{2}$

Ex. 10.67

Area of a parallelogram $A = \frac{ab \sin \theta}{2}$

Area of a parallelogram $A = \frac{ab \sin \theta}{2}$

10.6 Trigonometric functions**Ex. 10.68**

$\sin(t) = \sin(t)$

$\sin(t) = \sin(t)$

Ex. 10.69

$1^\circ = \frac{\pi}{180} \text{ rad} \approx 0.017453 \text{ rad}$

$1^\circ = \frac{\pi}{180} \text{ rad} \approx 0.017453 \text{ rad}$

Ex. 10.70

$\cos v = \frac{2}{3} \approx 0.6667$

$\cos v = \frac{2}{3} \approx 0.6667$

Ex. 10.71

$OP = 2(\cos 70^\circ, \sin 70^\circ)$

$OP = 2(\cos 70^\circ, \sin 70^\circ)$

Ex. 10.72

$$\frac{1}{x} \arctan \frac{\pi}{2} = \frac{\pi}{2} \arctan \frac{\pi}{2} > 0$$

$\arctan x < \frac{\pi}{2}$

$\frac{1}{x} \arctan \frac{\pi}{2} < \frac{\pi}{2} \arctan \frac{\pi}{2}$

$\arctan x < \frac{\pi}{2}$

$\frac{1}{x} \arctan \frac{\pi}{2} < \frac{\pi}{2} \arctan \frac{\pi}{2}$

Ex. 10.73

$$\frac{x^{n+1}}{n+1} \arcsin x - \frac{1}{n+1} \int \frac{x^{n+1}}{\sqrt{1-x^2}} dx$$

$\arcsin x < \frac{\pi}{2}$

$\frac{1}{x} \arcsin x < \frac{\pi}{2} \arcsin x$

$\arcsin x < \frac{\pi}{2}$

Commentary on the

example: When line breaks with an implicit multiplication

sign, a continuation sign must be used. See also examples 1.5, 1.7 and 10.7.

10.7 Probability theory and statistics**Ex. 10.74**

$$P(k) = \frac{1}{n} \binom{n}{k} p^k (1-p)^{n-k} \quad \text{such as } k \in \{0, 1, 2, \dots, n\}$$

$P(k) < \frac{1}{n}$

$\sum_{k=0}^n P(k) = 1$

Ex. 10.75

$$T(\vec{m}) = \sum_{j=1}^n \vec{m}_j \cdot \vec{e}_j$$

$$_E(Y) = \int_0^1 \frac{1}{2} \ln(1-x) dx = -\frac{1}{4}$$

Ex. 10.76

$$P(x) = \int_0^x \frac{1}{15} dt = \frac{x}{15}, \quad 0 \leq x \leq 15$$

$$_P(0) = \int_0^0 \frac{1}{15} dt = 0$$

Ex. 10.77

$$p^2 = E \cdot \vec{p} \cdot \vec{p} = E \cdot p^2$$

$$s^2 = \int_0^1 \frac{1}{2} \ln(1-x) dx = -\frac{1}{4}$$

11 Physics and astronomy

Ex. 11.1

$$E_0 = mc^2$$

$$E_0 = mc^2$$

Ex. 11.2

$$E = \frac{mc^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$E = \frac{mc^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Ex. 11.3

$$U = E - E_{\text{rest}}$$

$$U = E - E_{\text{rest}}$$

Ex. 11.4

$$a = \frac{F}{m} = \frac{m \cdot \frac{in^2}{r}}{m} = r \cdot \frac{in^2}{r^2}$$

$$a = \frac{F}{m} = \frac{m \cdot \frac{in^2}{r}}{m} = r \cdot \frac{in^2}{r^2}$$

$$a = \frac{F}{m} = \frac{m \cdot \frac{in^2}{r}}{m} = r \cdot \frac{in^2}{r^2}$$

$$a = \frac{F}{m} = \frac{m \cdot \frac{in^2}{r}}{m} = r \cdot \frac{in^2}{r^2}$$

Comment on the example:

Line breaks have been made at the equals sign to avoid breaking inside the fraction separator.

Ex. 11.5

$$\hat{in}_L = L \hat{oh}, \quad \hat{in}_R = R \hat{i}$$

uſſſ!ê_L<=<"w<i.<_L<i.<iſſſ!;<< uſſſ!ê_R<=<_R<i.<iſſſ!<<<<<<
<<

Ex. 11.6

μ Cephei Position (2000.0) 21h 43.5 min + 58o 57y magn 3.4 – 5.1 period 730 days

```
"m<_Cephei<_Position<<<<<<<< <<( #2000.0)<#21<h<#43,5<min<<  
<<$#58'ig<#57'<<<<<< <<<<<<<<<< <<magn<#3,4--  
#5,1<<<<<<<<< <<period<#730<dygn<<<<< <<<<<
```

Ex. 11.7

$$\frac{a^\circ}{360^\circ} = \frac{\text{arc } a}{\text{Pi}}$$

"aïgü#360ïg<=<é(arc"aü#2"pé)<

Ex. 11.8

$$^{10} \log 2,512 \cdot 0,4 \ddot{y}$$

$\log_{10} 2,512 \approx 0,4$

Ex. 11.9

$$m^* l = 2a [\sin(l + \frac{\pi}{2}) + \sin(l - \frac{\pi}{2})]$$

m*"l<=<#2ûd*àsin(_l\$a)<@\$-<< <<@\$-<sin(_l-"a)ù<<<<<<<<<<

Ex. 11.10

$$PTZ = \left[\frac{\ddot{y}}{N} \right] / \left[\frac{\ddot{y}}{N * N * R} \right]$$

$$\frac{PTZ}{N} = \frac{N * N * R}{N * N * R} = 1$$

$$\frac{PTZ}{N} = \frac{N * N * R}{N * N * R} = 1$$

12 Chemistry and biology

For different types of chemical bonds see section 8.3. For different types of arrows, see sections 8.4 and 8.5.

Lower index is written before upper index. Index to the left of the main symbol is written before and index to the right of the main symbol is written after it. See also section 7.1.

12.1 Chemical designations and formulas

Ex. 12.1

EPK = erythrocyte particle concentration; $\ddot{y}$
 $3.7\text{--}5.0 \times 10^{12}/l$ $\ddot{y}$ $4.0\text{--}5.5 \times 10^{12}/l$

Comment on the example:

Note that here the characters for female and male respectively have been reproduced in plain text in parentheses. See section 1.4 for how to reproduce characters and symbols that lack representation in braille.

```
__EPK<=<erythrocyte particle-<<<
<<concentration;<<<<<<<<<<<<<<< <<~(hona~)<#3,7--
#5,0<i>x<<<< < <<<<<#10§#12/<<<<<<<<<<<<<<<<<<
<<~(cock~)<#4,0--<#5,5<i>x<< <<<< <<<<<#10§#12/
|<<<<<<<<<<<<<<<<<<
```

Ex. 12.2

HCO is called glyoxal

_Hê#2_Cê#2_Oê#2<kallas<<<<<<
glyoxal<<<<<<<<<<<<<<<<<<<

Ex. 12.3

NaCl

 In_2Cl_6 **Ex. 12.4**

NOX

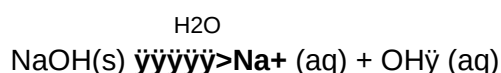
 N_2O_5 **Ex. 12.5**Already K^+ , Cl^- , Fe^{3+} Na^+ , K^+ , Cl^- , Fe^{3+} and**Ex. 12.6** H^+ H_2O **Ex. 12.7** $2\text{NH}_3 + \text{CO}_2 \rightarrow \text{NH}_2\text{CO}_2\text{NH}_2 + \text{H}_2\text{O}$ NH_3 , CO_2 , H_2O NH_3 , CO_2 , H_2O H_2O **Ex. 12.8** $P = [\text{Mg}^{2+}][\text{OH}^-]^2$ $\text{P} = [\text{Mg}^{2+}][\text{OH}^-]^2$ $\text{P} = [\text{Mg}^{2+}][\text{OH}^-]^2$ **Ex. 12.9**

