

CONSEJO IBEROAMERICANO DEL BRAILLE

C · B

Código **matemático**
unificado
para Iberoamérica

Edita

Unified mathematical code for Latin America



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Technical Commission of Sciences

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Introduction

In all areas of knowledge, new contents and ways of representing them have emerged. Access to all this information is a universal and unrestricted right.

During all these years, the need to represent mathematical notations and expressions not contemplated in the initial version of the Unified Mathematical Code (CMU) of 1987 (statistics, financial mathematics, two-dimensional representations, some delimiters, typographical resources that were not used in those years, etc.) or appeared later in the general educational or scientific field.

Braille is a living organism that, moreover, in the last decades, has been demonstrating astonishing vitality. It remains unfinished, displaying a potentiality that honors its inventor.

In particular, the braille signography of mathematics and other scientific disciplines is an open, flexible and dynamic tool, with the capacity to face the challenges and continuous changes in the graphic representation of mathematical expressions.

On the other hand, inclusive education has meant the participation of a greater number of students with visual disabilities, both in middle and higher levels, which has motivated the need to update the representation of some of the expressions used in the mathematics classroom. It is a signography that, of course, covers different educational stages and allows symbols to be represented both at an elementary level and at a higher level.

This social and educational dynamic led the Ibero-American Braille Council (CIB), made up of representatives of the Spanish and Portuguese-speaking countries, to consider the need to update the Unified Mathematical Code and to decide, for this, the formation of a Technical Commission of Sciences, dedicated to the wide and deep study of the contents of mathematics, its representations and correct application using the braille system. The present update of the CMU is the result of the work of that commission.

For all of the above, this code and its Braille representation standards are subject to further extensions and modifications that will impose its application and the evolution of educational and scientific processes in the future.

Based on the validity and consistency of most of the signs approved in 1987, the final result of this update has been the incorporation of new signs and representations, as well as some modifications that are considered necessary.

A novelty of the 2023 version of the CMU is its publication in Spanish and Portuguese.

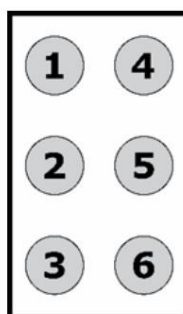


The code update has been done taking into account:

- What is the literacy tool for braille-using students?
within the novelty that supposes the generalized reality of «education inclusive».
- The needs of braille-using mathematics professionals.
- The needs of the braille user student body, detected by the teachers in their daily work in the mathematics classroom. good use of the code makes it easier for the blind student to write and avoids some mistakes observed in braille reading.
- New technologies, which are increasingly present in the classroom and in the education of blind people.
- The demands, current or future, of digital editing and transcription, which, to produce higher quality braille texts, require the use of a appropriate code.
- That transcription guidelines have been given that have allowed us not to be exhaustive in the enumeration of punctual representations.
- The graphic representation of visual symbols has been taken into account as relative positions, except in some widely used signs, such as adding or that of equality, in which meaning is taken into account.

Throughout the chapters of this new edition of the Unified Mathematical Code, alludes to the series into which the combinations formed with the six dots of the braille generator sign are divided.

The dot assignment to represent a braille character is:



For example, the braille character that represents the letter z is made up of dots 1, 3, 5, and 6: z



The seven series are listed below:

1st series: points 1, 2, 4 and 5 are used.

A b c d e f g h i j

2nd series: point 3 is added to the combinations of the 1st series.

K l m n o p q r s t

3rd series: point 6 is added to the combinations of the 2nd series.

The vxyz ç \ á é ú

4th series: point 6 is added to the combinations of the 1st series.

§ (œ ¥ Ý ë ñ ü ö w

5th series: one position is lowered to the points of the 1st series, points 2, 3, 5 and 6.

, ; : * ¿ + = []

6th series: points 3, 4, 5 and 6.

In) # ó - .

7th series: points 4, 5 and 6.

¾ ^ % » _ @ {

Representation agreements

Throughout the chapters that make up this code, the signs will be presented in tables with a series of columns: visual sign, braille sign, number of braille dots that make up the sign, and meaning.

In the respective column, the enumeration of the braille dots that make up each sign conforms to the following conventions:

- The braille sign is represented by a number made up of the digits of each of the dots that make it up.

Example:

P braille dots: 1234

- When a braille sign consists of more than one cell, the dots of each braille character are separated from the previous and following one with a hyphen.



Example:

{n braille dots: 46-1345

- When the blank space is part of a sign, it is represented by 0.

Example:

l braille dots: 0-123-0

- It will be understood by "blank semi-box" when one of the columns of the braille box does not have any dots.
- When a sign requires to have a blank title page below (unless its right) is represented 0D.

Examples of the sign 456-0D. Note that, in this first case, the box that comes below does not contain any of items 1, 2, or 3:

%{p braille points: 456-0D-46-1234

However, in this other case it does have them, so it is necessary to leave a title block with no dot between the two characters:

% p braille points: 456-0-1234

- When a sign must be preceded by a blank half box (to its left) is represented as l0.

Examples of the sign l0-123. Note that, in this first case, the box above does not contain any of items 4, 5 or 6:

at braille dots: 13-l0-123

However, in this case it does have them, so it is necessary to leave a title block with no dot between the two characters:

l braille dots: 3456-0-123

- Throughout the text, reference is sometimes made to "signs or numbers in low position." With this, reference is made to the totality of the signs of the 5th series.

Numerous examples are included in order to clarify the use of the signs.

The code has been structured in 14 chapters and three appendices. It is recommended to read the Chapter 14. *Adaptation and editing criteria*, before addressing the use of the code.



Some aspects to highlight of the code are:

1. News.

- The distinction of colors and typography changes are contemplated within numerical and mathematical expressions (chapters 1 and 2).
- The representation of fractional numbers has been modified (*Chapter 2*).
- Added rendering of other delimiters horizontally (*Chapter 3*).
- Differentiated representation of two-dimensional expressions (systems, matrices, determinants, etc.) in developed and semi-linearized formats (*Chapter 3*).
- Signs for statistics and financial mathematics are collected in their most frequent notations (chapters 12 and 13).
- Issues related to the adaptation to Braille of new typographical resources used in the edition of current textbooks, which are often used for educational purposes, such as the Braille representation of «blank spaces» or «a fill in», and underlined, crossed out and colored expressions or characters and signs (*Chapter 14*).
- Rules are established on the partition of mathematical expressions that exceed the number of characters of the braille print (*Chapter 14*).
- Abbreviated and alternate representations are included to allow for some flexibility for note-taking by students or for handling in editors (trigonometrics, limits, derivatives...) (chapters 9 and 10).
- Braille representations of “physicochemical units” (or “algebra of quantities”) are included following the international agreements contained in the 2019 9th edition of the International System of Units (*Appendix 1*).

2. Recommendations for braille editions.

- It is recommended (fundamentally to editors) that tables be included in science texts with the signs used and their meaning.
- It is convenient to make known the function and use of the auxiliary parentheses when they appear for the first time in a text, since it is a resource of the braille system (*Chapter 3*).
- When a mathematical expression appears within a text, two spaces must be left before and two after (*Chapter 14*).
- To avoid possible confusion, it is recommended not to use shorthand Braille in exact or natural science texts.



Chapter 1. Character literals

Distinctive prefixes

In the Unified Mathematical Code approved in Montevideo (Uruguay) in June 1987 the concept of "alphabetic prefixes" was introduced. This meant that, taking as a base the lowercase Latin letters, each of these prefixes characterized them as letters of an alphabet, according to the sign fixed to be the distinctive of each of them. The lowercase Latin letters also had their prefix, as it was necessary, for example, to avoid confusion between numbers and letters.

This concept is maintained in substance and also in form, but it is necessary make some precisions.

- A) Except for lowercase Latin letters, in which the prefix is omitted except to avoid confusion, each letter must be considered (regardless of the alphabet) as a Braille sign made up of two inseparable characters —*prefix + base letter*— and consider it like any other sign that occupies two cells. This will mean that, in mathematical expressions, no prefix (not even the lower case Latin letters from "a" to "j" within numerical expressions) will be valid for several consecutive letters.
- B) Since the function of "alphabetic prefix" is not the only one performed by the Braille signs chosen for this (precisely, they are quite used for brands), care must be taken not to create confusion, applying for the lowercase Latin letters a correct use of point 5 when used as a "lowercase latin prefix".
- C) From what has been said, it can be deduced that in numerical expressions that contain letters, in which not all of them always go to the end, all the braille characters of the 1st series not preceded by point 5 have numerical value. I mean, they are numbers.

Examples:

234a5 #bcd@ae

234ae #bcd@a@e

In addition to what is stated later in this chapter, other examples of the use of the Point 5 will be dealt with in detail in the corresponding chapters.

1.1. Latin characters

Only the letters of the Latin alphabet used in mathematics are included.



Lowercase letter	Signo braille	braille dots	Capital letter	Signo braille	braille dots
a	A	1	A	{a {b	46-1
b	B	12	B	{c {d	46-12
c	C	14	C	{e {f	46-14
d	D	145	D	{g {h	46-145
It is	AND	15	AND	{i {j	46-15
f	F	124	F	{k {l	46-124
g	G	1245	G	{m	46-1245
h	H	125	H	{n {o	46-125
i	I	24	I	{p {q	46-24
j	J	245	J	{r {s	46-245
k	K	13	K	{t {u	46-13
l	L	123	L	{v	46-123
m	M	134	M	{w	46-134
n	N	1345	N		46-1345
O	O	135	O		46-135
p	P	1234	P		46-1234
q	Q	12345 Q			46-12345
r	R	1235	R		46-1235
s	S	234	S		46-234
t	T	2345	T		46-2345
in	IN	136	IN		46-136
in	IN	1236	IN		46-1236
In	IN	2456 W			46-2456
x	X	1346	X	{X {y	46-1346
and	AND	13456	AND	{z	46-13456
with	WITH	1356	WITH		46-1356



In the event that lower case letters may cause confusion as part of signs or expressions, must be preceded by the character @ (5), called "prefix of Latin minuscule."

The braille character { (46), which is an inseparable part of the Latin letters capital letters, it is called a "Latin capital prefix".

1.2. Greek characters

Name	Letter lower case	Signo braille	Points braille	Letter capital letter	Signo braille	Points braille
alfa	a	$\frac{3}{4}\mathbf{a}$ 4-1 $\frac{3}{4}\mathbf{b}$		A	$\wedge\mathbf{a}$ 45-1 $\wedge\mathbf{b}$	
beta	b	4-12		B	45-12	
gamma γ		$\frac{3}{4}\mathbf{g}$ 4-1245		c	$\wedge\mathbf{g}$ 45-1245	
delta	d	$\frac{3}{4}\mathbf{d}$ 4-145		D	$\wedge\mathbf{d}$ 45-145	
epsilon e		$\frac{3}{4}\mathbf{e}$ 4-15		E	$\wedge\mathbf{e}$ 45-15	
dseta	g	$\frac{3}{4}\mathbf{z}$ 4-1356 $\frac{3}{4}\mathbf{Y}$		G	$\wedge$ of 45-1356	
and	the	4-156 $\frac{3}{4}\mathbf{Y}$ 4-1456		THE	$\wedge$ Italian 45-156	
zeta	i	Th			$\wedge\mathbf{Y}$ 45-1456	
iota	i	$\frac{3}{4}\mathbf{i}$ 4-24		I	$\wedge\mathbf{i}$ 45-24	
kappa	K	$\frac{3}{4}\mathbf{k}$ 4-13 $\frac{3}{4}\mathbf{l}$		K	$\wedge\mathbf{k}$ 45-13	
lambda γ		4-123 $\frac{3}{4}\mathbf{m}$ 4-134		L	$\wedge\mathbf{l}$ 45-123	
me	m	M $\frac{3}{4}\mathbf{n}$ 4-1345 $\frac{3}{4}\mathbf{x}$ 4-1346			$\wedge\mathbf{m}$ 45-134	
in	n	$\frac{3}{4}\mathbf{o}$ 4-135 $\frac{3}{4}\mathbf{p}$		N	$\wedge\mathbf{n}$ 45-1345	
xi	x	4-1234 $\frac{3}{4}\mathbf{r}$ 4-1235		X	$\wedge\mathbf{x}$ 45-1346	
ómicron o		$\frac{3}{4}\mathbf{s}$ 4-234 $\frac{3}{4}\mathbf{t}$		THE	$\wedge\mathbf{o}$ 45-135	
pi	Pi	4-2345 $\frac{3}{4}\mathbf{u}$ 4-136		Pi	$\wedge\mathbf{p}$ 45-1234	
ro	r	$\frac{3}{4}\mathbf{f}$ 4-124 γ		R	$\wedge\mathbf{r}$ 45-1235	
sigma	S S			S	$\wedge\mathbf{s}$ 45-234	
yes	t			T	$\wedge\mathbf{t}$ 45-2345	
ipsilon y				Y	$\wedge\mathbf{in}$ 45-136	
be	Phi				$\wedge\mathbf{f}$ 45-124	



Name	Lowercase letter	Signo braille	braille dots	Capital letter	Signo braille	braille dots
	h	$\frac{3}{4}\text{c}$ 4-12346	$\times \frac{3}{4}\text{y}$ 4-13456		45-12346 _	
psi	p	W $\frac{3}{4}\text{w}$ 4-2456	$\dot{\text{y}}$		^y 45-13456	
omega	oh				^w 45-2456	

The character $\frac{3}{4}$ (4), which is an inseparable part of the lowercase Greek letters, is called a "lowercase Greek prefix."

The character ^ (45), which is an inseparable part of the capital Greek letters, is called a "capital Greek prefix".

Other commonly used Greek characters that carry a different prefix are:

Name	sight sign	Signo braille	braille dots
varzetta	$\ddot{\text{y}}$	$\frac{3}{4}\text{ó}\text{y}$	4-346-1456
varépsilon	e	$\frac{3}{4}\text{óe}$	4-346-15
varro	$\dot{\text{y}}$	$\frac{3}{4}\text{ór}$	4-346-1235
nest	p	$\frac{3}{4}\text{óp}$	4-346-1234
varsigma	$\dot{\text{y}}$	$\frac{3}{4}\text{ós}$	4-346-234
the poor	<i>Phi</i>	$\frac{3}{4}\text{óf}$	4-346-124
warrior	$\dot{\text{y}}$	$\frac{3}{4}\text{ók}$	4-346-13
digamma	F	%v	456-1236

1.3. Typeface variants of the Latin alphabet

Different fonts, either because they belong to another character set (as it happens with the Gothic letters) or because in their representation they are used different typographic resources (such as colors, shading effects, contours...), will require the following resources for their representation in braille.

First typographical variant

The character _ (6), which is an inseparable part of this first typographical variant, is applied preferably to differentiate lowercase letters with a typeface distinct from base; in particular, the Gothic letter.



The character ° (56), which forms an inseparable part of this first typographic variant, It is applied preferably to differentiate capital letters with a typeface distinct from base; in particular, the Gothic letter.¹

In the table below, the known character set has been used in Unicode as "Mathematical Bold Fraktur", just by way of example.

Character latino	Letter lower case	braille character	Points braille	Letter capital letter	braille character	Points braille
a/A		_A 6-1			»a 56-1 »b	
b/B		_B 6-12			56-12	
c/C		_C 6-14 ÿ			»c 56-14	
d/D		_D 6-145			»d 56-145	
e/E		_E 6-15			» e 56-15	
f/F		_F 6-124			»f 56-124	
g/G		_G 6-1245			»g 56-1245	
h/H		_H 6-125 ÿ			»h 56-125	
i/I		_I 6-24 ÿ			»i 56-24	
j/J		_J 6-245			»j 56-245	
k/K		_K 6-13			»k 56-13	
l/L		_L 6-123			»l 56-123	
m/M		_M 6-134			»m 56-134	
n/N		_N 6-1345			»n 56-1345	
o/O		_O 6-135			» the 56-135	
p/P		_P 6-1234			»p 56-1234	
q/Q		_Q 6-12345			»q 56-12345	
r/R		_R 6-1235 ÿ			»r 56-1235	
s/S		_S 6-234			»s 56-234	
t/T		_T 6-2345			»t 56-2345	
u/U		_U 6-136			» in 56-136	

¹ See in chapter 14 the use of 56 as a sign of space to fill.



