

Unified English Braille

Guidelines for

Technical Material

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About this Document

This document has been produced by the Maths Focus Group, a subgroup of the UEB Rules Committee within the International Council on English Braille (ICEB). At the ICEB General Assembly in April 2008 it was agreed that the document should be released for use internationally, and that feedback should be gathered with a view to producing a new edition prior to the 2012 General Assembly.

The purpose of this document is to give transcribers enough information and examples to produce Maths, Science and Computer notation in Unified English Braille.

This document is available in the following file formats: pdf, doc or brf. These files can be sourced through the ICEB representatives on your local Braille Authorities.

Please send feedback on this document to ICEB, again through the Braille Authority in your own country.

Guidelines for Technical Material

1	General Principles.....	1
1.1	Spacing	1
1.2	Underlying rules for numbers and letters.....	2
1.3	Print Symbols	3
1.4	Format.....	3
1.5	Typeforms	4
1.6	Capitalisation.....	4
1.7	Use of Grade 1 indicators.....	5
2	Numbers and Abbreviations.....	8
2.1	Whole numbers	8
2.2	Decimals.....	9
2.3	Dates	9
2.4	Time	10
2.5	Ordinal numbers.....	10
2.6	Roman Numerals	11
2.7	Emphasis of Digits.....	11
2.8	Ancient Numeration systems.....	11
2.9	Hexadecimal numbers.....	12
2.10	Abbreviations.....	12
3	Signs of operation, comparison and omission	15
3.1	Examples.....	16
3.2	Algebraic Examples.....	17
3.3	Use of the braille hyphen.....	17
3.4	Positive and negative numbers	18
3.5	Calculator keys.....	18
3.6	Omission marks in mathematical expressions.....	19
4	Spatial Layout and Diagrams	20
4.1	Spatial calculations.....	20
4.2	Tally marks	25
4.3	Tables	26
4.4	Diagrams.....	27
5	Grouping Devices (Brackets)	30
6	Fractions	31
6.1	Simple numeric fractions	31
6.2	Mixed numbers.....	31
6.3	Fractions written in linear form in print.....	32
6.4	General fraction indicators.....	32
6.5	Extra Examples	33
7	Superscripts and subscripts.....	34
7.1	Definition of an item.....	34
7.2	Superscripts and subscripts within literary text.....	35
7.3	Algebraic expressions involving superscripts	35
7.4	Multiple levels.....	37

7.5 Negative superscripts	37
7.6 Examples from Chemistry	38
7.7 Simultaneous superscripts and subscripts	38
7.8 Left-displaced superscripts or subscripts	38
7.9 Modifiers directly above or below	39
8 Square Roots and other radicals.....	40
8.1 Square roots.....	40
8.2 Cube roots etc.....	41
8.3 Square root sign on its own	41
9 Functions	42
9.1 Spelling and capitalisation	42
9.2 Italics	42
9.3 Spacing	43
9.4 Trigonometric functions	44
9.5 Logarithmic functions	45
9.6 The Limit function	46
9.7 Statistical functions.....	46
9.8 Complex numbers	47
10 Set Theory, Group Theory and Logic.....	48
11 Miscellaneous Symbols	50
11.1 Spacing	51
11.2 Unusual Print symbols.....	51
11.3 Grade 1 indicators	51
11.4 Symbols which have more than one meaning in print	51
11.5 Examples.....	52
11.6 Embellished capital letters.....	55
11.7 Greek letters.....	56
12 Bars and dots etc. over and under.....	57
12.1 The definition of an item	57
12.2 Two indicators applied to the same item	59
13 Arrows.....	60
13.1 Simple arrows.....	60
13.2 Arrows with unusual shafts and a standard barbed tip	61
13.3 Arrows with unusual tips.....	62
14 Shape Symbols and Composite Symbols	65
14.1 Use of the shape termination indicator	66
14.2 Transcriber defined shapes	66
14.3 Combined shapes	67
15 Matrices and vectors.....	69
15.1 Enlarged grouping symbols	69
15.2 Matrices.....	69
15.3 Determinants	70
15.4 Omission dots.....	70
15.5 Dealing with wide matrices	71
15.6 Vectors	72
15.7 Grouping of equations	73