(GIVE)

 $\text{C}_6\text{H}_{10}\text{O}_4$

Ex. 12.10

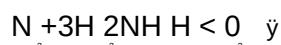
$\text{Na}_2\text{Z(s)} < \$ < \text{Ca}^{\text{aq}} < \text{CaZ(s)} + 2\text{Na}^{\text{aq}} < <$
 $< < \sim (\text{harpun} < \text{forward} < < < < < < < < < < < < < < < < < \text{Ca}_2\text{Z(s)} < \$$
 $< < < < < <$
 $< < \$ < \#2 \text{Na}^{\text{aq}} < < < < < < < < < < <$

Ex. 12.11

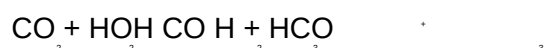
Comment on the example:

Here, H₂O is written on the line above the arrow in the black-and-white template. In braille, H₂O is surrounded by the warning sign ~ and the closing sign û and preceded by two §§ to show that the text is directly above the arrow. See also section 7.1.

$\text{Na}_2\text{O}_2\text{(s)} < : \text{o} \sim \text{H}_2\text{O} < < < < <$
 $< < \text{Na}^{\text{aq}} < \$ < \text{O}_2\text{(s)} < < < < <$

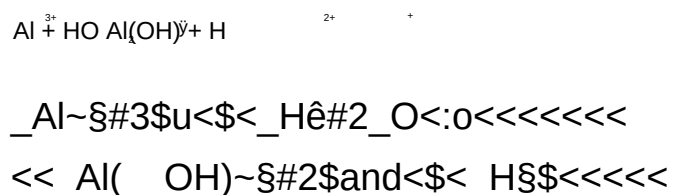
Ex. 12.12

$\text{N}_2 < \$ < \#3 \text{H}_2 < : \text{o} \ddot{\text{o}} : < < < < < < <$
 $< < \#2 \text{NH}_3 < " \text{d}_\text{H} < \# \ddot{\text{o}} < \#0 < < < < < <$

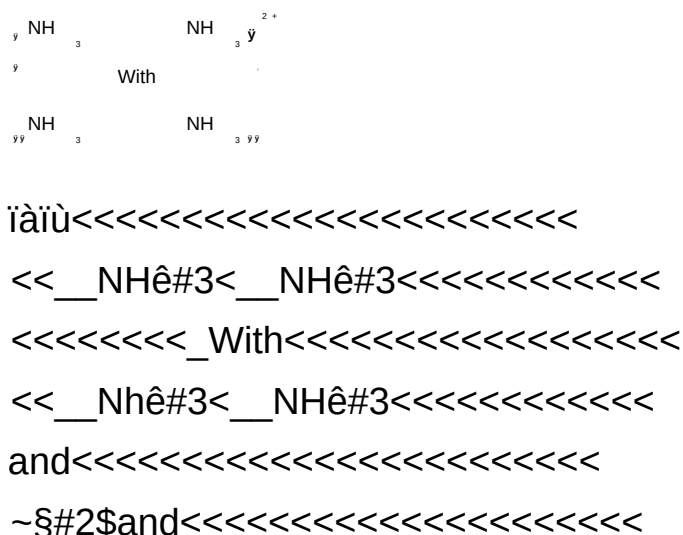
Ex. 12.13

$\text{Co}_2 < \$ < \text{H}_2\text{O} < : \text{o} \ddot{\text{o}} : < < < < < <$
 $< < \text{H}_2\text{CO}_3 < : \text{o} \ddot{\text{o}} : < \text{H}^+ < \$ < < <$
 $< < \$ < \text{HCO}_3^- < < < < < < < < < < < <$

Ex. 12.14



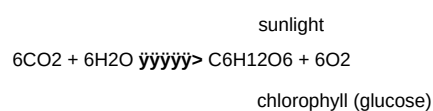
Ex 12.15



Comment on the example:

Alternatively, this example can be reproduced tactilely with a relief image, on swelling paper or on drawing sleeve.

Ex. 12.16



Comment on the example:

Photosynthesis is shown in three lines. The words "sunlight" are above and "chlorophyll" are below the reaction arrow. The word "glucose" is in parentheses directly below the formula. The example is reproduced using the characters for "directly below" $\hat{=}$ and "directly above" $\hat{=}$ respectively (§§ (see section 7.1), as well as warning signs $\sim$ and closing signs $\hat{=}$.

#6__COê#2<\$<#6_Hê#2_O<<<<<<<
<<:o~êêChlorophyllû~§§Solljusû<
<<<_Cê#6_Hê#12_Oê#6<<<<<<<<<
<<êê(Glucose)<\$<#6_Oê#2<<<<<<<

12.2 Structural Formulator

Complicated structural formulas should be illustrated with tactile images.

Ex. 12.17

$$\text{HC}\ddot{\text{C}}\text{H}$$
[illegible]

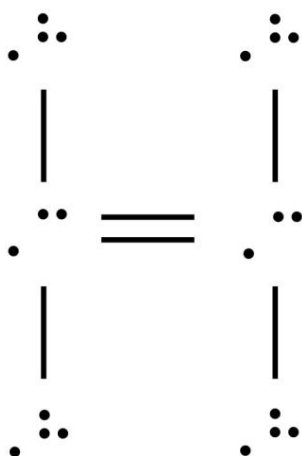
Ex. 12.18

HH

$$C = C$$

HH

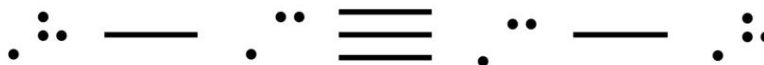
Here is how the structural formula could look on a tactile image, for example a puff-paper image.



Ex. 12.19

$$\text{H}\ddot{\text{C}}\ddot{\text{C}}\ddot{\text{H}}$$

Here is how the structural formula could look on a tactile image, for example a puff-paper image.



Ex. 12.20

H

HyyCyyH

H

[illegible]

13 Programming and Internet

When program code is to be written in Braille, blanks must be reproduced exactly as in the model. Indents must be used according to the template to clarify structure.

Note that the continuation character ¶ must be used when you have to change lines in braille (due to braille's shorter line length) - hyphens must not be used. This applies to writing Internet addresses, e-mail addresses and when writing program code.

See section 9.6 for additional signs that occur during programming and Internet use.

Ex. 13.1

C:\>

[illegible]

Ex. 13.2

Internet addresses <http://www.punktskriftsnamnden.se/>

Internetadressen<<http://www.punktskriftsnamnden.se/>>>

Ex. 13.3

The email address is anna-maria.johansson@comhem.se

_The e-mail address<anna-maria.ïï
johansson~àcomhem.se<<<<<<<

Ex. 13.4

```
PROCEDURE A (i:Integer);
BEGIN
  IF i > 0 THEN BEGIN
    d(i-1);
    x := x-h;
    plot;
    and
    (i-1); y := y - h;
    plot;
    a(i-1);
    x := x + h;
    plot;
    b(i-1);
  END;
END;
```

[illegible]

Ex. 13.5

```
$ cat > script.ksh #! /bin/ksh
```

```
^s<cat<#o<script.ksh<<<<<<< ~#!/bin/ksh<<<<<<<<<<<<<
```

Ex. 13.6

```
#include <sys/stat.h>
```

```
int chmod(path, mode) char
*path; mode_t
mode;
```

```
~#include<#ösys/stat.h#o<<<<<
```

[illegible]

```
int<chmod(path,<mode)<<<<<<<
```

```
char<*path;<<<<<<<<<<<<< mode~-
```

```
t<mode;<<<<<<<<<<<<<<
```

APPENDIX – changes in the second edition

Listed below are the most important changes and news in the second edition of *the Point Writing Rules for Mathematics and Science* :

- The use of the sign $\dot{\cdot}$ (p12456) has been changed to become a general sign for mathematical characters. To make it easier to remember different representations in braille, this sign has in many cases been combined with the braille characters for the letters that are the first letter of various character names. An example of that is $\dot{u}$ for "union". Also combinations with this sign and other signs as capital letters have been used, for example $\dot{k}$ for "complement".
- Each new equation in a system of equations must be written on a new line. See example 8.6.