Character latino	Lowercase letter	braille character	braille dots	Capital letter	braille character	braille dots
v/V		_V 6-1236			» in 56-1236	
w/W		_W 6-2456			»at 56-2456	
x/X		_X 6-1346			»X 56-1346	
and/and		_Y 6-13456			» and 56-13456	
z/Z		_Z 6-1356			»from 56-1356	

Second typographic variant

If, in addition, it is necessary to distinguish one more typographical variant, the inseparable prefix **ó** (346) for lower case and **œ** (146) for upper case.

Note: in the edition of mathematical expressions in Braille, for literal characters and their fonts, only the signs included in this chapter will be used, except that in other chapters another form of representation is provided for which must be attach an explanatory note and what is established in chapter 14 regarding *Adaptation and editing criteria* or indications that could be collected as "braille transcription notes".

Chapter 2. Figures and numbers

2.1. Figures or figures

They are represented by the braille characters of the first series preceded by # (3456).

sight sign	Signo braille	braille dots	Meaning
1	#a	3456-1	one
2	#b	3456-12	of the
3	#c	3456-14	three
4	#d	3456-145	four
5	#e	3456-15	five
6	#f	3456-124	six
7	#g	3456-1245	seven
8	#h	3456-125	eight



sight sign	Signo braille	braille dots	Meaning
9	#i	3456-24	nine
0	#j	3456-245	zero

2.2. Integer numbers

The # sign (3456) acts as an indicator for all the digits of the number, so it only appears at the beginning of the quantity.

As long as there is separation between the groups of figures in visual characters, in Braille point 3 will be used as a separator.

Examples:

31,720 **#ca.gbj**

3 802 197 **#c.hjb.at**

46781 **#dfgha**

Negative numbers will be represented with the first braille character sign - (36).²

Examples:

-7 **-#g**

-29 **-#with a**

-25 347 **-#be.cdg**

23. Decimal numbers

The sign separating the decimal part in Braille will be represented with the element , (2), even when other signs appear in visual characters, such as the point.

Examples:

3.2 **#c,b** three integers, two tenths

² The sign - (36) corresponds to the minus sign (see chapter 5. *Arithmetic and algebraic operators*).



3,2 #c,b three integers, two tenths

3'2 #c,b three integers, two tenths

In periodic decimal expressions, the beginning of the period will be transcribed through point 2, regardless of its representation in visual characters. Whether considers it necessary to highlight the representation of said period, you can go to the use of auxiliary parentheses³ after point 2 that marks the beginning of the period.

Examples:

3,254 #c,b,ed

7,29 #g,, would

3,73456345 #c,gcdef,{cde}

Expressions with an ellipsis in the decimal part will be written with ...
(3-3-3):

3,1415... #c, come on...

2.4. fractional numbers

This section deals only with whole fractions or numbers fractional.

$\frac{3}{4}$ 0 $\frac{3}{4}$

The numerator, preceded by a numerical sign, will be written at the top of the box (1st series). The denominator, below, without numerical sign, in the upper part bottom (5th series), followed by a blank box.

Examples:

$\frac{3}{4}$ 0 $\frac{3}{4}$ #c* Three quarters

$\frac{38}{63}$ #ch+: thirty-eight sixty-thirds

$3\frac{1}{5}$ #AC? three integers and a fifth

³ On the use of auxiliary parentheses see chapter 3.



2.5. special representations

a) Special numbers

Some numbers have special representations, such as:

- The number pi: $\ddot{y} \frac{3}{4}p$ (4-1234)
- The number e (base of natural logarithms): **e e** (15)
- The number i (imaginary unit): **i i** (24)

Examples:

$\ddot{y}=3,141592\dots \frac{3}{4}p=\#c,adaeib\dots$

$e=2,718281\dots e=\#b,gahbha\dots$

$1+2i$ **$\#a+\#b@i$**

In this example, it can be seen that the point 5 @ has been used before the letter "i", with which the imaginary unit is represented, to indicate that it is a lower case Latin letter of the first series instead of a number.

b) Numbers that include letters with numerical value

The # sign (3456) acts as an indicator for all the digits of the number, whether they are numbers or represented by letters (as is the case with numbers in bases greater than 10), so it only appears at the beginning of the quantity.

The letters are represented as indicated in chapter 1 and, in this case, the Latin small letters from "a" to "j" will be preceded by the Braille character @ (5) to indicate their lower case Latin status.

Examples:

1B4D **$\#a\{bd\{d$**

1b4d **$\#a@bd@d$**

14bd **$\#ad@b@d$**

b1d4 **$\#@ba@dd$**

1axb **$\#a@ax@b$**



c) Numbers with figures in typographic or color variant

When there is a significant typographical or color variant in the numbers, they will be transcribed preceded by the numerical sign of the prefix ° (56).

Example:

24 °#bd

If a second typographical or color variant appears, the sign **⠠** (146) may be used.⁴

In the event that there are typographical or color variants in certain numbers of the same number, the corresponding indicator will immediately precede the respective number.

The text in which this situation occurs must necessarily include an explanatory note.

Example: 3429, where the number 4 is red and 9 is green. The text where this distinction appears will begin with a note:

"In what follows, the sign **⠠** (146) indicates that the character immediately to its right is red, and the sign ° (56) will indicate that the character immediately to its right is green":

#c⠠Edb°i

d) Numbers indicating the numbering base

In the visual representation of numbers in different bases, this is usually written in subscript to the right after the figures that make up the number.

In braille, the subscript sign on the right is represented by **⠨** (34) (see chapter 4. *Indices and marks*) and is written after the digits of the number and before the digit that indicates the base.

1012 **#ajaí#b** Number 101 in base 2

⁴ As can be seen in chapter 1. *Literal characters*, section 1.3, both **⠠** and **⠠** are they correspond to some of the prefixes for typographical variants of letters.



2.6. Representation of numerical sets

Visual sign	Braille sign	Braille dots	Meaning
ÿ	%N	456-1345	natural numbers
ÿ	%z	456-1356	integer numbers
ÿ	%q	456-12345	rational numbers
ÿ	%r	456-1235	real numbers
ÿ	%c	456-14	complex numbers
ÿ	%h	456-125	quaternions
ÿ	%o	456-135	Cailey numbers (octonions)
ÿ	%p	456-1234	Prime numbers

Example:5 «The set of real numbers, ÿ, is formed by...» is transcribed in braille:

**[{The set of numbers
reals, %r, consists of...]**

Other special representations can be expressed in braille by going to the typographic variants considered in chapter 1. For example, for numbers irrational could be:

»i (56-24)

I »i (56-24)

Chapter 3. Delimiters

3.1. Horizontal delimiters

Those graphic resources that separate or unify written expressions one after the other, in the same line. For example, a numeric interval.

⁵ For writing a mathematics text within a literary text, see chapter 14.



Visual sign	Braille sign	Braille dots	Meaning
(		126	open parentheses
)		345	close parentheses
[		12356	open brackets
]		23456	close brackets
{	()	5-123	open keys
}	Á	456-2	close keys
⸮	Ú	5-13	open angle brackets
⸮	@l %, @k {,	46-2	close angle brackets
⸮	@ on	5-12356	open class brackets
⸮		23456-2	close class brackets
(	ugh, @)	5-345	open special keys
)	(,	126-2	close special keys
		456-0d	barra vertical
⸮	% %l	456-123	double bar
braille specific	¿	26	open auxiliary brackets
braille specific	}	35	close auxiliary parentheses
/	—,	6-2	slash
\	@.	5-3	backslash
,	,	0-2	separation comma
.	▪	0-3	point of separation
;	;	0-23	separating semicolon
⸮	on,	12356-2	open roof
⸮	@ú	5-23456	close roof
⸮	on.	12356-3	open ground
⸮	_u	6-23456	close ground
:	@,	5-2	two points



Visual sign	Braille sign	Braille dots	Meaning
-	-	0-36-0	short dash
---	---	0-36-36-36-0	long dash
?	¿	0-26-0	question

Use:

- *Ceiling function* is the one that assigns to each real number the largest integer next by excess, that is, the smallest integer equal to or greater than that real number.
- *Ground function* or *integer part* is the one that assigns the greatest value to each real number integer equal to or less than that real number.

Note: The occurrence of the space preceding the comma, the period, the semicolon, and the question mark is justified by the need to avoid confusion with fractional numbers.

Examples of some horizontal delimiters:

Order the numbers from smallest to largest

$$\frac{3}{2}, y1, 4, 7, 8, 0, \quad \frac{1}{-}, \dots, 3, 2$$

{ order from smallest to largest the numbers #c; ,-

**#a ,#d ,#g,h ,#j ,#a: ,³/₄p
 ,#c,b**

The scale is one thirty thousand,
1:30000

{the scale is one thirty thousand,

#a@,#cjjjj

Note: auxiliary parentheses do not have their corresponding sign in ink.

They constitute a braille own resource to limit certain expressions that, in the visual writing, appear unified in various ways, such as the different size, different level with respect to the basic line of writing, horizontal line on the fractions and radicands, etc. (see, among others, chapters 4 and 5).



Auxiliary parentheses can be repeated indefinitely without misunderstanding, since closing signs occur in the reverse order of opening signs.
corresponding.

3.2. vertical delimiters

"Vertical delimiters" are considered to be graphic resources that determine two or more written expressions one below the other. This is the case of the keys used to cover the equations of a system and the formulas that define a "function in pieces".

For example, in a system of equations. In the following case the graphic resource is a key:

System of equations

$$\begin{cases} x + y + z = 1 \\ 2x - 3y - 4z = -2 \\ 4x + 2z = 0 \end{cases}$$

In this other case, the graphic resource is a background of another color:

System of equations

$$\begin{aligned} x + y + z &= 1 \\ 2x - 3y - 4z &= -2 \\ 4x + 2z &= 0 \end{aligned}$$

Regardless of the graphic resource used, the following will be transcribed in Braille:

1st) Blank line.

2nd) Vertical grouping indicator, which includes:

- "Vertical delimiter" sign:

#p (3456-1234) (system of equations) and #t (3456-2345) (function in pieces)

- Number of expressions to delimit, as an ordinary number, # (3456 + braille sign of the 1st series).
- Sign "" (1456-1456) (system of equations) and "ü" (1256-1456) (piecewise function).
- Where appropriate, title or definition expression of the structure.

3rd) The expressions to delimit, in independent lines.

4th) Blank line, which will be omitted if it coincides with the end of a page.



The two examples above will be written in braille in the same way:

#p#c"" {system of equations
x+y+z=#a #bx-
#cy-#dz=-#b #dx+#bz=#j

All these elements, except the blank lines, must be contained in the same page.

Here is an example with a piecewise function:⁶

$$f(x) = \begin{cases} 3x & \text{si } x < 0 \\ 6x & \text{si } x > 0 \end{cases}$$

#t#b" f(x)=
#cx si xö#j #fx si
xo#j

The *less than* (<) and *greater than* (>) signs can be found in Chapter 6. *Arithmetic and algebraic relations*. In braille they are represented as **9** and **o**, respectively.

In summary, the delimiters for system of equations and piecewise function are:

Signo braille	braille dots	Meaning
#p "" 3456-1234	and 1456-1456	system of equations
#t ü" 3456-2345	and 1256-1456	piecewise function

⁶ See functions in chapter 9. *Analysis and calculation*.



3.3. Two-dimensional structures (matrices, determinants and tables)

"Two-dimensional structure" shall be understood as any spatial arrangement in rows and columns of numerical quantities or individualizable mathematical expressions of any kind. Each one of said quantities or expressions will be called an "element" in one of these structures, regardless of its size and complexity.

The most characteristic two-dimensional structures are considered to be the «matrices» (enclosed between curved brackets), the «determinants» (between simple vertical bars) and the «general tables», in which rows and columns can be distinguished, enclosed or not within a frame. , with or without a grid, graphically affected by a certain background, with a rectangular or triangular aspect, etc.

The Braille representation of a two-dimensional structure (matrix, determinant, general table, or chart) includes:

1st) Blank line.

2nd) The "structure indicator", made up of:

- The start sign corresponding to the two-dimensional structure:

• Curved parentheses (commonly used for matrices): **#s** (3456-234).

• Simple vertical bars (usually used for determinants): **#1** (3456-123).

• Any other representation (general tables): **#v** (3456-1236).

In this case, a Transcript Note must be included, in which the graphic resource that determines the table in the original will be described (for example: framed table, with a specific color background, etc.)

- Number of rows (ordinary writing: number sign, character in "high position").
- Multiply sign («quote»): **[(236)]**.⁷
- Number of columns (ordinary writing: number sign, character in "high position").
- Signs **Ý** (156-1456) for matrices, **%¥** (456-1456) for determiners and **#¥** (3456-1456) for tables. • Where appropriate, title or definition expression of the structure.

⁷ See chapter 5. *Arithmetic and algebraic operators*.



In summary, the delimiters for matrix, determinant and system are:

Signo braille	braille dots	Meaning
#s Italy¥	3456-234 and 156-1456	headquarters
#l %¥	3456-123 and 456-1456	determining
#in #¥	3456-1236 and 3456-1456	board

3rd) The Braille representation of the two-dimensional structure can be made in two forms:

- **Explicit two-dimensional representation**, in which it will be respected, in which as far as possible, the spatial distribution of the elements; in particular, the correspondence in columns (section 3.3.1).
- **Semi-linearized representation**, facilitating the student's tasks especially when taking notes, in which the correspondence Column spatial has a secondary value (Section 3.3.2).

In the edition and transcription of braille texts it is recommended to include both representations, separated by a blank line.

The first, the explicit, is considered the most convenient and should appear always. For didactic reasons, and for the reader's knowledge, it should The second form, the semi-linearized form, should also be included, at least in the first examples of each work or chapter.

3.3.1. Explicit two-dimensional representation

The opening (left) and closing (right) signs corresponding to each of the rows are detailed below:

Structure enclosed in parentheses (array):

Line	Opening braille sign (left)	Points braille	Signo braille closing (right)	Points braille
First row	S	0-234	IDEA	156-0
middle rows	L	0-123	%	456-0
last row	(	0-126	)	345-0

**Structure enclosed between bars (determinant):**

Line	Opening braille sign (left)	Points braille	Signo braille closing (right)	Points braille
First row	%	0-456-0d	%	456-0
middle rows	%	0-456-0d	%	456-0
last row	%	0-456-0d	%	456-0

Any other structure (tables in general):

Line	Opening braille sign (left)	braille dots	Signo braille closing (right)	braille dots
First row	P	0-1234	“	1456-0
middle rows	L	0-123	%	456-0
last row	IN	0-1236	#	3456-0

Note that closures formed by points 456 require a space to be left blank below and not a blank half-box, as in the general rule.

If it coincides with the end of the line, it will not be necessary to leave the space in white.

Example when the structure has the vertical bars as delimiters:

$$\begin{vmatrix} 1 & 2 & 3 \\ 10 & 20 & 30 \\ 1,5 & 2 & 3 \end{vmatrix}$$

#l#c[#c%“ % #a

#b #c % % #aj #bj #cj% %

#a,e #b #c %



Example when the structure has parentheses as delimiters:

$$\begin{pmatrix} 1 & 2 & 3 \\ 10 & 20 & 30 \\ 1,5 & 2 & 3 \end{pmatrix}$$

#s#c[#cÝ“ s#a #b

#c Ý l#aj #bj #cj% (#a,e #b #c)

Example when the structure has any other structure as delimiters (in this case the structure is boxed):

1	2	3
10	20	30
1,5	2	3

#v#c[#c#“ p#a #b

#c “ l#aj #bj #cj% v#a,e #b #c #

In the following examples, ordinary parentheses will be used as delimiters, which are normally used to represent matrices.