New look characters in braille

Character	New appearance	Previous appearance	Character name
$\dot{\cdot}$	$\dot{g}$	$\wedge$	straight corners
$\dot{\cdot}$	$\dot{.}$	$\cdot$	multiplication sign (dot)
$\times$	$\dot{x}$	$\times$	multiplication sign (cross)
$\ddot{y}$ in		$\#.$	normal, perpendicular to
$\ddot{y}$ that's it		$:$	assertion
$\ddot{y} \wedge \dot{a}$		$: $	mirrored assertion
$\%$		$@)$	percent
$\hat{o} \ \% \ \hat{o} \hat{o}$		$@))$	blood alcohol level

Character New appearance Previous appearance			Character
name circle with dot	$\ddot{y}$	$\ddot{i}.c$	circle with minus
$\ddot{i}.\hat{u}$	$\ddot{y}$	$\ddot{i}-c$	
$\ddot{i}-\hat{u}$	$\ddot{y}$	$\ddot{i}\$c$	
$\ddot{i}\$u$	$\ddot{y}$	$\ddot{i}xc$	
$\ddot{i}x\hat{u}$	$\ddot{y}$	$\ddot{i}''_d$	circle with plus
$\ddot{i}''_d$	$\ddot{y}$	$\ddot{i}''_d$	circle with cross
$\ddot{i}_n$	$\ddot{y}$	$\ddot{i}\sim a$	Laplace delta
$\ddot{y}$		$\backslash d$	partiell derivative
		$\backslash n$	nabla (gradient)
A		$\backslash a$	alef
$\ddot{y}$	id	$\ddot{i}/o$	diameter (circle with slash) circle
•	$\ddot{i}c$	$\ddot{i}\hat{u}$	
$\ddot{y}$	$\ddot{i}t$	$\ddot{i}!$	triangle
$\ddot{y}$	$\ddot{i}v$	$\ddot{i}\ddot{o}$	angle
$\ddot{y}$	$\ddot{i}k$	$\ddot{i}=$	square
	$\ddot{i}r$	$\ddot{i}\acute{e}$	rectangle
$\ddot{y}$	$\ddot{i}u$	$\sim\hat{i},$	union
$\ddot{y}$	$\ddot{i}s$	$\sim\mathfrak{s},$	average
$\ddot{y}$ or $\ddot{y}$	$\sim:$	it's	proportional to, uniform with
{	$\ddot{i}_\grave{a} \hat{u}$	$@_\grave{a} < @\hat{u}$	single-sided left bracket (single- sided left angle bracket) over multiple
}	$\ddot{i}_\grave{u}$ and	$@\acute{e} < @_\grave{u}$	lines single-sided right bracket (single-sided right angle bracket) over several lines
(...)	$\ddot{i}(\ddot{i})$ and	$@(<@)$	double-sided round bracket over several lines
[...]	$\ddot{i}\grave{a}\grave{u}$ and	$@\grave{a} < @\grave{u}$	double-sided square brackets over multiple lines

Character	New look	Previous look	Character name	double-sided
{...}	$\ddot{_}\grave{_}\grave{_}\grave{_}$ and	@_à<@_ù	brace (double-sided curly brace)	over multiple lines
	$\ddot{ }$ and	@ <@	double-sided plumb line across multiple lines	
ÿ	''	''	only	
ÿÿÿ	'''	'''	triss, triple prime	
$\ddot{_}\grave{_}\grave{_}\grave{_}$		\lt is	belongs to	
$\ddot{_}\grave{_}\grave{_}\grave{_}\grave{_}$			does not belong	
$\ddot{_}\grave{_}\grave{_}\grave{_}\grave{_}\grave{_}$			contained in	
$\ddot{_}\grave{_}\grave{_}\grave{_}$		~d.	strictly contained in	
$\ddot{_}\grave{_}\grave{_}\grave{_}$		~o,	contains (as true subset) contains	
$\ddot{_}\grave{_}\grave{_}\grave{_}\grave{_}\grave{_}$			(as subset)	
$\ddot{_}\grave{_}\grave{_}\grave{_}$		§,	and	
$\ddot{_}\grave{_}\grave{_}\grave{_}$		eh	or	
$\ddot{_}\grave{_}\grave{_}\grave{_}$		~î,	union	
$\ddot{_}\grave{_}\grave{_}\grave{_}$		~§,	average	
$\ddot{_}\grave{_}\grave{_}\grave{_}\grave{_}\grave{_}$			XOR sign	
$\ddot{_}\grave{_}\grave{_}\grave{_}\grave{_}\grave{_}$			NOR sign	
$\ddot{_}\grave{_}\grave{_}\grave{_}\grave{_}\grave{_}$			NAND characters	
$\ddot{_}\grave{_}\grave{_}\grave{_}\grave{_}\grave{_}$		\,	all quanta	
$\ddot{_}\grave{_}\grave{_}\grave{_}\grave{_}\grave{_}$		\c	complement	

Sign	New look	Previous Appearance	Character Name
ÿ	ï_e	\?	quanta of existence
ÿ	~(rvinkel~) ï)		perpendicular
ÿ	um	=	module

In addition to the two following characters, another ten characters of the same type have been given a new appearance in Braille according to the same principle – for example "not greater than". See section 9.1 Comparison operators.

>	#O	~O,	greater than (greater than sign)
<	#he	~d.	less than (less than sign)

An auxiliary sign has also been given a new look in Braille:

ïï	~	continuation character
----	---	------------------------

Arrows with a new look in Braille

The following arrows are reproduced in Braille by writing a variant of the character name in parentheses.

Sign	New look	Previous appearance	Character name
ÿ	~(noise~)	§O	up arrow (up arrow)
ÿ	~(many~)	yeah	pil nedåt (npil)
ÿ	~(vharpun~) ,:		left-handed harpoon (vharpun)
ÿ	~(hharpun~) :'		right-handed harpoon (hharpun)

Sign	New look	Previous appearance	Character name
			left-handed harpoon above right-handed harpoon (vharpoon above hharpoon)
			right-handed harpoon above left-handed harpoon (vharpoon above hharpoon)
			single curved right arrow (pictured in)
	Alternative card form:		

New characters in braille

Characters in black writing	Braille	Character name
[No equivalent] êê [No equivalent] §§ [No equivalent] é(<é)		directly below
[No equivalent] é([No equivalent] é)		directly above
		fraction adder
		the beginning of the quarrel
		breaking point
		multiplication sign (dot in bold)
B		but
d		the valley
		gimel

Characters in black writing	Braille	Character name
⠏	⠏⠒ (and	single-sided left angle bracket across multiple lines
⠏	⠏⠒ and	single-sided right angle bracket over multiple lines
⠏⠏	⠏⠒⠏⠒ and	double-sided angle bracket over multiple lines
(	⠏⠒ (and	single-sided left round parenthesis over several lines
)	⠏⠒) and	one-sided right round bracket over several lines
[	⠏⠒à and	single-sided left square bracket over multiple lines
]	⠏⠒ù û	single-sided right square bracket over multiple lines
⠏	⠏⠒	contains
⠏⠒	⠏⠒⠒	does not contain
⠏⠒	⠏⠒⠒=	not contained in
⠏⠒	⠏⠒⠒=	does not contain (as subset)
r:	⠏⠒⠒⠒⠒⠒⠒ northeast arrow ⠏⠒⠒⠒⠒⠒⠒	
t:	northwest arrow ⠏⠒⠒⠒⠒⠒⠒ southwest arrow	
and	⠏⠒⠒⠒⠒⠒⠒ southeast arrow ⠏⠒⠒⠒⠒⠒⠒ double	
from	up arrow ⠏⠒⠒⠒⠒⠒⠒ double down arrow	
⠏		
⠏		

Removed characters

Characters in black script Braille

ȳ

ȳ

::

÷

^/ /.

::

.*

\

Character name

in other words

because

identical to

divisible by, departs

the sign of some
mathematical signs

Alphabetical index

A

absolute sum left and right, plumb line, divisor, set builder, "such that", determinant	$\ $	(8.3)
accent detached acute	$\sim^*$	(9.6)
accent detached grave	$\sim?$	(9.6)
addition sign, plus sign	$+$ \$	(5)
acute accent detached	$\sim^*$	(9.6)
alef (first letter of the Hebrew alphabet) all quanta	$A \quad \ddot{a}$	(9.5)
	$\ddot{y} \quad \ddot{a}$	(9.2)
apostrophe; minute, photo	'	(4.1)
assertion	$\ddot{y}$ is $\ddot{y}$	(9.2)
assertion mirrored	$\wedge \ddot{a}$	(9.2)
asterisk, multiplication sign	$*$ *	(5)
at sign, proboscis-a	@ $\sim \grave{a}$	(9.6)
depicted in (single curved right arrow)	$\ddot{y}$ $\sim$ (depicted on $\sim$)	(8.5)
	Alternative card form: $\sim$ (avb $\sim$)	
delimiter, closing character closing	and	(1.3)
character, delimiter	and	(1.3)

B

backslash, backslash, backslash	$\backslash \sim /$	(8.3, 9.6)
backslash, backslash, backslash	$\backslash \sim /$	(8.3, 9.6)
bet	$\text{in } \ddot{\text{i}} \sim \text{b} "$	(9.5)
only	$\ddot{\text{y}}$	(9.4)
dashes in plain text, minus signs, subtraction signs	$\ddot{\text{y}} -$	(5)
bareback	$<$	(1.2)
tick (bottom value) (directly below main character) fraction horizontal, horizontal division sign	' will= $\ddot{\text{y}} \text{ u}$	(7.1) (5, 6.1)
hyphen invisible	$\sim \ddot{\text{u}}$	(6.5, 10.7)
hyphen, horizontal main hyphen	$\ddot{\text{y}} \ddot{\text{y}} _$	(6.1, 6.4)
fractional slash, slash, division sign	$//$	(4.2, 5, 6.1, 8.3)
dashes, slanted main dashes	$/ //$	(6.4)

C

centered lower index (index directly below) centered upper index (index directly above) circle	will $\S \S$ $\bullet \ddot{\text{i}} \text{c } \ddot{\text{y}}$	(7.1) (7.1) (9.3)
circle with cross	$\ddot{\text{i}} \text{x c } \ddot{\text{y}} \ddot{\text{i}} \text{-c}$	(9.5)
circle with minus	$\ddot{\text{y}} \ddot{\text{i}} \$ \text{c } \ddot{\text{y}}$	(9.2)
circle with	$\ddot{\text{i}} \text{.c } \ddot{\text{y}} \ddot{\text{i}} \text{è}$	(9.2)
plus circle with		(9.5)
point circle		(9.4)
integral, contour integral		

circumflex freestanding	$\wedge \sim !$	(9.6)
quotation marks	" "	(1.3, 9.6)
D		
the valley	d ï~d	(9.5)
horizontal		
division sign, horizontal fractional line	÷ u	(5, 6.1)
division sign, slash, slash double double	//	(4.2, 5, 6.1, 8.3)
arrow (equivalent to) double right arrow	→ ð=0	(8.4, 9.2)
(implies, entails) double down arrow double	→ =0 ÿ	(8.4, 9.2)
up arrow	~(n_pil~) (8.5) ÿ ~(u_pil~) (8.5)	
double left arrow (required for) double bond	↔ o=	(8.4, 9.2)
(double dash) double integral	∫ " =;	(8.3, 12.2)
colon above	ÿÿ yes	(9.4)
letter (time derivative, trema above letter)	§;	(9.4)
double square bracket		
over multiple lines	⌈ ⌋ ïàïù and	(8.2)
double-sided brace (double-sided brace) over multiple lines	{ } ï_àï_ù û	(8.2)
double-sided parenthesis over several lines	() ï(ï) and	(8.2)
double-sided angle bracket over multiple lines	∠ ÿ ÿ ï_(ï_) and	(8.2)

double-sided plumb line over several lines	$\parallel$ and $\parallel$	(8.3)
double dash (double bond) double	$\ddot{y} =$	(8.3, 12.2)
vertical dash, standard	$\parallel \parallel$	(8.3)
double dash (directly below the main character)	$\ddot{y} \hat{=}$	(7.1)
AND		
not divisible	$\nmid \nmid \ddot{y}$	(8.3)
by not identical to	$\wedge = \ddot{y}$	(9.1)
not congruent with	$\wedge \sim = \wedge =$	(9.1)
not equal to, distinct from	$\ddot{y}$	(2.4, 9.1)
not uniform or equal to not	$\ddot{y} / \wedge \sim :-$	(9.1)
uniform with not	$\ddot{y} / \wedge \sim : < /$	(9.1)
less than not	$\wedge \# \ddot{o}$	(9.1)
less than or equal to	$\ddot{y} / \wedge \# \ddot{o} =$	(9.1)
not parallel to	$\backslash \wedge \parallel > /$	(9.1)
no bigger than	$\wedge \# 0$	(9.1)
not greater than or equal to	$\ddot{y} / \wedge \# 0 =$	(9.1)
equivalent to (double bidirectional arrow)	$\ddot{y} \ddot{o} = 0$	(8.4, 9.2)
or	$\ddot{y} \ddot{e}$	(9.2)
single curved right arrow (pictured in)	$\ddot{y} \sim$ (depicted on $\sim$)	(8.5)
Alternative card form:		
$\sim (avb \sim)$		
simple two-way arrow	$\ddot{y} \ddot{o} : 0$	(8.4)
simple right-directional arrow	$\ddot{y} : 0$	(8.4)

simple right arrow above simple left arrow	$\rightarrow\leftarrow$	(8.4)
single left-pointing arrow $\tilde{y}$ island: single		(8.4)
left-pointing arrow above single right-pointing arrow	$\tilde{y} \rightarrow::o$	(8.4)
single dash (single bond)	$- \text{ '},$	(8.3, 12.2)
single bond (single dash)	$- \text{ '},$	(8.3, 12.2)
one-sided right square bracket across multiple lines	$\lceil \tilde{u} \hat{u}$	(8.2)
one-sided right round bracket over several lines	$\rceil \tilde{u}$ and	(8.2)
one-sided right angle bracket over several lines	$\lceil \tilde{u}$ and	(8.2)
single-sided right brace (single-sided right angle bracket) over multiple lines	$\rceil \tilde{u}$ and	(8.2)
single-sided left square bracket over several lines	$\lfloor \tilde{a}$ and	(8.2)
single-sided left round bracket over several lines	$\lceil \tilde{u}$ and	(8.2)
single-sided left angle bracket over several lines	$\lceil \tilde{u}$ and	(8.2)
single-sided left brace (single-sided left angle bracket) across multiple lines	$\lceil \tilde{a} \hat{u}$	(8.2)
quanta of existence	$\tilde{y} \tilde{u}_e$	(9.2)