In case the matrix has only one row, this will be written as if it were the last one.

Example:

#s#a[#cÝ" (#a #b

#c)

a) Two-dimensional structures with headers and footers in the rows and/or columns. The column headers and footers will be written on separate lines, not encompassed by the delimiters of the structure (parentheses, bars, square brackets, etc.).



Row headers and footers will be written outside the row delimiters.
structure and adjacent to them.

Example: 3x3 matrix from the previous examples, with column headings a, b, c and row headers 1, 2 and 3.

$$\begin{matrix} & a & b & c \\ \begin{matrix} 1 \\ 2 \\ 3 \end{matrix} & \begin{pmatrix} 1 & 2 & 3 \\ 10 & 20 & 30 \\ 1,5 & 2 & 3 \end{pmatrix} \end{matrix}$$

#s#c[#cÝ¥

A b c

#as #a #b #cÝ #bl#aj #bj #cj% #c (#a,e

#b #c)

- b) Encolumnation.** The elements of each column will be written in columns of according to the most convenient criterion according to the nature of said elements: with respect to the units figure, with respect to the number sign, etc.

Example: Tartaglia triangle.

$$\begin{array}{ccccccc} & & & 1 & 1 & & \\ & & & 1 & 2 & 1 & \\ \ddot{y} & & 1 & 3 & 3 & 1 & \ddot{y} \\ & & 1 & 4 & 6 & 4 & 1 \\ & & 1 & 5 & 10 & 5 & 1 \end{array}$$

#s#e[#aaÝ¥

With #a #a Ý

L #a #b #a %

L #a #c #c #a %

L #a #d #f #d #a % (#a #e #aj #aj #e #a)



c) Separation between columns. At least one column of a space will be respected in white between all elements in contiguous columns.

d) Ellipsis points. If ellipses appear in the structure to indicate an indefinite number of elements or other details, they will be represented in Braille by the sign ... (3-3-3), regardless of the direction represented (horizontal, vertical or oblique in any direction). .

$$\begin{pmatrix} 1 & \dots & 3 \\ 10 & \ddots & 30 \\ 1,5 & \dots & 3 \end{pmatrix}$$

#s#c[#cÝ¥ S#a ...

#cÝ

L#aj ... #cj% (#a,e ... #c)

e) Writing rows that exceed the length of the braille line. If the representation of the elements of a row of the two-dimensional structure exceeds the length of the braille display:

- After the expression indicative of the structure and the header row of column, if applicable, the row headers —if any—, the opening delimiter sign and the complete columns of the structure that do not exceed the length of the braille line, with the corresponding headers or footers, will be written first. column if any.
- A blank line will be respected.
- The remaining columns of the structure will be written, with the corresponding column headers or footers —if any—, the closing delimiter sign and the row footers, if applicable.

Example:

$$\begin{pmatrix} 300 & 400 & 500 & 600 & 700 & 800 \\ a & b & c & d & e & f \end{pmatrix}$$



#s#b[#fY¥

S#cjj #djj #ejj #fjj

(a b c d

#gjj #hjjY

f)

If the number of rows in the structure exceeds the number of lines on the page Braille, the headers and initial rows of the structure will be written first -if necessary, unfolded into two or more pages-, including the last line of the braille page the column footers -if they exist-, and the writing would continue of the following rows, repeating the column headings, if they exist.

f) Successive horizontal structures. If the length of the braille display allows it, several complete structures related to each other can be written. The sign indicative of each of the structures will be written in the upper line columned with the opening sign of the structure.

$$\begin{pmatrix} a & b & c \\ d & e & f \\ g & h & i \end{pmatrix} \quad \begin{pmatrix} a & b & c \\ d & e & f \\ g & h & i \end{pmatrix}$$

#s#c[#cY“ #s#c[#cY¥

Sa b CY sa b cY

Ld ef% ld ef% (ghi) (ghi)

3.3.2. Semi-linear braille representation

It tries to preserve the two-dimensionality and a certain correspondence in column of the elements, allowing to differentiate the position in each line and the row and column headers/footers. The count of spaces required by a strict correspondence in column is dispensed with, which allows taking notes or making operations quickly.



The following sequence will be followed:

- 1st) Blank line.
- 2nd) The "indicative of structure", which is formed with the sign of structure, the number of rows, the multiplication sign, the number of columns, the sign of closure and the title or name, if applicable.
- 3rd) The first row begins with the structure indicator sign.
- 4th) Each element is separated by the "column separator" sign . (0-3).
If an element does not appear, nothing will be put in its place.
- 5th) Each row, starting from the second, is written on a different line, started by the sign "row separator" ; (0-23).
- 6th) The last row concludes with the sign of "closure of the structure", symmetrical that of "start" by vertical symmetry.
- 7th) Blank line.

The indicator and all the rows of the semi-linearized structure must be in the same page braille.

Example:

$$\begin{pmatrix} 1 & 2 & 3 \\ 10 & 20 & 30 \\ 1,5 & 2 & 3 \end{pmatrix}$$

#s#c[#cÝ¥

#s#a .#b .#c ;#aj .#bj .#cj ;#a,e .#b .#cÝ¥

- a) Column headers.** If they exist, they will be written as a first line inside the matrix, starting with the structure indicator sign and then the sign ; (23), separated by signs "separator of column» . (0-3). The rows will be rendered as in the previous example, where there were no column headers.

$$\begin{matrix} a & b & c \\ \begin{pmatrix} 1 & 2 & 3 \\ 10 & 20 & 30 \\ 1,5 & 2 & 3 \end{pmatrix} \end{matrix}$$



#s#c[#cÝ¥ #s;a .b .c

;#a .#b .#c ;#aj .#bj .#cj ;#a,e .#b .#cÝ¥

If there is no header in any of the columns, nothing will be entered.
instead.

$$\begin{array}{ccc} a & & c \\ \left(\begin{array}{ccc} 1 & 2 & 3 \\ 10 & 20 & 30 \\ 1,5 & 2 & 3 \end{array} \right) \end{array}$$

#s#c[#cÝ“

#s;a . .c ;#a .#b .#c ;#aj .#bj .#cj ;#a,e .#b .#cÝ¥

b) Column feet. If they exist, they will be written on an additional line that will start with ;; (0-23-23). Each of the feet, starting from the second, it will be preceded by the “column separator” sign . (0-3).

If there is no footer in any of the columns, nothing will be placed in its place. This additional line with the "column feet" will be closed with the sign of closure of the structure, keeping the 0-3 as a column separator.

$$\begin{array}{ccc} \left(\begin{array}{ccc} 1 & 2 & 3 \\ 10 & 20 & 30 \\ 1,5 & 2 & 3 \end{array} \right) \\ a & & c \end{array}$$



#s#c[#cÝ“

#s#a .#b .#c

;#aj .#bj .#cj

;#a,e .#b .#c ; ;a . .cÝ¥

c) Row headers. If they exist, they will be written at the beginning of the row, after the "row separator sign", preceded by the distinguishing sign @ (5-0) and followed by a column separator sign . (0-3). In this way it achieves greater encolinization. This pair of signs, @ (5-0), is will write to all rows even if there is no header in that row. In case of that no header appears in a certain row, since an indicator of row header will be followed by a column separator, one will be deleted of the two consecutive spaces that are generated.

$$A \begin{pmatrix} 1 & 2 & 3 \\ 10 & 20 & 30 \\ 1,5 & 2 & 3 \end{pmatrix}$$

#s#c[#cÝ“ #s@

{a .#a .#b .#c ;@ .#aj .#bj .#cj ;@

{c .#a,e .#b .#cÝ¥

d) Row feet. If there is a row with a "footer", it will be written at the end of the same after the indicator sign @ (5-0). If in some row it did not exist «foot», the @ sign (dot 5) must be written as the last character of the line.

$$A \begin{pmatrix} 1 & 2 & 3 \\ 10 & 20 & 30 \\ 1,5 & 2 & 3 \end{pmatrix} \begin{matrix} a & c \\ 1 \\ 3 \end{matrix}$$



#s#c[#cÝ“

#s;a . .c ;@

{a .#a .#b .#c@ #a

;@ .#aj .#bj .#cj@ ;@ {c .#a,e . .@

#c ;;a . .cÝ¥

- e) **Writing rows that exceed the length of the braille line.** if the braille representation of a row exceeds the length of the braille line, the braille line is ends with the sign «column separator» . (0-3) and continues in the following, respecting an indentation of two blank spaces followed by the point 3. That is, the line continuation on the next line would begin with . (0-0-3).

Example:

$$\begin{array}{ccccc}
 & a & & c & & e \\
 1 & \left(\begin{array}{ccccc} 1 & 2 & 3 & 5/2 & 14 \\ 10 & 20 & 30 & 25/12 & z \\ 1,5 & \dots & \dots & 545 & 4/3 \\ 545 & 623 & 161 & 488 & 487 \\ 115 & 644 & 331 & 622 & 758 \end{array} \right) & \begin{array}{c} 2 \\ 3 \\ 4 \end{array} \\
 & b & & d & &
 \end{array}$$

#s#e[#eÝ“

#s;a . .w . .It is

;@ #a .#a .#b .#c .#e; .#ad@ ;@ .#aj .#bj .#cj .#be;; . .z@ #b

;@ #c .#a,e#ede . .#d: @#c

;@ .#ede .#fbc .#side .#dhh

.#dhg@ #d



;@ #e .#aae .#fdd .#cca .#fbb .

.#go@ ;; .b . .d .Y"

3.4. Delimitation of regions within a structure two-dimensional

The graphic differentiation of regions or groups of elements within a structure bidimensional is done with different graphic resources: color differentiations of text or background, enclosing or linking by lines, vertical or horizontal delimiters...

However, all these resources seem to have the sole function of determining the region, there being no specific mathematical meaning in the graphic resource employee. The meaning of the region or the purpose of the sign is established by the context.

There is, however, an exception: tensors, which are usually represented as "arrays of arrays". In which case, the parentheses inside the general matrix have specific meaning.

In braille, any of these forms will be represented by the signs and applying the rules listed below in sections 3.4.1 for the explicit two-dimensional representation, and 3.4.2 for the semi-linearized form.

Items not marked by the same type of braille signs may be considered as a differentiated region, although they do not need to be signposted.

3.4.1. *Regions in two-dimensional structures represented in explicit braille*

Preceding the representation of the structure (and forming part of it), it is includes a "Transcript Note" indicating the graphic value of the differentiation Braille, or each of them, if there are several.

The delimitation of regions is done by enclosing said regions in "boxes" or "tables" formed by consecutive Braille signs horizontally and vertically. In the explanations that follow we will call them "boxes".

To form these boxes, two collections of braille signs are considered, with independent meaning.



Priority would be preferred

}::: 0-35-25-25-25-26-0

L % L % e::i 0-123-... -456-0

0-123-... -456-0

0-15-25-25-25-24-0

Secondary

}::,? 0-35-2-2-2-26-0

K { K { e,,i 0-13-... -46-0

0-13-... -46-0

0-15-2-2-2-24-0

The "0" values of blank cells preceding the leading signs, or of the left, and that follow the endings, or on the right, are part of spaces of column spacing.

For the enclosure of the typographically differentiated elements in Braille, will consider the following issues:

- a) The necessary spaces will be increased to maintain the array of elements.
- b) The horizontal borders (upper and lower) are located on independent lines and may not contain elements of the structure.
- c) The representation of the vertical borders of the box is omitted if they coincide with the global delimiters of the structure (parentheses, bars, square brackets, etc.).
- d) If in the same structure there are several regions with the same differentiation graphic but separated from each other, in braille a single family of letters will be used. signs.
- e) The elements not enclosed in a box can be considered as a differentiated region, although they do not need to be enclosed in a different box.
- f) For places of intersection, where appropriate, of regions differentiated by the two families of braille signs, signs resulting from the overlap of both directions or types: r (1235) or w (2456).
- g) However, if horizontal borders of both differentiations coincide braille, will be placed on separate lines.
- h) When the region to be highlighted is formed by an isolated element:
 - If the graphic differentiation is made by means of signs of the first family, they are preceded by the sign $\frac{3}{4}$ (points 4-35).



- If it corresponds to the second graphic differentiation, $\emptyset$ (45-35).
- i) If the two differentiations coincide in the same element, the $\emptyset$ sign (points 45-4-35).
- j) When the graphic differentiation consists of the link by a line oblique (v. gr., diagonally), each of the elements will be considered as "isolated element", applying what is indicated above.

Some of these details are illustrated in the examples that follow.

If it were necessary to highlight the minor complementary to element a31 (the one represented in red in the original):

$$\begin{pmatrix} 1 & 2 & 3 \\ 10 & 20 & 30 \\ 1,5 & 2 & 3 \end{pmatrix}$$

In braille it would be represented like this:

#s#c[#cY"

}:::.....?

S#al#b#c Y

L #aj l#bj #cj % L e:::.....w (#a,e #b

#c)

If it were also necessary to indicate the symmetric minor a31 (region made up of elements 10, 20, 1.5 and 2, boxed in the original):

$$\begin{pmatrix} 1 & 2 & 3 \\ \boxed{10 \quad 20} & 30 \\ \boxed{1,5 \quad 2} & 3 \end{pmatrix}$$



#s#c[#cÝ"

}:::.....?

S #a l #b #c Ý r,,,,,,r,,,? % l #aj l#bj{ #cj % l

e:::w:::w l #a,e #b { #c) e,,,,,,,,,i

In the following example, the elements 1, 20 and 3, which form one of the diagonals, They have a different typeface:

$$\begin{pmatrix} 1 & 2 & 3 \\ 10 & 20 & 30 \\ 1,5 & 2 & 3 \end{pmatrix}$$

In braille its representation will be:

#s#c[#cÝ"

S`#a #b #c Ý

L#aj `#bj #cj%

(#a,e #b `#c)

In the following example, the graphic resource used to differentiate regions is a vertical delimiter, whose representation does not require the use of signs typographic variant.

$$\begin{pmatrix} 3 & 4 & | & 1 & 0 \\ 5 & 7 & | & 0 & 1 \end{pmatrix}$$

In braille, its representation will be:

#s#b[#dÝ"

S #c #dl #a #jÝ (#e #gl #j #a)



3.4.2. Regions in two-dimensional structures represented in braille in semi-linear form

If this representation is not preceded by the explicit two-dimensional one, it must go preceded by a transcript note describing the correspondence, indicating which typographic resource of the original is represented with the braille signs to indicate the different differences that are presented below.

In the semilinearized representation, the delimitation of regions (or groups of elements) is done row by row, using braille signs marking the first element belonging to the region and the latter, if applicable. The first will be preceded by a sign distinctive and the last will be followed by the corresponding distinctive sign. The different graphically differentiated rows: first row, intermediate rows and last row.

Two collections of braille signs are considered, with independent meaning.

preferential differentiation

Line	Home braille sign (left)	braille dots	Signo braille closing (right), in Their case	braille dots
First row (top edge)	$\frac{3}{4}?$	0-4-26	$\frac{3}{4}\}$	4-35-0
Intermediate rows @?		0-5-26	@}	5-35-0
Last row (bottom edge)	$_?$	0-6-26	$_}$	6-35-0
single row	$\frac{3}{4}?$	0-4-26	$_}$	6-35-0

secondary differentiation

Line	Home braille sign (left)	braille dots	Signo braille closing (right), in Their case	braille dots
First row (top edge)	$\emptyset?$	0-45-26 $\emptyset\}$		45-35-0
middle rows {?		0-46-26 $\{\}$		46-35-0
Last row (bottom edge)	$\gg?$	0-56-26 $\gg\}$		56-35-0
single row	$\emptyset?$	0-45-26 $\gg\}$		56-35-0



In your braille transcription, the following issues will be taken into account:

- a) The braille signs of differentiation of regions, both opening and closing, if any, have value of column separators, so these are ignored.
- b) Closing signs are omitted if the differentiation extends to the end of the row, except in the case of "single row" or "row footers". c) If there are several regions in the same structure with the same graphic differentiation, the same family of signs will be used in Braille.
- d) When the region to be highlighted is formed by an isolated element:
 - If the graphic differentiation is carried out by means of primary differentiation, the sign $\frac{3}{4}$ is used before it (4-35).
 - If it is carried out by means of secondary differentiation, the sign is preceded $\wedge$ (45-35).
 - If the two differentiations coincide in the same element, the the sign $\wedge \frac{3}{4}$ (45-4-35).
- e) When the graphic differentiation consists of linking or marking in a vertical or oblique direction (eg, diagonally), each of the elements will be considered as an "isolated element", applying what is indicated above.