F

faculty sign (exclamation mark)	!!	(9.5)
continuation sign (marks at the end of the braille line that the black-line line continues)	⠇⠇	(1.3, 1.5, 9.6, 10.6, 13)
foot, apostrophe; minute	˘ ˘	(4.1)
detached acute accent	˘*	(9.6)
standalone circumflex	ˆ ˆ!	(9.6)
detached grave accent	˘?	(9.6)
detached tilde	˘ ˘: (9.6)	(9.6)
independent underscore	˘ ˘- ˘ ˘-(fkom˘) (5)	
function composition		
"function arrow" (right arrow with cross bar)	↗ :o	(8.4)
"square" (number sign)	# ˘#	(9.6)
sign for single highlighted character (applies only to the next closest character) sign for		
exponent or superscript (also paragraph sign §)	§	(1.1, 4.2, 7.1)
signs for several consecutive capitalized words	— And	(1.1, 2.1)
signs for several consecutive uppercase letters signs for	—	(1.1, 2.1)
lowercase greek	"	(1.1, 2.2)
uppercase greek letters	" —	(1.1, 2.2)
subscript sign	eh	(1.1, 7.1)

signs for some characters that occur, among other things, in computer contexts	~	(1.1, 9.6)
signs for numbers	#	(1.1, 3.1)
sign for crossed out character, often with the meaning not/not	^	(1.1, 2.4)
uppercase letter sign	—	(1.1, 2.1)
signs of several mathematical signs	ï	(1.1, 9.2, 9.3, 9.4)

G

gimel	ÿ ï~g ÿ	(9.5)
gradient (nabla)	ï_n ïg ~?	(9.4)
degree sign	•	(4.1)
grav accent detached		(9.6)

H

square bracket single-sided right across multiple lines	ïù û	(8.2)
square bracket single-sided left over multiple lines	ïà and	(8.2)
square bracket right	] ù [to	(8.1)
square bracket left		(8.1)

harpoon (right) ÿ ~(hharpun~) (8.5)

harpoon (right above left) ÿ ~(hvharpun~) (8.5)

harpoon (left) ÿ ~(vharpun~) (8.5)

harpoon (left above right)	$\dot{\sim} \sim(\text{vharpun}\sim)$	(8.5)
auxiliary bracket left	$\sim($	(1.3.4, 1.4, 8.1)
auxiliary bracket right	$\sim)$	(1.3.4, 1.4, 8.1)
horizontal fraction bar, horizontal division sign	$\ddot{y} \text{ u}$	(5, 6.1)
horizontal main dash	$\ddot{y}\ddot{y} \text{ _}$	(6.1, 6.4)
horizontal main dash	$\ddot{y}\ddot{y} \text{ _}$	(6.1, 6.4)
main fractional line slanted	$\dot{y} //] \dot{u}$	(6.1, 6.4)
right square bracket		(8.1)
right single-sided square bracket over several lines	$\ddot{u}$ $\hat{u}$	(8.2)
right auxiliary bracket	$\sim)$	(1.3.4, 1.4, 8.1)
right curly brace, right curly brace right	$\} \text{ _}\dot{u}$	(8.1)
round parenthesis	$) \text{)}$	(8.1)
right round bracket, single-sided over several lines	$\text{ , } \ddot{u})$ and	(8.2)
right angle bracket, right brace	$\} \text{ _}\dot{u}$	(8.1)
right angle bracket	$\dot{y} \text{ _})$	(8.1)
single-sided right bracket (right angle bracket) over multiple lines	$\text{ , } \ddot{u}$ and	(8.2)
right arrow with cross bar ("function arrow")	$\dot{y} \text{ :o}$	(8.4)
right-directed single arrow	$\dot{y} \text{ :o}$	right- (8.4)
directed harpoon	$\dot{y} \sim(\text{hharpun}\sim)$	(8.5)

right-directed harpoon above left-directed harpoon	$\dot{\curvearrowright} \sim (\text{hvharpun} \sim$ (8.5)	
right-directed single arrow above	$\rightarrow$	(8.4)
single left-directed arrow	$\leftarrow$	
I		
identical to	$\dot{=}$	(9.1)
implies, entails (double right-pointing arrow) index = subscript sign	$\dot{=}_0$	(8.4, 9.2)
index = directly below (centered lower index)	eh	(1.1, 7.1)
index = directly above (centered upper index)	will	(7.1)
contains	$\dot{\subseteq}$	(9.2)
contains (as subset)	$\dot{\subseteq}_0$	(9.2)
contains (as true subset)	$\dot{\subseteq}_0$	(9.2)
does not contain	$\dot{\not\subseteq}$	(9.2)
does not contain (as subset)	$\dot{\not\subseteq}_0$	(9.2)
contained in	$\dot{\subseteq}$	(9.2)
not contained in	$\dot{\not\subseteq}$	(9.2)
contained strictly	$\dot{\subset}$	(9.2)
in not/not, sign for crossed out sign, often with the meaning	$\wedge$	(1.1, 2.4)
not/not integral	$\dot{\neq}$	(9.4)
integral (circle integral, contour integral)	$\oint$	(9.4)

integral (double integral) $\iint$ $\mathbb{R}^2$ (9.4)

integral (trippelintegral) $\iiint$ $\mathbb{R}^3$ (9.4)

K

staples one-sided right
(one-sided right lace par-
entes) over several lines $\}$ $\mathbb{R}_+$ and (8.2)

single-sided left staple
(single-sided left angle
bracket) across multiple lines $\{$ $\mathbb{R}_-$ $\hat{u}$ (8.2)

braces double-sided (double-
sided curly braces)
over multiple lines $\{\}$ $\mathbb{R}_+ \mathbb{R}_- \hat{u}$ (8.2)

right brace, right brace left
brace, left brace $\}$ $\mathbb{R}_+$ (8.1)

colon, slash, relation $\{$ $\mathbb{R}_+$ has (8.1)

$::$ (5)

come $,$ $,$ (3.1.2)

complement $\mathbb{Y}$ $\mathbb{R}_k$ (9.2)

congruent with $\mathbb{Y} \sim :=$ (9.1)

contour integral,
circle integral $\mathbb{Y}$ yes (9.4)

cross,
multiplication sign $\times$ $\mathbb{X}$ (5)

square $\mathbb{Y}$ $\mathbb{R}_k$ (9.3)

square root, root sign $\sqrt{\quad}$ $\mathbb{Q}$ (7.2)

L

Laplace delta	$\ddot{y} \ddot{y}''_d$	(9.4)
equal to (equal sign)	$= =$	(9.1)
uniform or equal to	$\ddot{y} \sim :-$	(9.1)
uniform with, proportional to	$\sim$ or $\ddot{y} \sim :$	(9.1)
equal sign, equal to	$= =$	(9.1)
plumb line double-sided over several lines	$\parallel \parallel$ and $\parallel \parallel$	(8.3)
double plumb line, norm	$\parallel \parallel$	(8.3)
plumb line, divisor, set-builder, "such that", left and right absolute sum, determinant	$\parallel \parallel$	(8.3)

M

entails, implies (double right-pointing arrow)	$\ddot{y} = 0$	(8.4, 9.2)
less than or greater than	$\ddot{y} \# \ddot{o}$	(9.1)
less than (less than sign)	$< \# \ddot{o}$	(9.1, 9.6)
less than or equal to $\ddot{y} \# \ddot{o}$ = minus sign, hyphen in plain text, subtraction sign	$\ddot{y} -$	(9.1) (5)
minus plus corners	$\ddot{y} @ - \$$	(5)
minute, apostrophe; photo	$' \quad ' \quad '$	(4.1)
module	$\ddot{y} \quad \text{um}$	(9.5)
multiplication sign (asterisk)	$* \quad *$	(5)

multiplication sign (cross)	$\times$	(5)
multiplication sign (dot)	$\cdot$	(5)
multiplication sign (bold dot) much less	$\boldsymbol{\cdot}$	(5)
than	$\lessgtr$	(9.1)
much greater than	$\gg$	(9.1)
set builder, plumb line, divisor, "such that", left and right absolute sum, determinant	$\ $	(8.3)
N		
nabla (gradient)	∇	(9.4)
NAND characters	$\sim$ (nand~) (9.2) $\sim$ (npil~)	
down arrow	$\downarrow$	(8.5)
nedåtriktad pill double	∇ (n_arrow~) (8.5)	
the negation of	$\neg$	(9.1)
northeast arrow	$\nearrow$	(8.5)
northwest arrow	$\nwarrow$	(8.5) $\ $: $\ $:
standard, double plumb line	$\ $	(8.3)
normal, perpendicular to	$\perp$	(9.3)
NOR sign	$\overline{\sim}$ (nor~) (9.2) number sign, "square"	
# ~# necessary for (double left arrow)	$\Leftarrow$	(9.6)
	$\circ$	(8.4, 9.2)

O

and	$\ddot{\text{y}} \ddot{\text{i}} \text{o}$	(9.2)
backslash backslash	$\backslash \sim /$	(8.3, 9.6)
backslash invisible		
dash infinity (note	$\sim \ddot{\text{u}}$	(6.5, 10.7)
that the full cell is part		
of the symbol)	$\ddot{\text{y}} \# \text{i s}$	(9.2)

P

parallel to	$\parallel \parallel$	(9.1)
partial derivative	$\ddot{\text{y}} \quad \ddot{\text{i}} \text{''d}$	(9.4)
arrow double bidirectional (equivalent to)	$\ddot{\text{y}} \ddot{\text{o}} = \text{o}$	(8.4, 9.2)
arrow double right directional (implies,	$\ddot{\text{y}} = \text{o}$	(8.4, 9.2)
entails) arrow double downward	$\ddot{\text{y}} \sim (\text{n_pil} \sim) \quad (8.5) \quad \ddot{\text{y}} \sim (\text{u_pil} \sim) \quad (8.5)$	
arrow double up arrow		
double left (required for)	$\ddot{\text{y}} \text{ o} =$	(8.4, 9.2)
arrow simple curved right (pictured on)	$\ddot{\text{y}} \quad \sim (\text{image} \text{ as} < \text{on} \sim)$	(8.5)
Alternative card form:		
	$\sim (\text{avb} \sim)$	
arrow simple bidirectional	$\ddot{\text{y}} \ddot{\text{o}} : \text{o}$	(8.4)
simple right-directed arrow	$\ddot{\text{y}} : \text{o}$	(8.4)
arrow simple right above simple	$: \text{ooo} :$	(8.4)
left arrow		
arrow simple left	$\ddot{\text{y}} \text{ island} :$	(8.4)

arrow simple left above	$\ddot{y} \text{ } \ddot{o}$	(8.4)
simple right arrow down	$\ddot{y} \text{ } \ddot{o}$	(8.4)
arrow	$\ddot{y} \sim (\text{npl}) \sim$ (8.5) $\ddot{y} \sim (\text{upil}) \sim$ (8.5)	
arrow up		
plus tuck, addition tuck	+ \$	(5)
plus minus checking	$\pm @ \$ -$	(5)
prim	' ,	(9.4)
percent	% Umbrella	(4.1)
product corners	$\ddot{y} " _ p$	(9.5)
blood alcohol level	$\%_o O h$	(4.1)
proportional to, uniform with	$\sim$ or $\ddot{y} \sim :$	(9.1)
point	. .	(3.1.2)
dot, multiplication sign dot	$\cdot \ddot{i}.$	(5)
above letter (time derivatives)	$\S.$	(9.4)
R		
directly below (centered lower index)	will	(7.1)
directly above (centered upper index)	$\S\S$	(7.1)
rectangle	ir	(9.3)
relation sign, colon, scale sign	: ::	(5)
root sign, square root	$\sqrt{\quad} Q$	(7.2)
round bracket right	))	(8.1)
round bracket left	((	(8.1)

round brackets double-sided over several lines	$\left(\right)$	$\ddot{i}(\ddot{i})$ and	(8.2)
round bracket one-sided right over several lines	$\right)$	$\ddot{i})$ and	(8.2)
round parenthesis single-sided left over several lines	$\left($	$\ddot{i}(\text{ and}$	(8.2)
s			
second, tum	"	"	(4.1)
semicolon	;	;	(3.1.2)
skalecken, colon, relationsticken	:	:	(5)
proboscis-a, at-	@	~to	(9.6)
character backslash, backslash, backslash,	\	~/	(8.3, 9.6)
slash, fraction slash, division slash fraction	/	/	(4.2, 5, 6.1, 8.3)
slash, slash, division	//	//	(4.2, 5, 6.1, 8.3)
slanted main fractional line	/	//	(6.1, 6.4)
average	$\ddot{y}$	is	(9.2)
mirrored assertion	$\ddot{y}$	$\wedge \ddot{i}a$	(9.2)
curly braces double-sided (double-sided curly braces) over multiple lines	$\{ \}$	$\ddot{i}_{\ddot{a}} \ddot{i}_{\ddot{u}} \hat{u}$	(8.2)
curly braces single-sided right (single-sided right bracket) over multiple lines	$\}$	$\ddot{i}_{\ddot{u}}$ and	(8.2)

angle bracket single-sided left (single-sided left bracket) across multiple lines	$\{ _ \grave{\text{a}} \hat{\text{u}}$	(8.2)
angle bracket right, right brace	$\} _ \grave{\text{u}}$	(8.1)
angle bracket left, left brace	$\{ _ \text{has}$	(8.1)
dash double (directly below main character)	$\text{will}=_$	(7.1)
dash (directly below main character)	$_ \text{will}-$	(7.1)
dash (directly above main character)	$\text{\S\S}-$	(7.1)
crossed out sign = sign for crossed out sign, often with the meaning not/not	$\wedge$	(1.1, 2.4)
greater or less than	$\grave{\text{y}} \# \text{o}\ddot{\text{o}}$	(9.1)
subtraction sign, minus sign, hyphen in plain text	$\grave{\text{y}} -$	(5)
greater than or equal to	$\grave{\text{y}} \# \text{o} =$	(9.1)
greater than (greater than sign)	$> \# \text{o}$	(9.1, 9.6)
summa corners	$\grave{\text{y}} _ \text{"_s}$	(9.5)
southeast arrow	$(\text{sopil}) (\text{8.5})$	
southwest arrow	$\grave{\text{y}} \sim (\text{svpil} \sim) (\text{8.5})$	

T

ceiling, peak value (directly above main character) time	$\overset{\wedge}{\S\S!}$	(7.1)
derivative (double dot above letter, treble above letter)	$\ddot{\S};$	(9.4)
time derivative (dot above letter) time	$\dot{\S}.$	(9.4)
derivative (triple dot above letter) tilde	$\dots \S;.$	(9.4)
(directly above capital character)	$\sim \S\S:$	(7.1)
tilde standalone	$\sim \sim:$	(9.6)
belongs to	$\ddot{y} \ddot{i}_t$	(9.2)
does not belong	$\ddot{y} \wedge \ddot{i}_t$	(9.2)
empty amount	$\ddot{y} \wedge O$	(9.2)
peak value (ceiling) (just above main character)	$\overset{\wedge}{\S\S!}$	(7.1)
trema above letter (time derivative, double-dot above letter)	$\ddot{\S};$	(9.4)
triangle	$\ddot{y} \ddot{i}t$	(9.3)
triple bond (triple dash)	$\ddot{y} he$	(8.3, 12.2)
trippelintegral	$\ddot{y}\ddot{y}\ddot{y} hey$	(9.4)
triple prime, triss	$\ddot{y}\ddot{y}\ddot{y} \quad \dots$	(9.4)
triple dot above letter (time derivative) triple	$\dots \S;.$	(9.4)
dash (triple bond)	$\ddot{y} he$	(8.3, 12.2)
triss, triple prime	$\ddot{y}\ddot{y}\ddot{y} \quad \dots$	(9.4)
tum, second	$\ddot{y} \quad \ddot{y}$	(4.1)