Some of these details are illustrated in the examples that follow.

In the following matrix, it is necessary to highlight the minor complementary to element a31 (the one represented in red in the original):

$$\begin{pmatrix} 1 & 2 & 3 \\ 10 & 20 & 30 \\ 1,5 & 2 & 3 \end{pmatrix}$$

In braille, it will represent:

#s#c[#cY" #s#a $\frac{3}{4}$?

#b .#c ;#aj $\frac{3}{4}$?

#bj .#cj ;#a,e .#b.#cY"

If it were also necessary to indicate the symmetric minor a31 (region made up of elements 10, 20, 1.5 and 2, boxed in the original):



$$\begin{pmatrix} 1 & 2 & 3 \\ 10 & 20 & 30 \\ 1,5 & 2 & 3 \end{pmatrix}$$

#s#c[#cÝ“ #s#a^{3/4}?

#b .#c ;^?#aj^{3/4}?#bj»}#cj ;^?

#a,e .#b»}#cÝ“

In the following example, the elements 1, 20 and 3, which form one of the diagonals, They have a different typeface:

$$\begin{pmatrix} 1 & 2 & 3 \\ 10 & 20 & 30 \\ 1,5 & 2 & 3 \end{pmatrix}$$

In braille, its representation will be:

#s#c[#cÝ“ #s^{3/4}}

#a .#b .#c

;;#aj^{3/4}}#bj .#cj ;#a,e .#b^{3/4}}#cÝ“

Chapter 4. Indexes and marks

4.1. positions

In visual characters, a sign can be affected by letters, numbers, expressions, brands, etc., in any of the positions that appear in the graph following:

2 4 6

WITH

1 3 5

Position 1: subscript to the left.

Position 2: superscript to the left.



Position 3: subscribed.

Position 4: superwritten.

Position 5: subscript to the right.

Position 6: superscript to the right.

4.2. Indexes

4.2.1. general case

To indicate the position in which the index is located, the following signs are used
Braille written below the base sign they affect:

Visual sign	Braille sign	Braille dots	Meaning
ÿ	_in	6-34	left subscript
ÿ	¾x	4-16	left superscript
ÿ ÿ	Yii	34-34	index on subscribed
ÿ ÿ	xx	16-16	index in superwritten
ÿ	ln	34	right subscript (sub)
ÿ	x	16	superscript right (super)

The last two positions are the ones that appear most frequently.

Examples (in them the "z" is used as the base letter and the "r" as the index):

Visual sign	Braille sign	Meaning
rz	Z_ír lowercase	z with left subscript "r"
^r z	Z¾xr lowercase	z with superscript "r" to the left
Z r	Zíir lowercase	z with "r" underwritten
^r Z	Zxxr lowercase	z with superscript "r"
zr	roars	z with subscript "r"



Visual sign	Braille sign	Meaning
zr	Zxr	z with superscript "r"

If the index were made up of several terms or a mathematical expression, will be enclosed in auxiliary parentheses.

Examples (for the writing of numbers, see chapter 2. *Figures and numbers*, and for the writing of auxiliary parentheses see chapter 3. *Delimiters*):

Visual sign	Braille sign	Meaning
zn-1	Zí?n-#a}	z with subscript "n-1"
yes, j	Zx?i ,j}	z with superscript "i,j"
learn-1	Zí?iír-#a}	z with subscript the difference between «i» sub «r» y 1
learn-1	Zííi?r-#a}	z with subscript "i" affected by subscript "r-1"
n-1z	z^{3/4}x?n-#a}	z with left superscript "n-1"
z-1/2	Zx-#a;	z with superscript on the right -1/2

Similarly for any position.

In some cases auxiliary parentheses are not necessary, although their use is not necessary either. its meaning would change. See the following example:

Visual sign	Braille sign	Meaning
Uncle	Zííi#j	z with subscript "i sub 0"
Uncle	Zí?iíi#j}	z with subscript "i sub 0"

4.2.2. Numeric subscripts

In the representation of two-dimensional structures (see chapter 3) whose elements have numerical subscripts, these will be represented in an abbreviated form using the braille elements of the fifth series (numbers in low position) without indicator of position or number sign.



In the event that the subscript is made up of two one-digit numbers separated by a comma, this may be omitted if there is no risk of confusion.

sight sign	Signo braille
a ₁₁ a ₁₂	A,, a,;
a ₂₁ a ₂₂	A;, a;;
a _{1,1} a _{1,2}	A,, a,;
a _{2,1} a _{2,2}	A;, a;;

4.3. Brands

4.3.1. Superscript marks to the right

Certain brands that are frequently used have a special representation in braille.

The marks «prime», «second» and «third» in visual characters are represented for one, two or three acute accents respectively in superscript position. en braille, each of these signs is written:

Visual sign	Braille sign	Braille dots	Meaning
ÿ		1256	Before
ÿÿ		1256-1256	second
ÿÿÿ	ÜÜÜÜÜÜ	1256-1256-1256	third

Other marks in this right superscript position are written below of the base sign using its specific sign followed by point 3. The main signs that are used as marks in the mathematical context are:

Visual sign	Braille sign	Braille dots	Meaning
ÿ+	+. .	235-3	superscript plus sign mark
ÿ-	-. .	36-3	superscript minus mark
ÿ°	]. .	356-3	superscript circle mark



Visual sign	Braille sign	Braille dots	Meaning
	ž.	256-3	superscript asterisk mark
¢* ÿÿ	¿.	26-3	grave accent mark
ÿ'	u.	1256-3	apostrophe mark

When there is more than one brand, repeated or different, point 3 will be written only at the end.

Here are examples of his writing, using the letter "z" as a base:

Visual sign	Braille sign	Meaning
z+	Z+.	z with a positive sign
With-	With-.	z with a negative sign
z°	WITH].	z with circle ⁸
With*	WITH*.	z with asterisk
z+++	Z+++.	z with three positive signs
with``	WITH??.	z with two grave accents
With*-	WITH*-.	z with asterisk and minus

In the particular case of one of the special marks repeated 4 or more times, it will be represented in braille with the superscript sign followed by the number, the corresponding mark and a last character with dot 3.

Example:

Visual sign	Braille sign	Meaning
z4*	Zx#d*.	z with four asterisks
With****	Zx#d*.	z with four asterisks

Any other brand not reflected in the previous table will be represented after the base letter, preceded by the braille sign indicative of position in superscript to the right, ending with point 3.

⁸ When ° is used to indicate *degrees*, it is not followed by a point (see 11.5. *Angle measurements*).



zÿ

Zx#u.

z with infinity sign in right superscript⁹

4.3.2. marks in superscript

Certain braille superscript markings have a special representation. HE written before the base letter ("z" or "Z" in the examples).

Visual sign	Braille sign	Meaning
$\bar{z}$	$\frac{3}{4}\text{CZ}$	super dashed lowercase z
y	$\frac{3}{4}\text{C}\frac{3}{4}\text{C}\{z$	capital z with two horizontal strokes in superscript
$\tilde{z}$	@?With	wavy line over lowercase z
$z\ddot{y}$	$\frac{3}{4}]z$	circle over lowercase z
$\hat{z}$	":With	circumflex over lowercase z
$\check{z}$	"-With	inverse circumflex over lowercase zeta
$\frown z$	$\frac{3}{4}:Z$	arc over capital z
$\breve{z}$	_:With	inverse arc over zeta

In the particular case of letters marked with one, two or three dots in superscript, it is necessary to use the corresponding alphabetic prefix, even for lowercase Latin letters, as seen in the following examples:

Visual sign	Braille sign	Meaning
y	$\frac{3}{4}\{r$	capital r with a period
y	$\frac{3}{4}\frac{3}{4}\frac{3}{4}Z$	lowercase greek letter zeta with colon
y	$\frac{3}{4}\frac{3}{4}\frac{3}{4}@r$	lowercase r with three dots

If the mark affects a compound expression, this expression will be enclosed between the corresponding auxiliary parentheses.

⁹ See chapter 7. *Set theory* for the sign of «infinity».



Visual sign	Braille sign	Meaning
$\overline{AB}$	$\frac{3}{4}c\{a\{b\}$ dashes over	A and B
$\overline{z''}$	$\frac{3}{4}c\{z\ddot{u}\}$ superhatched	second zeta

Any other brand not reflected in the previous cases will be represented after the base letter preceded by 16-16 and ending with point 3.

$\overset{++}{Z}$ **Zxx++.** zeta with two plus signs in superscript

4.3.3. brands in subscribed

Certain markings in Braille have a special representation. are written before the base letter.

Visual sign	Braille sign	Meaning
With 	$_?With$	wavy line under z
With 	$_-With$	z underlined
With 	$_ _ -z$ z with double	underscore

If the mark affects a compound expression, this expression will be enclosed between the corresponding auxiliary parentheses.

Visual sign	Braille sign	Meaning
$\underline{ab}$	$_ - \{ab\}$ ayb underlined	
$\underline{z''}$	$_ - \{z\ddot{u}\}$ zeta second	underlined

Any other brand not reflected in the previous cases will be represented after the base letter, preceded by 34-34 and ending with point 3.

$\overset{<}{Z}$ **Zííö.** zeta with less than sign in subscribed



4.3.4. Marks in subscript to the right or to the left or superscript to the left

When any of the trademarks included in the previous sections appears in any of these positions, will be written preceded by the position braille indicator corresponding after the base letter and followed by point 3:

Visual sign	Braille sign	Meaning
z+	z í+.	z with positive sign in right subscript
---With	z ^{3/4} ×#d-.	z with four negative signs in superscript position to the left
++z" züÜ	í++.	second z with two plus signs in left subscript position

4.4. Symbols affected by several indices and/or marks

4.4.1. writing order

When a symbol or letter is affected by several indices and/or marks, it must be follow the following order:

- 1) Signed trademarks that do not require a positional Braille sign.
- 2) Marks in superscript that do not require a positional Braille sign.
- 3) Base symbol.
- 4) Mark that does not require a position indicator in superscript to the right.
- 5) Marks and/or indices in subscript on the left.
- 6) Marks and/or indices in superscript to the left.
- 7) Trademarks and/or subscribed indices.
- 8) Marks and/or indices in superscript.
- 9) Marks and/or indices in subscript position to the right.
- 10) Marks and/or indices in superscript position to the right.

Note that for the writing of letter and number indices that require signs of position, the writing order determined in section 4.1 is followed.



Examples:

Visual sign	Braille sign	Meaning
z_4^3	$z\acute{\#}d\times\#c$	z with subscript "4" and superscript "3"
$z_{i,j}^2$	$z\acute{?}i,j\times\#b$	z with subscript "i,j" and superscript "2"
z'_0	$z\ddot{u}\acute{i}\#j$	z prime with subscript "0"
z'^3	$Z\ddot{u}\times\#c$	z prime with superscript "3"
$\overline{z}_0$	$\textcircled{z}\acute{?}i,j\times\#b$	z with superhatched subscript "0"
$\overline{(z'_0)}^2$	$\textcircled{z\ddot{u}\acute{i}\#j}\times\#b$	z prime with subscript "0", in parentheses, super dashed and with superscript "2"

If parentheses do not appear in this expression, for its transcription into Braille will use auxiliary parentheses.

$$\overline{z'_0} \quad \textcircled{z\ddot{u}\acute{i}\#j}\times\#b \quad \text{z prime with subscript «0», superhatched and with superscript «2»}$$

4.4.2. displaced indices

The Braille writing of the displaced indices will be done by writing, before the corresponding position indicator, the sign » (56) for subscripts and the sign ø (45) for superscripts.

The index closest to the base sign will always be written first.

Visual sign	Braille sign	Braille dots	Meaning
$\ddot{y}\ddot{y}$	$\wedge x$	45-16	displaced superscripts
$\ddot{y}_{\ddot{y}}$	$\gg in$	56-34	displaced subscripts



In these two examples the "s" is displaced:

Visual sign	Braille sign	Meaning
TRs	$\{t\overset{r}{r}s$ T subscript «r», displaced superscript «s»	
Tr _s	$\{t\overset{r}{r}s$ T superscript "r", shifted subscript "s"	

Observe in the previous case that, following the rule of writing «indices displaced», the superscript that affects the base letter is written first, instead of the subscript. If the subscript is not displaced, the order would be the reverse, as can be seen below (see section 4.3).

T_s^r $\{t/sxr$

Chapter 5. Arithmetic and Algebraic Operators

5.1. elementary arithmetic operations

Visual sign	Braille sign	Braille dots	Meaning
+	+	235	summer
-	-	36	subtract
x	[	236	multiply (quote)
.	—	6-0d	multiply (dot)
/	*	256	division with forward slash (exclusively when indicating division)
—	*	256	division with horizontal stroke
: ÷ · ÷ @,		5-2	division with a colon (in any of the variants in which they appear)
ÿ, ÿ, ÿ †, ÿ	».	56-3	generic operator (often used to represent an operation between elements of a set)



Examples:

sight sign	Signo braille	Meaning
6+2 #f+#b		six plus two
6-2	#f-#b	six less than
6x2 #f[#b		six for two
6·2	#f_ #b	six for two
6÷2 #f».#b		six operated with two
3b	#c@b	three b
3a+5x #c@a+#ex		three to plus five x
a+bc a+bc		a plus b minus c
x y	x_y	x by y
x÷y x»y		x operated on y
3:4	#c@,#d	three divided by four (with colons)
$\frac{3}{4}$	#c*#d #c*	three divided by four, with horizontal bar ¹⁰
—	A*c	a divided by c, with horizontal or oblique bar
—	A*cx	a divided by c, with horizontal bar, multiplied by x
—	A*¿c_x}	a divided with horizontal bar by the product of c by x (with multiplying point)
$\frac{+}{+}$	¿a+b}*c	a plus b divided by c with horizontal bar

¹⁰ For the abbreviated representation, see chapter 2.



sight sign	Signo braille	Meaning
$\frac{+ \quad -}{+}$	$\zeta a+b*c\}^*?d+e\}$	fraction whose numerator is the sum to plus the quotient from b to c, and whose denominator is d plus e
$+ / a+b*c$		a plus b divided by c, with horizontal or oblique bar
$\frac{\frac{a+b}{c+d}}{x+y}$	$??a+b\}\zeta c+d\}\}^*?x+y\}$	fraction whose numerator is the fraction of numerator a plus b and denominator c plus d whose denominator is denominator is x plus y
$\frac{3}{5} \cdot \frac{2}{7} = \frac{6}{35}$	$\#c? [\#b= =\#f:?$	three fifths by two sevenths equals six thirty-fifths

5.2. powers and roots

5.2.1. Powers

Since, from the graphical point of view, the exponent of a power is a superscript, will be written after the base preceded by the braille indicator corresponding $\times$ (points 16) —see 4.2—.

Examples:

sight sign	Signo braille	Meaning
2	$x \times \#b$	X squared
	$x \times n$	x raised to an
$^{-1}$	$x \times -\#a$	x raised to -1
$^{\frac{1}{2}}$	$x \times \#a;$	x raised to $\frac{1}{2}$
$^{+}$	$x \times ?a+b\}$	x raised to the sum of a+b
$^{+}$	$X1-(a+b)$	x raised to minus (a+b)
2	$X1n1\#b$	x to the square of n



sight sign	Signo braille
$7^3 \cdot 2^2 + 1$	$\#gx1\#c\#bx1\#b+x+\#a$
$3a + \frac{1}{2} \cdot 2^3$	$\#c@a+\#a; x1\#by1\#c$
$\frac{2+1}{2 \cdot 1}$	$\wr x1\#b+\#a\}^*?x1\#b-\#a\}$
$\frac{4}{3 \cdot 2}$	$\#d^*?\#c@a1\#b\}$
$+$	$x1a+b$

5.2.2. Estate

$\sqrt[n]{}$ E IDEA 1246 ... 156 root sign

The root index is placed between the two braille elements that make up the sign and, after it, the radicand is written.

Example:

$\sqrt[3]{8}$ $\#c\acute{Y}\#h$ Cube root of eight

In the case of the square root, the index (2) is omitted by analogy with writing in ink.

Example:

$\sqrt{8}$ $\acute{E}\acute{Y}\#h$ square root of eight

When the radicand is a compound expression, it is closed in parentheses. auxiliaries. Graphically, the radicand is distinguished because it encompasses everything that is lies under the horizontal stroke of the root sign.

Examples:

sight sign	Signo braille	Meaning
$\sqrt{x}$	$\acute{E}\acute{Y}x$	square root of x
$\sqrt[n]{a+b}$	$\wr \acute{E}\acute{Y}\wr a+b\}$	nth root of a plus b



sight sign	Signo braille	Meaning
$\sqrt[n]{a+b}$	$\text{Un-}\#a\text{Y?}a*b\}$	to the nth root of a se the suma b
$\sqrt[n-1]{\frac{a}{b}}$	$\text{Un-}\#a\text{Y?}a*b\}$	n-1 index root of a over b
$\sqrt{\sqrt{16}}$	$\text{EY}\text{EY}\#of$	square root of the root square of 16
$\sqrt{x^2 + y^2}$	$\text{EY}\text{EY}\#x1\#b+y1\#b\}$	square root of the sum of x squared plus y squared
$\sqrt[3]{9} + 9$	$\text{E}\#c\text{Y}\text{E}\#c@a1\#ba\}+9i$	cube root of the difference from three to squared minus ay, outside the root, plus 9

5.3. combinatorics

Visual sign	Braille sign	braille dots	Meaning
$n!$	$n^{\wedge}.$	1345-45-3	factorial of n
$n!!$	$n^{\wedge}.\text{.}$	1345-45-3-45-3	double factorial of n
$\binom{n}{r}$	$\{(n:r)\}$	46-126-1345-25-1235-345	binomial coefficient n over r

As can be seen in the following examples, the permutations, variations and combinations, with or without repetition, will be written exactly as they come in the original, but without the need to respect the offset of indices.

$$C_n^k = \binom{n}{k} = \frac{n!}{k!(n-k)!} \quad \text{combinations without repetition}$$

$$\{tin1k=\{(n:k)=n^{\wedge}.*?k^{\wedge}.(nk)^{\wedge}.\}$$

$$CR_n^k = \binom{n+k-1}{k} \quad \text{combinations with repetition}$$

$$\{c\{rin1k=\{(n+k-\#a:k)$$



$$= \frac{n!}{(n-k)!}$$

variations without repetition

$$\{w_{1k} = n! / (n-k)!\}$$

=

variations with repetition

$$\{v_{1k} = n! / (n-k)!\}$$

$$= (n-1)(n-2) \dots (n-k+1)$$

variations without repetition

$$\{v_{1k} = n! / (n-k)!\}$$

$$(n-k+1) \dots (n-k+a)$$

5.4. Other operators

Visual sign	Braille sign	braille dots	Meaning
$\pm$	$\mathbf{+:-}$	235-25-36	more or less
$\dot{\pm}$	$\mathbf{-: +}$	36-25-235	less or more
%	$\mathbf{\%]}$	456-356	So much percent
‰	$\mathbf{\%]]}$	456-356-356	so much per thousand
$ \dots $	$\mathbf{\% \dots \%}$	456-0d-...-456-0d	absolute value; module (vertical bars)

Examples:

$$6 \pm 2 \mathbf{\#f+:-\#b}$$

$$21\% \mathbf{\#ba\%]}$$

$$|\alpha| = 1 \mathbf{\% \frac{3}{4} a \% \#a}$$
 absolute value of alpha equal to one

$$|x| = 1 \mathbf{\% x \% \#a}$$
 absolute value of x equals one

5.5. Operators on sets of numbers

5.5.1. Summation or summation

$$\sum_{i=1}^n s_i \text{ Italy} \quad 45-234-...-156$$



The limits of the sum, if they appear at different levels, are placed between the Greek letter capital sigma Σ (45-234) and the sign Υ (156), separated by the sign : (25).

Examples:

$\sum_{j=1}^4 j^2$ sum of j=1 up to 4 of j²

$\Sigma_{j=1}^4 j^2$

$\sum_{j=1}^4 j^2$ sum for 1 less than or equal to j less than or equal to 4 of j squared

$\Sigma_{j=1}^4 j^2$

In this example it is not necessary to write the open and close parentheses in braille, since the limits of the sum are already delimited by the summation sign as opening and 156 as closing.

5.5.2. Producer or producer

Π_{Italy} 45-1234-...-156

Product limits, if they appear at different levels, are placed between the letter Greek capital pi Π (45-1234) and the sign Υ (156), separated by the sign : (25).

Examples:

$\prod_{j=1}^n S_j$ product, from j=1 to n, of the S_j

$\Pi_{j=1}^n S_j$

$\prod_{j=1}^n S_j$ product for 1 less than or equal to j less than or equal to n of S_j

$\Pi_{j=1}^n S_j$

In this example it is not necessary to write the open and close parentheses in braille since the limits of the sum are already delimited by the summation sign, as opening, and 156 as closing.

5.5.3. Co-producer or co-producer

$\prod \Pi$ 45-12456-...-156

The co-product limits, if they appear at different levels, are placed between the sign Π (45-12456) and sign Υ (156), separated by sign : (25).



Example:

$$X = \bigcup_{j \in J} X_j$$

$\{x = \wedge \tilde{n} j (\{j \tilde{Y} \{x/y$

The most frequent functions on sets of numbers are included below represented by symbols/textual notations.

In braille they will be represented the same as in visual characters. These representations end with point 3.

sight sign	Signo braille	Meaning
max	max	maximum
min	min.	Minimum
mcd	mcd.	greatest common divisor
etc	etc.	least common multiple
inf	inf.	tiny
sup	sup.	supreme

The delimiters of the original in ink will be used (parentheses, brackets or braces). as well as the separators (comma or semicolon).

Examples:

m.c.d.(28,34) **mcd.(#bh ,#cd)**

max.[28;36] **max.á#bh ;#cfú**

5.6. Operators on two-dimensional structures

For their braille writing, they will be represented as follows:

- Blank line.
- Next, a first line in which the headers of the structures to operate separated by operator signs. If the braille line, is interrupted by one of these signs and is repeated on the line following, respecting an indentation of two blank spaces.



c) Blank line.

d) The operating structures are represented in the manner indicated in section 3 of chapter 3.

The operation sign will be placed in the position that best suits

adjustment.

e) Blank line.

Example:

$$A + B = \begin{pmatrix} -2 & 4 \\ 2 & 6 \\ 0 & -1 \end{pmatrix} + \begin{pmatrix} 2 & 1 \\ -3 & 5 \\ -1 & 0 \end{pmatrix} = \begin{pmatrix} 0 & 5 \\ -1 & 11 \\ -1 & -1 \end{pmatrix}$$

#s{a+{bY¥=

s-#b #dY s #b #AY s #j #eY

I #b #f% + I-#c #e% = I-#A #AA%

(#j -#A) (-#A #j) (-#A -#A)

Chapter 6. Arithmetic and algebraic relations

6.1. Relations

Visual sign	Braille sign	Braille dots	Meaning
=	=	2356	equal to
ÿ	¾=	4-2356	approximately equal to
ÿ	=?	2356-26-0	questioned to be equal to
ÿ	°=	56-2356	equal by definition
ÿ	°:=	56-25-2356	corresponds to
ÿ	==	2356-2356	identical to; congruent with
	%	456-0d	divide a



Visual sign	Braille sign	Braille dots	Meaning
ÿ	%*	456-256	proportional to
ÿ	°;	56-23	proportion; equality of reasons
ÿ	@,	5-2	ratio
ÿ	@?. 5-26-3		tilde operator; similar to; difference between; proportional to
ÿ	@=. 5-2356-3		almost equal to; asymptotically equal to
ÿ	{:k 46-25-13		geometric progression
÷	{:	46-25	arithmetic progression

Examples:

$p \cdot v = m \cdot v$ p equals by definition to m by v

$A \approx B$ $\{a \approx . \{b$ A almost equal to B

$4 \text{ is to } 3 \text{ as } 8 \text{ is to } 6$

Other relationships:

sight sign	Braille sign	Braille dots	Meaning
< ≤ ≲ ≴	he	246	smaller than
> ≥ ≳ ≴	O	135	greater than
ÿ	night	246-246	much less than
ÿ	Oh	135-135	much greater than
ÿ ÿ ÿ	d=	246-2356	less than or equal to
ÿ ÿ ÿ	O=	135-2356	greater than or equal
ÿ ÿ	@he	5-246	anterior a
ÿÿ	O,	135-2	posterior a



sight sign	Braille sign	Braille dots	Meaning
ÿ	@night	5-246-246	long before
ÿ	And,	135-135-2	much later than
ÿ ÿ	@ö=	5-246-2356	before or equal to
ÿÿ	O,=	135-2-2356	later than or equal to

6.2. relationships denied

The braille representation of the negation of a certain relationship has the first character 45 points, followed by the representation of the relationship that is denies.

For example:

Visual sign	Braille sign	Braille dots	Meaning
ÿ	^=	45-2356	other than
ÿ ÿ	^oo	45-135-246	neither greater nor less than
ÿ	^@=.	45-5-2356-3	is not asymptotically equal to
ÿ	^@?.	45-5-26-3	up-down tilde crossed out
ÿ	^%	45-456-0d	is not a divisor of
ÿ	^ö	45-246	not less than
ÿ	^o	45-135	not greater than
ÿ	^ö=	45-246-2356	is not less than or equal to
ÿ	^o=	45-135-2356	is not greater than or equal to
ÿ	^@ö	45-5-246	is not before
ÿ	^o,	45-135-2	is not later than



Chapter 7. Set Theory

7.1. Basic concepts

Visual sign	Braille sign	Braille dots	Meaning
=	=	2356	equal to
ÿ	==	2356-2356	identical to
{	@l	5-123	open key sets
}	%,	456-2	lock wrench sets
(	@(	5-126	open class key
)	),	345-2	close class key
ÿ	@ on	5-12356	open class brackets
ÿ	uh	23456-2	close class bracket
,	,	0-2	comma separating elements
:	% @,	456-0d	such that
:	% @,	5-2	
:	;	0-23	
ÿ	—,	6-2	
ÿ	%j	456-245	empty set
	%in	456-136	set or universal class
ÿ	(,	126-2	is element of; belonging to
ÿ	@)	5-345	understands; has as element
ÿ	^,(45-126-2		is not an element of; does not belong to
ÿ	^@) 45-5-345		does not understand; there is no way element
ÿ	(.	126-3	Including; subset



Visual sign	Braille sign	Braille dots	Meaning
$\ddot{y}$	(;	126-23	included or equal to
$\ddot{y}$	—)	6-345	Includes; has as a subset
$\ddot{y}$	th)	56-345	includes or is equal to
$\ddot{y}$	^(.	45-126-3	not included in
$\ddot{y}$	^_)	45-6-345	does not include
$\ddot{y}$	^(;	45-126-23	not included nor equal to
$\ddot{y}$	^o)	45-56-345	does not include nor is equal to

7.2. Operations between sets

Visual sign	Braille sign	Braille dots	Meaning
$\ddot{y}$	%)	456-345	union
$\ddot{y}$	%IDEA	456-156	intersection
$\ddot{y}$	\) Italy	123456-345-...-156	union of a family of sets
$\ddot{y}$	\italian	123456-156-...-156	intersection of a family of sets
$\ddot{y}$	@.	5-3	set difference
$\ddot{y}$	^d	45-145	symmetric difference of sets
x	{[	46-236	Cartesian product
	°c{a	56-14-46-1	complementary of A
A'	{aü	46-1-1256	complementary of A
	¾c{a	4-14-46-1	complementary of A



Examples:

Let $= \{2, 4, 6, 8, 10\}$ and $= \{ : \ddot{y} \ddot{y}, < 7 \}$

{sean {a=@l#b ,#d ,#f ,#h ,#aj%,

Y {b=@lx@,x(, %n ,xö#g%,

B is the set of elements x such that x belongs to the set of numbers natural and x is less than 7.

$\ddot{y} = \{2, 4, 6\}$ **{a%Y{b=@l#b ,#d ,#f%,**

$\ddot{y} \quad \ddot{y} \quad \backslash j \{ \{ i Y \{ a j$

Union for j belonging to a set of indices I of the family $A_{\text{sub } j}$.

For the union and intersection of several sets, the norms seen for the summatory and productive (see chapter 5).

7.3. Relations between the elements of a set

Visual sign	Braille sign	Braille dots	Meaning
$\ddot{y}$	x°ry	1346-56-1235-13456	x related by the ratio $\ddot{y}$ to y
$\ddot{y}-$	^°r	45-56-1235	denial of relationship $\ddot{y}$
$\ddot{y}$	—,	6-2	quotient set
$\ddot{y}$	@he	5-246	precede a; anterior a
$\ddot{y}$	O,	135-2	follow; after to
$\ddot{y}$	@ö=	5-246-2356	precedes the equal to
$\ddot{y}$	O,=	135-2-2356	follows or equal to
$\ddot{y}$	^@ö	45-5-246	is not before
$\ddot{y}$	^o,	45-135-2	is not later than
$\ddot{y}$	^@ö=	45-5-246-2356	is not before nor equal to
$\ddot{y}$	^o,=	45-135-2-2356	is not after or equal to



7.4. Cardinals

Visual sign	Braille sign	braille dots	Meaning
Card	{card. 46-14-1-1235-145-3	cardinal of a set	
#	#k	3456-13	cardinal of a set
∞	#ü	3456-1256	infinite
A_ ü		6-1256	aleph
	#p	3456-1234	power of a set

Chapter 8. Logic

8.1. Quantifiers

Visual sign	Braille sign	Braille dots	Meaning
∀	{.	46-3	universal quantifier: for everything
∃	{¿	46-26	existential quantifier: at least one element exists
∃!	{;	46-23	unitary quantifier: there is a single element
¬∃	^ {¿ 45-46-26		does not exist

8.2. Logic of propositions

Visual sign	Braille sign	braille dots	Meaning
⊤	%=	456-2356	tautology
⊥	^%=	45-456-2356	no tautology
⊢	%s	456-234	true proposition
⊢	%()	456-126	false proposition
∨	%i	456-24	disjunction (or)



Visual sign	Braille sign	braille dots	Meaning
$\ddot{y}$	$\%?$	456-26	conjunction (and)
$\ddot{y}$	$\vee$	Italy 123456-24...15611	disjunction of a family of propositions
$\ddot{y}$	$\vee?$	Italy 123456-26...15611	conjunction of a family of propositions
$\ddot{y}$	$\%It is$	456-2346	exclusive disjunction
$\neg$	$_ \cdot$	6-312	logical negation
$\sim$	$_ \cdot$	6-312	logical negation
$\vdash$	$\circ$	246-25-135	double implication "if and only if"
$\ddot{y} : \circ$		25-135	direct involvement; it implies
$\ddot{y} \circ :$		246-25	reciprocal involvement; because
$\ddot{y}$	$_ 1$	0-6-16-0	therefore
$\ddot{y}$	$\frac{3}{4} \acute{I}$	0-4-34-0	since

Examples:

$\ddot{y} \quad , \quad \neg(\ddot{y}) \quad \ddot{y} \neg \ddot{y} \neg$

$\{.p, q _ .(p\%?q)\ddot{o} : \circ _ .p\%i _ .q$

$\ddot{y} : \ddot{y} \sim = \ddot{y}$

$\wedge\{?p@, q\%? _ .p=\% =$

Chapter 9. Analysis and calculation

9.1. Generalities

This section collects examples of how general notations are written. of functions. They use the signs of basic writing, in addition to some

¹¹ If indexes appear, the system indicated in chapters 5 and 7 will be followed for summary, producer...: lower index, points 25, upper index.