IN

underscore stand alone	$_ \sim -$	(9.6)
approximately equal to	$\tilde{y} \sim ::$	(9.1)
union	$\tilde{y} \tilde{u}$	(9.2)
up arrow	$\tilde{y} \sim (\text{noise} \sim)$	(8.5)
uppåtriktad double pill	$\tilde{y} \sim (\text{u_pil} \sim)$	(8.5)
exclamation mark, faculty sign	$!$	(9.5)

IN

warning signs	$\sim$	(1.3.2)
vector	$_ \S\S -$	(7.1)
vector arrow	$\S\S : O$	(7.1)
sold pi	$\tilde{y} _p \tilde{y} _s$	(2.2)
versalt sigma		(2.2)
angle	$\tilde{y} \tilde{v}$	(9.3)
angle bracket double-sided over multiple lines	$\tilde{y} \tilde{y} \quad \tilde{i} _ (\tilde{i} _)$ and	(8.2)
angle bracket one-sided right across multiple lines	$\tilde{y} \quad \tilde{i} _)$ and	(8.2)
angle bracket single-sided left over multiple lines	$\tilde{y} \quad \tilde{i} _ ($ and	(8.2)
angle bracket right	$\tilde{y} _)$	(8.1)
angle bracket left	$\tilde{y} _ ($	(8.1)
perpendicular to, normal	$\tilde{y} \text{ in}$	(9.3)
left square bracket	$[$ has	(8.1)

left square bracket single-sided over several lines	$\lceil$ and	(8.2)
left auxiliary parenthesis	$\sim($	(1.3.4, 1.4, 8.1)
left bracket single-sided (single-sided left angle bracket) over multiple lines	$\{ _ \grave{\text{a}} \hat{\text{u}}$	(8.2)
left curly brace, left curly brace	$\{ _ \text{has}$	(8.1)
left parenthesis	$(($	(8.1)
left round bracket one- sided over several lines	$($ $\grave{\text{i}}($ and	(8.2)
left angle bracket	$\grave{\text{y}} _ ($	(8.1)
left angle bracket single- sided over multiple lines	$_ \grave{\text{i}} _ ($ and	(8.2)
left double arrow (required for	$\grave{\text{y}} \text{ o} =$	(8.4, 9.2)
left-directed single arrow $\grave{\text{y}}$ is and: left-		(8.4)
directed single arrow above right-	$\grave{\text{y}} \ddot{\text{o}} :: \text{o}$	(8.4)
directed single arrow		
left-handed harpoon $\grave{\text{y}} \sim(\text{vharpoon}\sim)$		(8.5)
left-handed harpoon above right-handed	$\grave{\text{y}} \sim(\text{vhharpoon}\sim)$	(8.5)
X		
XOR sign	$\grave{\text{y}} \sim(\text{free}\sim)$	(9.2)

Character index

Sorting in the character register is done according to the number of points in the Braille characters from one to six. Braille characters with the same number of points are sorted according to the mutual number order. Characters that are reproduced in braille with several braille characters have been sorted first by the first braille character, then the second, etc.

$\wedge \sim :$	$\bar{y}/$	not uniform with (9.1)
$\wedge \sim : -$	$\bar{y}/$	not uniform or equal to (9.1)
$\wedge \sim : =$	$\bar{y}/$	not congruent with (9.1)
$\wedge \emptyset$	$\bar{y}$	the empty set (9.2)
$\wedge $	η	no divisor of (8.3)
$\wedge $	$\backslash$	not parallel to (9.1)
$\wedge =$	$\bar{y}$	not equal to, distinct from (2.4, 9.1)
$\wedge ==$	$\bar{y}/$	not identical to (9.1)
$\wedge \# \emptyset$	$>/$	not greater than (9.1)
$\wedge \# \emptyset =$	$\bar{y}/$	not greater than or equal to (9.1)
$\wedge \# \emptyset$	$</$	not less than (9.1)
$\wedge \# \emptyset =$	$\bar{y}/$	not less than or equal to (9.1)
That's it	$\bar{y}$	mirrored assertion (9.2)
$\wedge \bar{i} _ \emptyset =$	$\bar{y}/$	does not contain (as subset) (9.2)
$\wedge \bar{i} _ \emptyset =$	$\bar{y}/$	is not contained in (9.2)
$\wedge \bar{i} _ t$	$\bar{y}$	does not belong (9.2)
$\wedge \bar{i} \bar{i}$	$\bar{y}/$	does not contain (9.2)
'	'	apostrophe; minut, fot (4.1): prim (9.4)
''	$\bar{y}$	only (9.4)

'''	'''	tris, triple prime (9.4)
'.	'.	single dash (single bond) (8.3, 12.2)
'.	'.	sign for capital letter (1.1, 2.1) sign for several capital letters in succession (1.1, 2.1)
—	—	signs for several consecutive capitalized words (1.1, 2.1)
—	—	
and		
_(	_(	left angle bracket (8.1)
)	)	right angle bracket (8.1)
_has	{	left brace, left curly brace (8.1)
_ù	}	right brace, right curly brace (8.1)
;	;	; semicolon (3.1.2)
:	:	colon, skalecken, relationsticken (5)
:O	→	single right arrow (8.4) single
:000:	→	right arrow above single left arrow (8.4)
:\$	¬	the negation of (9.1)
/	/	slash, slash, division sign (4.2, 5, 6.1, 8.3) slash (6.1, 6.4)
//	/	
*	*	* multiplication sign (asterisk) (5)
-	-	minus sign, subtraction sign, hyphen in plain text (5)
~	~	warning signs (1.3); signs for e.g. some characters that appear in a computer context (1.1, 9.6)
~:	~	independent tilde (9.6)
~:	~ or ÿ	proportional to, uniform with (9.1)

$\sim::$	$\ddot{y}$	approximately equal to (9.1)
$\sim:-$	$\ddot{y}$	uniform or equal to (9.1)
$\sim:=$	$\ddot{y}$	congruent with (9.1)
$\sim?$		detached grave accent (9.6)
$\sim/$	$\backslash$	backslash, backslash, backslash (8.3, 9.6); difference (in quantities) (9.2)
$\sim*$		detached acute accent (9.6)
$\sim-$	$-$	independent underscore (9.6)
$\sim!$	$\wedge$	independent circumflex (9.6)
$\sim($		left auxiliary bracket (1.3.4, 1.4, 8.1)
$\sim(\text{depicted} \leftarrow \text{on} \sim) \ddot{y}$		single curved right arrow (shown in) (8.5)
$\sim(\text{fkom} \sim) \sim(\text{hharpun} \sim)$	$\circlearrowright$	functional composition (5)
$\ddot{y}$		right-directed harpoon (8.5)
$\sim(\text{hvharpoon} \sim) \ddot{y}$		right-directed harpoon above left-directed harpoon (8.5)
$\sim(\text{in_pil} \sim)$	$\ddot{y}$	double upward arrow (8.5)
$\sim(\text{sniffle} \sim)$	$\ddot{y}$	up arrow (8.5)
$\sim(\text{sophisticated} \sim)$	$\ddot{y}$	sydospil (8.5)
$\sim(\text{svpil} \sim)$	$\ddot{y}$	southwest arrow (8.5)
$\sim(\text{vharpoon} \sim) \ddot{y}$		left-handed harpoon (8.5)
$\sim(\text{vhharpoon} \sim) \ddot{y}$		left-handed harpoon above right-handed harpoon (8.5)
$\sim(\text{nand} \sim) \ddot{y}$		NAND character (9.2)
$\sim(\text{n_pil} \sim) \ddot{y}$		double downward arrow (8.5)
$\sim(\text{nopil} \sim) \ddot{y}$		northeast arrow (8.5)
$\sim(\text{nor} \sim)$	$\overline{\ddot{y}}$	NOR sign (9.2)