¹² Whatever the visual representation of the logical negation, in braille it will be represented with the sign 6-3.



specific signs for the representation of functions that are listed below.

For the representation of functions in Braille, the individual letter will be used. corresponds to the original ink without using the distinctive typographical variant (f, g, h...).

Visual sign	Braille sign	Braille dots	Meaning
$\longrightarrow$	::	25-25-2	correspondence or application between sets
$\longleftarrow$	@::	5-25-25	reverse correspondence
$\longleftrightarrow$	@::	5-25-25-2	bijective application

When the function arrow is affected by an index, the index is written in braille between the two elements 25 containing the arrow:

ȳ

:f,

sight sign	Braille sign	Braille dots	Meaning
: @,		5-2, as the two points are represented on other occasions (division, ratio, such that...)	colon (when used in functions)
f^{-1}	Fã-#a Sub.	124-16-36-3456-1 124-346-3 (abbreviated form)	inverse function of f
ȳ ==		2356-2356	identical to
ȳ _«		6-23	composition of functions

Writing Ordered Pairs

In braille, like visual characters, ordered pairs are written between comma-separating parentheses.



Examples:

sight sign	Signo braille	braille dots	Meaning
(1, 2) (x ¹ #a°,x ¹ #b)		126-1346-34-3456-1-0-2-1346-34-3456-12-345	ordered pair x1, x2
$\begin{pmatrix} 1 & 3 \\ 2 & 2 \end{pmatrix} (\#a; ,\#c;)$		126-3456-1-23-0-2-3456-14-23-0-345	ordered pair one half, three half

For the representation of usual symbols in Theory of Functions, the following are followed: rules established in section 5.5.

For example:

Visual sign	Braille sign	Braille dots	Meaning
Dom	{dom.	46-145-135-134-3	Domain
Or	{or.	46-135-1235-3	Original
Img In the	{img. {in the.	46-24-134-1245-3 46-24-134-3	Image
conc	conc.	14-135-1345-14-3	concave
conv	Conv.	14-135-1345-1236-3	convex
i think	i think	14-1235-15-14-3	growing
dec	dec.	145-15-14-3	decreasing
dec	Maint.	134-1-1345-2345-3	decimal or mantissa
arg	arg.	1-1235-1245-3	argument
rot	rot.	1235-135-2345-3	rotational or rotor



Visual sign	Braille sign	Braille dots	Meaning
div	div.	145-24-1236-3	divergence
grad	deg.	1245-1235-1-145-3	gradient
Re	{re.	46-1235-15-3	real part
In the	{in the.	46-24-134-3	imaginary part
Rec	{rec.	46-1235-15-14-3	Route

Any other symbol/other notation will follow the regulations in chapter 5.

Examples:

sight sign	Signo braille	Meaning
$f: A \rightarrow B$	f@,{a:.,{b	map f from A to B
$f: A \rightarrow B$	{a:f:.,{b	map f from A to B
$B \xrightarrow{f^{-1}} A$	{b:fã-#a:.,{a	Reverse application of f , from B to A (f to the -1 of B in A)
$B \xrightarrow{f^{-1}} A$	{b:fó:.,{a	inverse application of f , from B to A (abbreviated form)
$f: A \rightarrow B$	{a@:.,{b	bijective application of A to B
$f(x) = y$	F(x)=y	f of x is equal to y
$f \equiv 0$	f==#j	f is identical to zero
$f \circ g(x) = f(g(x))$	f_ ;g(x)=f(g(x))	composition of functions



piecewise function

$$f(x) = \begin{cases} 3x & \text{si } x < 0 \\ 6x & \text{si } x > 0 \end{cases}$$

f(x)=

#cx si x<0 #fx si x>0

See chapter 3, where this form of representation was established.

Breaks

The signs of common parentheses or square brackets are used as in characters visuals.

Visual sign	Braille sign	Meaning
$] , [$	Úa ,bá	open interval of extremes a and b
$(,)$	(a ,b)	open interval of extremes a and b
$[,]$	Áa ,bú	closed interval of ends a and b
$[, [$	Ah, ba	interval closed on the left and open on the right
$[,)$	b)	interval closed on the left and open on the right
$] ,]$	Wow, suck!	interval open on the left and closed on the right
$(,)$	(a, boo	interval open on the left and closed on the right



9.2. Boundaries

Visual sign	Braille sign	braille dots	Meaning
	lim.	123-24-134-313	limit
$\dot{y}$	∴,	25-2	tends to
$\ddot{y}$	%.	456-3	tends decreasing to
$\ddot{y}$	%a	456-1	tends to grow to
$\overline{\lim}$	$\frac{3}{4}\text{clim.}$ 4-14-123-24-134-3	upper limit	
	limsup.	123-24-134-234-136-1234-3	upper limit
$\underline{\quad}$	_lim. 6-36-123-24-134-3	lower limit	
	liminf.	123-24-134-24-1345-126-3	lower limit

If the "limit" has subscribed information in visual characters, in braille it will be written between the "limit" sign and character 156.

Visual sign	Braille sign	Meaning
$\dot{y}$	x∴,c	x tends to ac
$\ddot{y} \ddot{y} X∴,\#ü$		x tends to infinity
$\lim_{\dot{y}}$	lim.x∴,cÝ	limit as x tends to ac
$\lim_{\ddot{y}}$	lim.x%acÝ	limit as x tends to grow to c
$\lim_{\dot{y}0\dot{y}}$	lim.x∴,#j-.Italy	limit as x tends to 0 from the left
$\lim_{\ddot{y}}$	lim.x%.cÝ	limit as x tends to decrease ac

¹³ See what was agreed in section 5.5 regarding symbols and notations.



Visual sign	Braille sign	Meaning
$\lim_{y \rightarrow 0^+}$	lim.x:,#j+.Italy	limit as x tends to 0 from the right

To simplify the braille representation in developments in which a expression of the limit operator, the form **IÝ** (123-156) can be used , indicating between these two signs the value to which the variable tends. This should be explained in *Braille transcription note*.

Examples:

$$\lim_{x \rightarrow c} (f(x) + g(x)) = \lim_{x \rightarrow c} f(x) + \lim_{x \rightarrow c} g(x)$$

$$\text{lim.x:;cÝ(f(x)+g(x))=lim.x:;cÝf(x)+lim.x:;cÝg(x)}$$

If the expression **lim.x:;cÝ** is replaced by the abbreviated form **lcÝ**, its transcript would be:

$$\text{lcÝ(f(x)+g(x))=lcÝf(x)+lcÝg(x)}$$

In the example below,

$$\lim_{y \rightarrow 5} \frac{2+3}{y} = \frac{y}{y} = \lim_{y \rightarrow 5} \frac{\frac{2}{2} 3 + \frac{2}{2}}{\frac{5}{2}} = \lim_{y \rightarrow 5} \frac{1 + \frac{3}{2}}{\frac{5}{2}} = \frac{1}{0} = y$$

in braille **lim.x:;#üÝ** has been replaced by the abbreviated form

l#üÝ; its transcription would be:

$$\text{L\#ült?commune\#b+\#cx\}*?x-\#e\}=\$$

$$\text{=\#ü*\#ü=}$$

$$\text{=L\#üY?commune\#b*commune\#b+\#cx*commune\#b\}$$

$$\text{*?x*commune \#b-\#e*commune\#b\}=\$$

$$\text{=L\#ülan?\#a+\#c*x\}*?\#a*x\#e*communal\#b\}=\$$

$$\text{=\#a*\#j=\#ü}$$



9.3. Derivatives and differentials

For the representation of increments, Δ (capital delta) will be used.

For the representation of differentials, the lowercase d will be used without using any hallmark of typographic variant.

Visual sign	Braille sign	braille dots	Meaning
D	Δ	45-145	increase of...
d	d	145	differential of...
∂	∂	456-145	partial derivative

derivative of a function

Visual sign	Braille sign	Meaning
—	$\frac{df}{dx}$	derived from «f» with respect to «x»
—	$D_x f$	derivative, with respect to «x», of «f»
$(f'(x))$	$d(f(x))$	derivative of «f» of «x»

If a function f is differentiable at all points of its domain, it remains defined the derivative function that is usually denoted with f' .

For example:

Si $f(x) = 2x^2$, then $f'(x) = 4x$

If $f(x) = ax^b$, then $f'(x) = bax^{b-1}$

derivative of order n

Visual sign	Braille sign	Meaning
—	$\frac{d^n f}{dx^n}$	nth derivative of «f» with respect to «x»



Visual sign	Braille sign	Meaning
—	Stretch*?dxân}f	derivative nth, with respect to «x», of «f»

As an alternative option, which abbreviates the braille representation of the derivatives, you can use the following sequence:

- 1st) Sign formed by the points 1456.
- 2nd) Order of the derivative if it is greater than one.
- 3.º) Derivation variable.
- 4th) Sign formed by the points 156.
- 5.º) Function to be derived.

The shorthand notation will be explained in an explanatory note.

Visual sign	Braille sign	Meaning
—	xÝf	derivative with respect to «x», of «f»
—	xÝf	derivative with respect to «x», of «f»
—	¥nxÝf	derivative nth with respect to «x», of «f»
—	¥nxÝf	derivative nth with respect to «x», of «f»

Partial derivative

— Partial derivative of «f» with respect to «x».

¿%df}*?%dx}

— Partial derivative, with respect to «x», of «f».

%d*?%dx}f



Visual sign	Braille sign	Meaning
—	» xýf	partial derivative with respect to «x», of «f»
—	»¶nxÝf	nth partial derivative of «f» with respect to «x» n times
—	»¶nxÝf	nth partial derivative with respect to «x» n times, of «f»
² —	»¶#bxyÝf	second partial derivative of «f» with respect to «x» and «y»
² —	»¶#bxyÝf	second partial derivative of «f» with respect to «x» and «y»
⁺ —	»¶m+nxmynÝf	partial derivative of order «m+n» of «f», with respect to «x» m times and with respect to «y» n times
⁺ —	»¶m+nxmynÝf	partial derivative of order “m+n”, with respect to “x” m times and with respect to “y” n times

Example:

$$\frac{\partial^2}{\partial x^2} (,) = (\frac{\partial}{\partial x} \frac{\partial}{\partial x} (,))$$

$$\frac{\partial}{\partial x} \left(\frac{\partial}{\partial y} \left(\frac{\partial}{\partial x} f(x, y) \right) \right) = \frac{\partial}{\partial y} \left(\frac{\partial}{\partial x} \left(\frac{\partial}{\partial x} f(x, y) \right) \right)$$

Shorthand notation:

$$\frac{\partial}{\partial x} \left(\frac{\partial}{\partial y} f(x, y) \right) = \frac{\partial}{\partial y} \left(\frac{\partial}{\partial x} f(x, y) \right)$$

Nabla, Laplacian, Alambertian

Visual sign	Braille sign	braille dots	Meaning
ÿ	¾ñ	4-12456	nabla operator
D	%[	456-236	laplacian operator



Visual sign	Braille sign	braille dots	Meaning
$\square$	%and	456-13456	alambertian operator

9.4. integral

Visual sign	Braille sign	braille dots	Meaning
$\int$	Italy	12346-...-156	indefinite integral, integral sign
$\iint$	ÇÇ Y	12346-12346-...-156	double integral
$\iiint$	Italy	12346-12346-12346-...-156	integral triple
$\oint$	] Italy	12346-356-...-156	contour integral
$\int_C$	⌈cY	12346-356-46-14-...-156	contour integral along curve C
$\int_a^b$	Italian .3/4s	12346-3-4-234-...-156	line integral
$\hat{y}$	@«	5-23	convolution product

The representation in visual characters of «definite integral» is characterized because the integral sign is accompanied by a subscript and a superscript, both to the right of the sign. This information will be written in braille between the two characters that form the integral sign, writing first the subscript and then the superscript, both separated by the braille character : (25).

Visual sign	Braille sign	Meaning
$\int_a^b$	it:b Ý	definite integral between a and b
$\overline{\int_a^b}$	English: b Ý	integral superior definitiva entre ayb
$\underline{\int_a^b}$	_ -cha:b ý	integral inferior definitiva entre ayb



Examples:

$$\int x^2 dx$$

ÇItalian#b@dx

$$\int_1^4 x^2 dx = \left[\frac{1}{3} x^3 \right]_1^4 = 21$$

ç#a:#dÝxã#b@dx=á#a: xã#cúí#aã#d=#ba

Chapter 10. Classic functions

10.1. Sequences, progressions and series

10.1.1. successions

Visual sign	Braille sign	braille dots	Meaning
(sn)	(his)	126-234-34-1345-345	general term sequence s sub n
{sn}	@lsín%,	5-123-234-34-1345-456-2	term sequence general s sub n
Sn	Sin	234-34-1345	general term sequence s sub n

Examples:

() = (1, 3, ... , 2 + 1, ...)

(its)=(#a ,#c ,... ,#bn+#a ,...)

{ } = {0ÿ9, 0ÿ99, ... ,1 ÿ 10 ¹ , ... }

**@l{peak%,=@l#j,i ,#j,ii ,... ,
#a-#a*?#aj\$K} ,...%,**



Note that in the case of ellipses it is not necessary to leave a space in white ahead.

In the transcription of documents, the representation used by the author.

Example:

$\lim_{n \rightarrow \infty} s_n$ Limit of s_n as n tends to infinity

Lim.n:,#ÜÝ{sín

Using the abbreviation for *lim.* (see 9.2. *Limits*):

L#ÜÝsín

10.1.2. progressions

Visual sign	Braille sign	braille dots	Meaning
$\div$	{:	46-25	arithmetic progression
$\ddot{y}$	{:k	46-25-13	geometric progression

10.1.3. Series

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \lim_{k \rightarrow \infty} \sum_{n=1}^k \frac{1}{n^2} = 1 + \frac{1}{4} + \frac{1}{9} + \frac{1}{16} + \dots$$

^sn=#A:#ÜÝ#A*n\$#b=

=lim.K:,#ÜÍ^sn=#A:KÍ#A*n\$#b=

=#a+#a*+#a}+#a,+...

10.2. Functions represented by symbols/literal notations

In braille they will be represented the same as in visual characters. These representations end with point 3.

Following the established criteria, these notations can be replaced by other that are frequently used in one of the countries in which the present code.

Some of them are listed below.



10.2.1. Exponential and logarithmic functions

Visual sign	Braille sign	Meaning
exp	exp.	exponential (in base e)
log _b x	log.b x logarithm to base b of x	
logx	log.x	decimal logarithm of x
Ln x ln x	ln.x	natural logarithm o neperian of x
shaking x antilog x	shaking.x antilog.x	antilog of x
aln x	aln.x	natural antilogarithm o neperian of x
cologx	colog.x cologarithm of x	

Decimal logarithms of negative characteristic: to write in braille the characteristic of a decimal logarithm when it is negative, the braille characters of the third series will be used (see *Introduction*) preceding the sign numeric.

Examples:

$\log 0,2 = \bar{1},30103$ The decimal logarithm of 0.2 has characteristic -1 and mantissa 30103

log.#j,b=#u,cjajc

-28,345 Decimal logarithm of characteristic -28 and mantissa 345

#go, cde



10.2.2. Trigonometric (circular) functions

sight sign	Signo braille	Other representations	Meaning
sin its	sin. its.		breast
cos	cos.		cosine
tan tg	tan. tg.		tangent
cot cotg	cot. cotg.		cotangent
sec	sec.		drying
csc cosec	csc. Cosec.		cosecant
arcsin face	arcsin. face.	salt. arsenic.	arc sine
arccos	arccos. acos.		arc cosine
arctan arctg	arctan. arctg.	for the purpose. atg.	arc tangent
arccot arccotg	arccot. arccotg.	acot. acotg.	cotangent arc
arcsec	arcsec. asec.		secant arc
arccsc arccosec	arccsc. arccosec.	accc. acosec.	cosecant arc



sight sign	Signo braille	Meaning
give verse	give verse	compete
coversin coversen	coversin. coversen.	coverseno
semiverse semiverse	semiverse. semiverse.	half verse
semicovers semicoversen	semicovers. semicoversen.	semicoverseno

10.2.3. hyperbolic functions

Visual sign	Braille sign	other representations	Meaning
born senh	born. senh.	sh.	hyperbolic sine
cosh	cosh.	ch.	cosine hyperbolic
fishy thg	fishy. thg.	th.	tangent hyperbolic
food ctgh	food ctgh.	cth.	cotangent hyperbolic
themselves	themselves.	sch.	drying hyperbolic
ch csech	ch. harvested	ch.	cosecant hyperbolic



Visual sign	Braille sign	other representations	Meaning
angry argsenh	angry argsenh.	ash.	sine argument hyperbolic
argcosh	argcosh. ach.		argument cosine hyperbolic
argtanh argtgh	argtanh. argtgh.	again	argument tangent hyperbolic
argcoth argcotgh	argcoth. argcotgh.	acth.	argument cotangent hyperbolic
angry	angry ash		argument drying hyperbolic
argcsch argcosech	argcsch. argcosech.	acsch.	argument cosecant hyperbolic

10.2.4. Other functions, parameters and characteristics represented by symbols

Visual sign	Braille sign	Braille dots	Meaning
(sn)	(his)	126-234-34-1345-345	general term sequence s sub n
int	int. 24-1345-2345-3	whole part	
dec	dec. 145-15-14-3		decimal part
sgn	sgn. 234-1245-1345-3	sign	
abs	abs. 1-12-234-3		absolute value



Visual sign	Braille sign	Braille dots	Meaning
Re	{re. 46-1235-15-3		real part of a complex number
In the	{in the. 46-24-134-3		imaginary part of a complex number
rg	rg.	1235-1345-3	range
Adj	{adj. 46-1-145-245-3		attached

If any function or literal symbol does not appear in this chapter, the same will be followed standard than in section 10.2. That is, point 3 later, with transcription note indicating its meaning.

Chapter 11. Geometry and Vectors

Note: the letters that appear are not part of the defined signs. they are generic and may be others, depending on the context.

11.1. geometric elements

sight sign	Signo braille	braille dots	Meaning
$\overrightarrow{r}$	@:,r	5-25-2-1235	straight r
$\overleftrightarrow{PQ}$	@:,?{p{q}	5-25-2-26-46-1234-46-12345-35	determined line through the points P and Q
$\overrightarrow{z}$	:,With	25-2-1356	right ray z
$\overleftarrow{z}$	@:With	5-25-1356	left ray z
$\overrightarrow{OA}$	:,z{O{a}	25-2-26-46-135-46-1-35	ray of origin O passing through point A
$\overline{AB}$	$\frac{3}{4}c?{a{b}$	4-14-26-46-1-46-12-35	segment AB
$\angle A$	^:{a	45-25-46-1	angle A



sight sign	Signo braille	braille dots	Meaning
$\widehat{aob}$	$\wedge : ? aob \}$	45-25-26-1-135-12-35	angle aob
$\ddot{y} \ddot{y} \% -$		456-36	right angle
$\ddot{y}$	{IDEA	46-156	positive oriented angle
$\ddot{y}$	{}	46-345	negative oriented angle
$\widehat{s}$	$\frac{3}{4} : s$	4-25-234	bow s
$\ddot{y} abc \widehat{} abc$	$\ddot{y} abc \widehat{} abc \}$	26-345-26-1-12-14-35	arc corresponding to angle abc

11.2. Vectors

Visual sign	Braille sign	braille dots	Meaning
$\ddot{y}$	$: , in$	25-2-1236	vector v
$\ddot{y}$	$@ : in$	5-25-1236	opposite vector of vector v
$ \ddot{y} $	$\% : , in \%$	456-0D-25-2-1236-456-0D	vector module v
$\ddot{y} \ddot{y} \ddot{y}$	$\% : , v \% $	456-123-25-2-1236-456-123	vector norm v
$\ddot{y}$	$_ IDE A$	6-156	positive axial vector
$\ddot{y}$	$\frac{3}{4})$	4-345	negative axial vector

Note: where there is no confusion depending on the context, the arrow may be deleted to the right, as will be shown in one of the dot product examples.

As already mentioned in previous chapters, with "0D" it is indicated that the braille sign that is to be written in that place must not have point 1, or 2, or 3 (blank half-box on the right). If this condition is not met, it is necessary leave a blank space between the "close bar" sign and the following sign.



Examples:

$ \overrightarrow{AB} $	Modulus of vector AB	% :,{a{b}%
$\ \overrightarrow{AB}\ $	Norm of vector AB	%l:,{a{b}%l
$\overrightarrow{\alpha}$	alpha positive axial vector	_Y ^{3/4} a
$\overleftarrow{\alpha}$	alpha negative axial vector	^{3/4}) ^{3/4} a
$\overline{AB}$	Vector libre AB	To:,{a{b}ú

11.3. geometric relations

Visual sign	Braille sign	Braille Dots	Meaning
ÿ	{he	46-246	is drying with
ÿ	%l	456-123	is parallel to
#	%l=	456-123-2356	is parallel and equal to
ÿ	#.	3456-3	perpendicular to orthogonal to
ÿ	°¿;	56-26-23	homologous to/similar to
~	@?.	5-26-3	equals/similar to 14
$\overline{\wedge}$	%E	456-1246	projectivity
$\overline{\overline{\wedge}}$	%I	456-12456	perspective
ÿ	@?=	5-26-2356	congruent with

Examples:

$\vec{l} \parallel \overline{MN}$ Line ÿ is parallel to the endpoint segment M and N

@:,%l^{3/4}c?{m{n}

¹⁴ Also in chapter 6.



$\overline{AB} \perp \overline{OX}$ The line determined by points A and B is perpendicular to the ray of origin O that contains point X

@:,?{a{b}#.,?{O{x}

Note: as regards the respective denials of each of these relations, it is worth the rules seen for the relationships discussed in chapter 6. That is, the signs of "denial" of the existence of a relationship (or "negative relationships") in braille have as the first character the sign formed by the points 45.

For example:

Visual sign	Braille sign	Braille Dots	Meaning
$\ddot{y}$	$\wedge\% $	45-456-123	not parallel
$\ddot{y}-$	$\wedge\#.$	45-3456-3	no perpendicular

11.4. Operations between geometric elements

sight sign	Signo braille	braille dots	Meaning
$\vec{v} \cdot \vec{w}$	$:,v_ : ,w$	25-2-1236-6-0-25-2-2456	dot product of the vector v times the vector w
$\langle \vec{v}, \vec{w} \rangle$	$@k:,v ,:,w\{,$	5-13-25-2-1236-0-2-25-2-2456-46-2	Scalar product of the vector v by the vector w

This is an example in which, if it is clear from the context that v and w are vectors, arrows can be deleted:

$\vec{v} \cdot \vec{w}$ **v. w**
 $\langle \vec{v}, \vec{w} \rangle$ **@kv ,w{,**

Visual sign	Braille sign	braille dots	Meaning
$\times$	$\frac{3}{4}[$	4-236	vector product
$\times\ddot{y}$	$\frac{3}{4}[$	4-236	vector product



Visual sign	Braille sign	braille dots	Meaning
$\vec{y}$	»,	56-2	vector product
$\vec{y}$	S+	246-235	direct sum
$\vec{y}$	HE[	246-236	tensor product
$\oplus$	%O+	456-246-235	orthogonal addition
$+\vec{y}$	¾+	4-235	vector addition
$\vec{y}\vec{y}$	¾-	4-36	vector subtraction

Note: when there is no room for confusion, these last two signs are usually replaced by the common signs of addition and subtraction.

Examples:

$$\vec{v} \times \vec{w} \quad \text{:,v}^3\text{/}_4\text{[:w}$$

$$\vec{v} + \vec{w} \quad \text{:,v}^3\text{/}_4\text{+[:w :v+[:w}$$

11.5. angle measures

Visual sign	Braille sign	braille dots	Meaning
	Rad.	1235-1-145-3	radian
$\vec{y}^\circ$	]	356	sixty degrees
$\vec{y}\vec{y}$	8	1256	sixty minutes
$\vec{y}\vec{y}\vec{y}$	88	1256-1256	sexagesimal seconds
$\vec{y}$	G	1245	grads
$\vec{y}\vec{y}$	ã8	16-1256	hundredth minutes
$\vec{y}\vec{y}\vec{y}$	ã88	16-1256-1256	hundredths seconds



Examples:

90° ninety degrees sexagesimal

#ij] (3456-24-245-356)

37° 22' 49" thirty-seven degrees twenty-two minutes forty-nine seconds

#cg]#bbü#diüü

(3456-14-1245-356-3456-12-12-1256-3456-145-24-1256-1256)

11.6. polygons and curves

In the case of polygons, auxiliary parentheses are not used to enclose the words. letters that designate the vertices, since once the figure has been identified, the number of vertices.

In accordance with the previous observation, the representation in visual characters of polygons will always consist of the drawing of the corresponding figure in position of superwritten on the letters that designate the vertices.

The Braille representation will be made by writing the letters of the vertices after the corresponding sign that characterizes the figure.

Visual sign	Braille sign	braille dots	Meaning
	_úabc	6-23456-1-12-14	triangle abc
ÿ	%[	456-236	right triangle
ÿ	%and	456-13456	square
ÿ	y	12346-13456	rectangle
ÿ	cho	12346-135	polygon
THE	o	246-135	circle
ÿ	¿}	26-35	geometric curve



Chapter 12. Statistics and probability

Since many expressions relating to this topic consist only of letters Latin or Greek —capital or small letters—, the transcription generally conforms to the respective notation in visual characters. According to this criterion, the list of notations that we will present below is not exhaustive and the user of the This code may introduce those that it deems necessary, adjusting to these guidelines and others already established in previous chapters, which are reflected in the following examples.

Likewise, what has already been established for the representation of symbols/notations is taken into consideration (see section 10.2. *Functions represented by symbols/literal notations*).

When a symbol/notation consists of a set of two or more characters, will always end with dot 3. If a symbol/notation is given by a single character, point 3 will not be added.

For this purpose, a letter and its alphabetic prefix are considered to constitute a single character. Thus, the letter "K" or the letter alpha are considered to be made up of a single character.

Visual sign	Braille sign	braille dots	Meaning
	$\frac{3}{4}CX$	4-14-1346	media
	$\frac{3}{4}m$	4-134	population mean
$\bar{y}$	@kx{, 5-13-1346-46-2		population mean
	{h	46-125	harmonic mean
	{g	46-1245	geometric mean
	{For.	46-134-135-3	fashion
	{Me.	46-134-15-3	median
	{r	46-1235	statistical range
	{i{q{r.	46-24-46-12345- 46-1235-3	interquartile range
	{q	46-12345	quartile



Visual sign	Braille sign	braille dots	Meaning
	{p	46-1234	percentile
²	³/₄sã#b.	4-234-16-3456-12-3	population variance
	{var. 46-1236-1-1235-3	variance	
	³/₄s	4-234	typical deviation
	r	1235	correlation coefficient
	{It is	46-15	hope the value expected
	{q{v.	46-12345-46-1236-3	quasivariance
	{c{v. 46-14-46-1236-3	coefficient of variation	
	³/₄s	4-234	population covariance
	{Cov. 46-14-135-1236-3	covariance	
	{d{m. 46-145-46-134-3	mean deviation	
	³/₄m	4-134	pivotal moment
	p	1234	probability
	{i{c. 46-24-46-14-3		confidence interval
	AND	15	error
	{n	46-1345	normal distribution
C	^g	45-1245	gamma distribution
	{f	46-124	Fisher distribution
	{in	46-136	uniform distribution
²	^çã#b.	45-12346-16-3456-12-3	distribution ji squared



Visual sign	Braille sign	braille dots	Meaning
	{p	46-1234	Poisson distribution
	{be.	46-12-15-3	Bernouilli distribution
	{b	46-12	binomial distribution
	τ	2345	Student's t-distribution
	κ	13	curtosis
Oh	^w	45-2456	sample space
	F	124	frequency
	{f	46-124	cumulative frequency

If necessary for the use of any computer program, you can enter some differentiating character before the sign. For example, **is** (2346).

Chapter 13. Financial Mathematics

Since many expressions relating to this topic consist only of letters Latin or Greek —capital or small letters—, the transcription generally conforms to the respective notation in visual characters. According to this criterion, the list of notations that we will present below is not exhaustive and the user of the This code may introduce those that it deems necessary, adjusting to these guidelines and others already established in previous chapters, which are reflected in the following examples.

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When a symbol/notation consists of a set of two or more characters, will always end with dot 3. If a symbol/notation is given by a single character, point 3 will not be added.

For this purpose, a letter and its alphabetic prefix are considered to constitute a single character. Thus, the letter "K" or the letter alpha are considered to be made up of a single character.



Visual sign	Braille sign	braille dots	Meaning
C	{c	46-14	capital
i	{i	46-24	interests
T.A.E.	{t}{a}{e}	46-2345-46-1-46-15-3	equivalent annual rate or effective annual rate
a	a	1	annuity
i	i	24	interest rate
M	{m	46-134	set the future value
D	{d	146-145	discount
d	d	145	discount rate
A	{a	46-1	amortization
n	n	1345	periods
AND	{v}{a}	46-1236-46-1-3	current value

If necessary for the use of any computer program, you can enter some differentiating character before the sign. For example, **is** (2346).

Chapter 14. Adaptation and editing criteria

14.1. Aspects to take into account when writing texts mathematicians

Mathematical expressions will generally be written without spaces in between. (blank spaces) except in those cases in which a blank box is part of the sign, as can be seen in the preceding chapters (examples: delimiters —comma, semicolon, colon—, therefore...).

Examples:

$3+4=7$ #c+#d=#g

1, 2, 3, 4 #a, #b, #c, #d



To avoid possible confusion, it is recommended not to use braille stenography in the texts of exact or natural sciences.

When a mathematical formula appears included in a text, two blank spaces will be left before and two after the formula. If the end of the formula coincides with the end of the line, it will not be necessary to leave any space at the beginning of the next line.

Examples:

Sea $(\cdot) = \log + \log$ the expression we are left with is...

{sea log.({m[{n)=log.{M+log.{n la

Expression we have left is...

Knowing that $\log = \log \ddot{\log}$, the expression we are left with is...

**{knowing that log. ?{m*{n}= =log.{m-log.{n the
expression**

what we have left is...

Sometimes, as an editorial device, mathematical expressions are placed on lines separated:

Knowing that

$$\log = \log \ddot{\log}$$

the expression we are left with is...

{knowing that

**log. ?{m*{n}=log.{m-log.{n the expression we
are left with is...**

14.2. Partition of mathematical expressions

In principle, no expression or structure will be broken. When a formula is too long it may be necessary to split it. For this, it is convenient to have Consider the following rules:

1. In general, expressions will be divided by operator signs relational and then by arithmetic operators. The sign will be repeated start the next line.



2. An exception to this rule are the expressions of sets defined by extension or by comprehension, sequences, etc., which can be split after a punctuation mark (such as "comma", "semicolon", "colon"), which it will not be repeated on the next line.