~(npil~)	ÿ pil nedåt (8.5)
~(nvpil~)	ÿ northwest arrow (8.5)
~(free~)	ÿ XOR sign (9.2)
~)	right auxiliary bracket (1.3.4, 1.4, 8.1)
~ü	invisible dash (6.5, 10.7)
~#	# number sign, "square" (9.6)
~to	@ snabel-a, at sign (9.6)
@	sign for single highlighted character (applies only to the closest following character) (1.1, 2.3)
@-\$	ÿ minus plus plugs (5)
@\$-	± plusminus checks (5)
@i.	· multiplication sign (bold dot) (5)
"	quotation marks (1.3, 9.6); second, inch (4.1); lowercase Greek letter sign
"_	(1.1, 2.2) Greek uppercase letter sign
"_s	ÿ (1.1, 2.2) sum sign (9.5); capital sigma (2.2)
"_p	ÿ product corners (9.5); versalt pi (2.2)
"=;	ÿ double dash (double bond) (8.3, 12.2)
eh	subscript sign (1.1, 7.1) directly below (centered subscript) (7.1)
will	dash (directly below main character) (7.1)
will-	ÿ bottom value (tick) (directly below main
will=	ÿ character) (7.1) double dash (directly below main character) (7.1)

Q	√	root sign, square root (7.2)
and		termination sign, separator (1.3)
!	!	faculty sign (exclamation point) (9.5)
(	(	left round bracket (8.1)
he:	↵	simple left arrow (8.4)
Ö::o	↔	single left arrow above single right arrow (8.4)
Ö:O	↔	simple bidirectional arrow (8.4)
O=	↔	double left arrow (necessary for) (8.4, 9.2)
Ö=O	↔	double double arrow (equivalent to) (8.4, 9.2)
\$	+	addition sign, plus sign (5)
§		sign for exponent or superscript (1.1, 4.2, 7.1) (also paragraph sign §)
§.	·	time derivative (point above letter) (9.4)
§;	·	time derivatives (colon above letter, triple above letter) (9.4)
§;.	...	time derivative (triple dot above letter) (9.4)
§§		directly above (centered superscript) (7.1)
§§:	˘	tilde (directly above capital) (7.1)
§§:O		vector arrow
§§-		(7.1) dash (just above main
§§-	—	character) (7.1) vector (7.1)
§§!	^	peak value (ceiling) (just above main character) (7.1)

)	)	right round bracket (8.1)
		plumb line, divisor, set builder, "such that", left and right absolute sum, determinant (8.3) right arrow with cross
:o	↗	bar ("function arrow") (8.4) vector (7.1)
§§-	—	
		double plumb line, norm (8.3); parallel to (9.1) triple
he	⋯	dash (triple bond) (8.3, 12.2)
u	⋮	horizontal fractional line, horizontal division sign (5, 6.1)
general	⋮	horizontal main fractional line (6.1, 6.4)
Underside	%	% percent (4.1)
oh	‰	‰ blood alcohol level (4.1)
And	∫	integral (9.4)
eh	∫∫	double integral (9.4)
hey	∫∫∫	trippelintegral (9.4)
=	=	= equal to (equal sign) (9.1)
=o	⇒	double right arrow (implies, entails) (8.4, 9.2) identical to (9.1)
==	≡	
#	±	signs of numbers (1.1, 3.1)
#O	>	greater than (greater than sign) (9.1, 9.6)
#00	≫	much larger than (9.1)
#00	≳	greater or less than (9.1)
#0=	≥	greater than or equal to (9.1)
#he	<	less than (less than sign) (9.1, 9.6)

#öo	ÿ smaller or larger than (9.1)
#night	ÿ much smaller than (9.1)
#ö=	ÿ less than or equal to (9.1)
#It is	ÿ infinity (note that the full cell is part of the symbol)(9.2) left square bracket
HAS	[(8.1)
ï	signs of several mathematical signs (1.1, 9.2, 9.3, 9.4)
Yes	ÿ assertion (9.2)
ï.	· multiplication plug (point) (5)
ï_a	ÿ all quanta (9.2)
ï_k	ÿ complement (9.2)
ï.c	ÿ circle with point (9.5)
ï_e	ÿ quanta of existence (9.2)
ï_o	ÿ contains (as real subset) (9.2)
ï_o=	ÿ contains (as subset) (9.2)
ï_(and	ÿ single-sided left angle bracket over several lines (8.2)
ï_(ï_) and	ÿ ÿ double-sided angle bracket over several lines (8.2)
ï_ö	ÿ is strictly contained in (9.2)
ï_ö=	ÿ contained in (9.2)
ï_) and	ÿ one-sided right angle bracket over several lines (8.2)
ï_n	ÿ nabla (gradient) (9.4)

$\ddot{t}$	$\ddot{y}$	belong to (9.2)
$\ddot{a} \hat{u}$	$\{$	single-sided left bracket (single-sided left angle bracket) over several lines (8.2)
$\ddot{a} \ddot{u} \hat{u}$	$\{\}$	double-sided brace (double-sided brace) over multiple lines (8.2)
$\ddot{u}$ and	$\}$	single-sided right bracket (single-sided right angle bracket) over several lines (8.2)
$\ddot{k}$	$\ddot{y}$	square (9.3)
$\ddot{c}$	$\bullet$	circle (9.3)
that's it	$\ddot{y}$	or (9.2)
$\ddot{e}$	$\ddot{y}$	contains (9.2)
$\ddot{c}$	$\ddot{y}$	circle with minus (9.2) aleph
$\ddot{a}$	$\aleph$	(first letter of the Hebrew alphabet) (9.5)
$\ddot{g}$	$\aleph$	gimel (9.5)
$\ddot{d}$	$\ddot{y}$	Laplace delta (9.4)
$\ddot{b}$	$\mathbb{B}$	but (9.5)
$\ddot{d}$	$\mathbb{d}$	the valley (9.5)
$\ddot{d}$	$\ddot{y}$	partial derivative (9.4)
$\mathbb{u}\mathbb{m}$	$\ddot{y}$	modulus (9.5)
$\ddot{o}$	$\ddot{y}$	and (9.2)
$\ddot{u}$	$\ddot{y}$	union (9.2)
$\mathbb{d}$	$\ddot{y}$	diameter (9.3)
$\mathbb{is}$	$\ddot{y}$	average (9.2)
$\ddot{(\text{and}}$	$($	one-sided left parenthesis over several lines (8.2)

ï(i) and	()	double-sided round bracket over several lines (8.2)
ï\$c	ÿ	circle with plus (9.2)
ï) and	)	one-sided right parenthesis over several lines (8.2)
ï i and		double-sided plumb line over several lines (8.3)
ïr		rectangle (9.3)
ïv	ÿ	angle (9.3)
ïg	•	straight corners (4.1)
ln	ÿ	normal, perpendicular to (9.3)
ïx	×	multiplication sign (cross) (5)
ïxc	ÿ	circle with cross (9.5)
ït	ÿ	triangle (9.3) ÿ
Yes		circle integral, contour integral (9.4)
ïà ú	[	single-sided left square bracket over multiple lines (8.2)
ïàïù And	[]	double-sided square bracket over several lines (8.2) continuation character (marks at the end of the braille line that the black-print line continues) (1.3, 1.5, 9.6, 10.6, 13)
ïï	]	single-sided right square bracket over several lines (8.2)
ïù û	]	right square bracket (8.1)
It is(		the beginning of the quarrel (1.3.5, 6.1)

is(<is)

It is)

fraction adder (1.3.5, 6.1)

fraction endings (1.3.5, 6.1)