Examples:

$$= \{ , , , , , \ddot{y}, , , \}$$

```
{a=@la,b,c,d,e,f,g,h,
    l,j,k,l,m%,
```

"C is the set of x such that x belongs to the set of numbers natural, 6 divides x and x is less than or equal to 12".

$$= \{ \ddot{y} \ddot{y}, 6 |, \ddot{y} 12 \}$$

```
{c=@lx_,x(,%n,#f% x ,xö=
ö=#ab%,
```

3. There are a number of expressions, unary operators represented by symbols/notations (limits, logarithms, etc.), which must not be split. Always They go along with your argument. If the argument does not fit, use the rules general partition by signs. The argument is put below and will leave if necessary.

Examples:

$$\lim_{\ddot{y} \rightarrow \ddot{y}} (2 \ddot{y}^3 + 15) = \lim_{\ddot{y} \rightarrow \ddot{y}} (2 \cdot 3) = +\ddot{y}$$

$$\lim_{x \rightarrow a} (f(x) + g(x)) = \lim_{x \rightarrow a} f(x) + \lim_{x \rightarrow a} g(x)$$

$$\lim_{y \rightarrow 5} (2^{-3} \ddot{y} 15^{-3} + 8 \ddot{y} 5 + 12) = \lim_{y \rightarrow 5} (2^{-3} \ddot{y} 15^{-3} + 12) = \ddot{y}\ddot{y}$$

$$\lim_{x \rightarrow -\infty} (f(x) + g(x)) = \lim_{x \rightarrow -\infty} f(x) + \lim_{x \rightarrow -\infty} g(x)$$



Equal signs do not have to appear only at the beginning of a line, provided that the cuts occur in accordance with the general rules partition:

$$\lim_{x \rightarrow a} f(x) = L \Leftrightarrow \lim_{x \rightarrow a} f(x) = L$$

4. If the partition has to be performed in an implicit multiplication (for example, if an expression should be transcribed in which the sign does not appear of multiplying in the original), we must add the multiplication symbol in braille.

Examples:

If the expression $39 \sqrt{147 + 44}$

#cix-#adgy+##ddz

should be cut for lack of space immediately after 147, it would have add a multiply sign before the break and repeat it on the line following:

$39 \sqrt{147 \times}$

$\times + 44$

#cix-#adg[

[y+##ddz

5. For the representation of quantities or structures that do not fit on a line and they cannot be divided by delimiters or by signs of operations (that is, there is no other option for partitioning), the mathematical script \ (123456) will be used at the end of the line, it will repeat at the beginning of the next and continue without number sign, if it were a quantity.

Example:

Approximation of the number with thirty-eight decimal places:

3,14159265358979323846264338327950288419

#c,adaeibfecehigicbchdfbfdcchcb

\giejbhhdai



The most common operator signs by which an expression can be divided are:

=	=	equal to
>	O	greater than
<	HE	smaller than
≥	O=	greater than or equal
≤	P=	less than or equal to
≫	and	much greater than
≪	night	much less than
≈	3/4=	approximately equal to
+	+	further
-	-	any less
×	[	multiply (quotes)
÷	*	divided by
±	+:-	more or less
∧	%?	logical conjunction
∨	%i	logical disjunction
∩	%IDEA	intersection of sets
∪	%)	Union of sets
⊂	(.	included in (sets)
⊃	—)	includes a (sets)

14.3. Other aspects to consider

1. It is recommended (fundamentally to editors) that in the texts of Sciences includes a list with the signs used and their meaning.
2. In chapter 3 you can consult what are the function and use of the auxiliary parentheses. It is convenient to make them known when they appear for the first time in a text, since it is a resource of the system braille.



3. Numbers or expressions crossed out in mathematical operations (not valid for relational denials).

In the event that crossed-out operands must be included due to simplification or resolution methods, the situation will be represented in braille through successive equalities, as shown in the examples following.

Optionally, the transcription of the complete operation can be made, including strikethrough operands preceded, without white space, by the ñ sign (12456). To group crossed out terms, if they were not grouped by other delimiters (parentheses, square brackets, braces, etc.), must be used auxiliary parentheses. The use of the strikethrough sign will be warned in the timely «Braille transcription note».

Examples:

- a) Transcription without including the strikeout marks, with the simplification step while, in general, it does not appear in the ink version of the same situation:

$$\frac{2 - (\ddot{y}2)(\ddot{y}1)32}{2 - (+1)(\ddot{y}1)} = \frac{(\ddot{y}2)(\ddot{y}1)(\ddot{y}1)2}{(+1)(\ddot{y}1)} = \frac{(\ddot{y}2)(\ddot{y}1)2}{(+1)}$$

$$\text{?#bx(x-#b)(x-#a)\~#c}* \text{?#bx(x+#a)(x-#a)} \\ =$$

$$= \text{?(x-#b)(x-#a)(x-#a)\~#b}* \\ * \text{?(x+#a)(x-#a)} = \text{?(x-#b)(x-} \\ \text{#a)\~#b}* \\ *(x+#a)$$

- b) Transcription without including strikeout marks, only with simplification final, which in ink is not written as an equality:

$$\frac{2 - (\ddot{y}2)(\ddot{y}1)32}{2 - (+1)(\ddot{y}1)} = \frac{(\ddot{y}2)(\ddot{y}1)2}{(+1)}$$

$$\text{?#bx(x-#b)(x-#a)\~#c}* \text{?#bx(x+#a)(x-#a)} \\ =$$

$$= \text{?(x-#b)(x-#a)\~#b}* * \text{?(x+#a)}$$



c) Complete transcription that includes the "strikethrough" sign:

$$\frac{2(\ddot{y} 2)(\ddot{y} 1)\cancel{3}}{2(+ 1)(\ddot{y} 1)\cancel{1}} = \frac{(\ddot{y} 2)(\ddot{y} 1)2}{(+ 1)}$$

?ñ?#bx}{x-#b}ñ?(x-#a)ã#c}}*

***?ñ?#bx}{x+#a}ñ(x-#a)}= =?(x-#b)(x-#a)ã#b}**

***(x+#a)**

14.4. Highlighting and coloring of elements and expressions

Faced with the need to somehow highlight a text or a formula, the criteria that will be adopted in the adaptation will be tactile and not visual.

If a mathematical expression appears boxed in a book to be transcribed, it must avoid, as far as possible, the reproduction of boxes that include Braille characters, which can cause confusion.

In this sense, a formula preceded by a text in words can be highlighted writing it with a blank line, before and after it, which will simulate the box. Likewise, indentations or centering can be defined that help to highlight it.

The use of colors serves to reinforce the importance of a text, an expression mathematics or part of it.

The colors are not part of a mathematical expression, but rather help to highlight what the author considers important to be noticed.

If the colors were dispensed with, the mathematical expression would not be modified, although the reference to those colors should be adapted in the braille text.

The author or editor who adds colors does so thinking of one of the qualities of the sense of sight, which allows an *a priori* look to visualize the texts as well highlighted. That is to say: the colors are added assuming that the reader can appreciate them, discern them and improve the understanding of a text through that perception that can be verified with a single glance. that kind of perception it is not verified by a blind reader.

Below is a series of illustrative examples of how to proceed in different cases that are not subject to rules.

When it is necessary to differentiate letters in different colors, the signs will be used collected in chapter 1. *Literal characters*, section 1.3. *typographic variants of the Latin alphabet*.



These are:

- Prefix of 1st typographical variant in lower case: braille sign $_$ (6).
- Prefix of the 1st typographical variant in capital letters: Braille sign $^{\circ}$ (56).
- Prefix of the 2nd typographic variant in lower case: braille sign **or** (346).
- Prefix of the 2nd typographic variant in upper case: braille sign **CE** (146).

Example:

The colors mentioned are those different from the one adopted by default.

$X+y+z=H$

{x+_y+óz=CEh

Uppercase X is black, lowercase y is red, lowercase z is green, and uppercase H is green.

If it is necessary to indicate that one of the figures of a number is written with a special typeface, the third series of the Braille alphabet can be used, which is made up of the first ten characters with which the figures are formed plus the points - (**36**).

Example:

8.592 #h

Number 8592 with the odd digits in blue.

Chapter 2 shows other ways to represent some color variants that can appear in numbers.

14.5. Spaces for completion or filling inside of mathematical expressions

1. A single character to fill in. There are two cases:

- a) Braille sign formed by the points $^{\circ}$ (56) if it replaces a letter (use normal literary) or an arithmetic sign will be put alone, since it is equivalent to a character.

For example, in an exercise where the student is asked to write the signs of plus, minus, by or divided in the appropriate place of the spaces in



blank to get the result, spaces are replaced by the sign

» (56) as shown in the following example:

$$5_4_2=10$$

In braille it would be written:

$$\#e^{\circ}\#d^{\circ}\#b=\#aj$$

- b) If it replaces a number, the number can have one, two, three or more characters, other than the number sign. So if it's a number three digits, write the number sign followed by three times » (56): #»»» .

It must always be used with the number sign in front, since this sign (fillable character) equals a single character.

Examples:

$$12+13=__ \quad \#ab+\#ac=\#^{\circ\circ}$$

Find the missing digits in the result of this operation:

$$23+145=1__$$

In braille it will be written: $\#bc+\#ade=\#a^{\circ\circ}$

2. Undetermined number of characters to fill in.

The braille sign $^{\circ}$ - will be used; (56-36-23).

Example:

$$719+83=__ \quad \#gai+\#hc=^{\circ}-;$$

$$3 \div 12 = 18 \div \square \quad \#c,; =\#ah^{\circ}-;$$



Appendix 1. Mathematical and physicochemical units

1.1. Fundamental physicochemical units

Visual sign	Braille sign	braille dots	Meaning
m	m	134	metro
kg	Kg	13-1245	kilogram
s	s	234	second
K	{k	46-13	Kelvin
A	{a	46-1	ampere
mol	Mol	134-135-123	mol
cd	cd	14-145	candela

Units of measure are represented by leaving a blank space of no separation between the quantity and the unit, in the same way that they are represented in visual characters.

Non-breaking white space means that the quantity and unit must be in the same line.

Examples:

We are more or less 10 km from the city.

**{we are, more or less, at
#aj km from the city.**

Approximate brightness 40 cd

**{approximate brightness
dh cd**

Although the use of a non-separation space is established for the representation of units, it will not be considered incorrect to represent it according to with what was established for algebraic expressions in chapters 1 and 5.

In this way, the last example would also be correctly written with the dot 5 separating the number from the first drive letter:



{approximate brightness

#dh@cd

If necessary for the use of any computer program or for other reasons, You can introduce some differentiating character instead of the space. For example, him point 6.

In this example, the unit of temperature (kelvin) is represented with the point 6 between the number and the symbol.

8 K #h_{k

1.2. Derived physicochemical units

For its writing, the same rules will be used as in the case of units elementary physical chemistry (see 1.1).

Visual sign	Braille sign	braille dots	Meaning
rad	Rad	1235-1-145	radian
sr	Sr	234-1235	steradian
Hz	{hz	46-125-1356	hopping
N	{n	46-1345	newton
Well	{well	46-1234-1	pascal
J	{j	46-245	July
IN	{ln	46-2456	watio
C	{c	46-14	columbia
IN	{in	46-1236	volt
F	{f	46-124	farad
Oh	^w	45-2456	ohmio
S	{s	46-234	siemens
Wb	{wb	46-2456-12	weber



Visual sign	Braille sign	braille dots	Meaning
°C	⠠⠠⠉	356-46-14	degree Celsius
lm	⠠⠇⠇	123-134	lumen
lx	⠠⠇⠭	123-1346	lux
Bq	{bq	46-12-12345	becquerel
Gy	{gy	46-1245-13456	gray
Sv	{sv	46-234-1236	sievert

Example:

J=kg m² s⁻² {j=kg m¹#b s¹-#b

1.3. Prefixes for multiples and submultiples

Visual sign	Braille sign	braille dots	Meaning
and	⠠⠠⠠	145-1	deca
d	⠠⠠	145	so
h	⠠⠠	125	hecto
c	⠠⠠	14	cm
k	⠠⠠	13	kilo
m	⠠⠠	134	mili
M	{m	46-134	mega
m	¾m	4-134	micro
G	{g	46-1245	high
n	⠠⠠	1345	nano



Visual sign	Braille sign	braille dots	Meaning
T	{t	46-2345	that
p	P	1234	pico
P	{p	46-1234	peta
AND	{It is	46-15	exa
a	A	1	deed
WITH	{With	46-1356	zetta
With	WITH	1356	zepto
AND	{and	46-13456	yota
and	and	13456	yocto

The set formed by a prefix symbol and a unit symbol constitutes a new inseparable symbol.

Examples:

1 m=100 cm=0.1 km

#am=#ajj cm=#j,a km

10 dm=1 m=100 cm=0,1 dam=0,001 km

**#aj dm=#am=#ajj cm=
=#j,a dam=#j,jja km**

1002 hPa

#ajjb h{pa



Appendix 2

2.1. ordinals

They are formed with the signs of the fifth series preceded by the numerical sign and followed by of the letters "a" or "o".

Examples:

#, a 1^o

2^o _

#,]a 10^a, etc.

The ordinals "first" and "third" are represented:

#,r 1er

#: r3er

2.2. roman numerals

Although Roman numerals are represented in ink with capital letters, for your braille transcription it will suffice to use the prefix { (46) only at the beginning of the number.

The horizontal line that multiplies by a thousand the covered part of the number and the double line which multiplies by a million, will be transcribed using : (25) and :: (25-25), respectively, after the last affected letter.

Example:

V̄IXLDXXI {vi::xl:dxxi

23. coins

The braille representation of most of the currency symbols is done with the sign formed by the points 456 followed by a box or more that represent the monetary unit.

The following table shows some of them:

Visual sign	Braille sign	braille dots	Meaning
Bs	%bs	456-12-234	bolivar



Visual sign	Braille sign	braille dots	Meaning
ÿ	%c	456-14	colon
€	%lt is	456-15	euro
\$	%p	456-1234	weight
R\$	%r	456-1235	real
\$	%s	456-234	dollar
DM	%m	456-134	German mark
¥	%and	456-13456	if
ÿ	%b	456-12	bitcoin

Other signs for which 456 is not used as a prefix are:

Visual sign	Braille sign	braille dots	Meaning
¢	^c	45-14	penny
£	@lt is	5-2346	libra

Note: In some countries, the monetary unit is written before the number and in others after it.

Examples:

\$10 = 1000 ¢ %p#aj=#ajj^c

5\$=4,23€ #e%s=#d,bc%e



Appendix 3. Combinations of arrows and dots

Visual sign	Braille sign	braille dots	Meaning
↕	%a	456-1	arrow up
↕	%.	456-3	Arrow down
↕	%k	456-13	up-down arrow
↖	@1	5-16	oblique arrow up left
↘	1,	16-2	oblique arrow down right
↗↘	@1,	5-16-2	arrow down-right and up-left
↙	@í	5-34	down-left arrow
↗	ln,	34-2	up-right arrow
↖↗	@in	5-34-2	down-left and up-right arrow
↙	@he:	5-246-25	dot-left arrow
↘	:O,	25-135-2	right arrow-dot
↙	¾ö:	4-246-25	left arrow with dot on
↙	_he:	6-246-25	left arrow with dot below
↘	¾:o	4-25-135	right arrow with dot on
↘	_:O	6-25-135	right arrow with dot below
↔	@:,With	5-25-2-1356	left-right arrow about the letter z
↙	@:.With	5-25-3-1356	left arrow-dot about the letter z



Visual sign	Braille sign	braille dots	Meaning
·ȳ	_:With	6-25-2-1356	dot-right arrow about the letter z
ȳ	_:With	6-25-3-1356	dot-top bar dot over the letter z
ȳ	_:With	6-25-1356	dot-top bar over the letter z
ȳ	_:WITH	25-3-1356	top bar-dot over the letter z

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