16 Chemistry.....	74
16.1 Chemical names.....	75
16.2 Chemical formulae	75
16.3 Atomic mass numbers.....	76
16.4 Electronic configuration	76
16.5 Chemical Equations	77
16.6 Electrons	78
16.7 Structural Formulae.....	78
17 Computer Notation.....	83
17.1 Definition of computer notation.....	83
17.2 Line arrangement and spacing within computer notation	83
17.3 Grade of braille in computer notation	86

Guidelines for Technical Material

1 General Principles

1.1 Spacing

1.1.1 The layout of the print should be preserved as nearly as possible. However care should be taken in copying print spacing along a line as this is often simply a matter of printing style. Spacing should be used to reflect the structure of the mathematics. Spacing in print throughout a work is often inconsistent and it is not desirable in the braille transcription that this inconsistency should be preserved.

1.1.2 For each work, a decision must be made on the spacing of operation signs (such as plus and minus) and comparison signs (such as equals and less than). When presenting braille mathematics to younger children, include spaces before and after operation signs and before and after comparison signs. For older students who are tackling longer algebraic expressions there needs to be a balance between clarity and compactness. A good approach is to have the operation signs unspaced on both sides but still include a space before and after comparison signs. This is the approach used in most of the examples in this document.

1.1.3 There are also situations where it is preferable to unspace a comparison sign. One is when unspacing the sign would avoid dividing a complex expression between lines in a complicated mathematical argument. Another is when the comparison sign is not on the base line (for example sigma notation where i equals 1 is in a small font directly below).

1.1.4 When isolated calculations appear in a literary text, the print spacing can be followed.

1.2 Underlying rules for numbers and letters

Listed below is a summary of the rules for Grade 1 mode and Numeric mode as they apply to the brailleing of numbers and letters in mathematics. Refer to the complete versions of these rules for more detail.

1.2.1 Grade 1 mode

A braille symbol may have both a grade 1 meaning and a contraction (i.e. grade 2) meaning. Some symbols may also have a numeric meaning. A grade 1 indicator is used to set grade 1 mode when the grade 1 meaning of a symbol could be misread as a contraction meaning or a numeric meaning.

Note that if a single letter (excluding a, i and o) occurs in an algebraic expression, it can be misread as a contraction if it is "standing alone" so may need a grade 1 indicator. The same is true of a sequence of letters in braille that could represent a shortform, such as ab or ac, if it is "standing alone".

A letter, or unbroken sequence of letters is "standing alone" if the symbols before and after the letter or sequence are spaces, hyphens, dashes, or any combination, or if on both sides the only intervening symbols between the letter or sequence and the space, hyphen or dash are common literary punctuation or indicator symbols. See the General Rule for a full definition of "standing alone".

1.2.2 Numeric mode

Numeric mode is initiated by the "number sign" (dots 3456) followed by one of the ten digits, the comma or the decimal point.

The following symbols may occur in numeric mode: the ten digits; full stop; comma; the numeric space (dot 5 when immediately followed by a digit); simple numeric fraction line; and the line continuation indicator. A space or any symbol not listed here terminates numeric mode, for example the hyphen or the dash.

A numeric mode indicator also sets grade 1 mode. Grade 1 mode, when initiated by numeric mode, is terminated by a space, hyphen or dash. Therefore while grade 1 mode is in effect, a grade 1 indicator is not required except for any one of the lowercase letters a-j immediately following a digit, a full stop or a comma. (Note that Grade 1 mode, when initiated by numeric mode, is not terminated by the minus sign, ⠆⠈⠆.)

1.3 Print Symbols

One of the underlying design features of UEB is that each print symbol should have one and only one braille equivalent. For example the vertical bar is used in print to represent absolute value, conditional probability and the words "such that", to give just three examples. The same braille symbol should be used in all these cases, and any rules for the use of the symbol in braille are independent of the subject area. If a print symbol is not defined in UEB, it can be represented either using one of the seven transcriber defined print symbols in Section 11, or by using the transcriber defined shape symbols in Section 14.

1.4 Format



continuation indicator

1.4.1 In print, mathematical expressions are sometimes embedded in the text and sometimes set apart. When an expression is set apart, the braille format should indicate this by suitable indentation, for example cells 3 with overruns in 5 or cell 5 with overruns in 7. An embedded expression which does not fit on the current braille line should only be divided if there is an obvious dividing point. Often it is better to move the whole expression to the next braille line.

1.4.2 When dividing a mathematical expression, choice of a runover site should follow mathematical structure:

- before comparison signs
- before operation signs (unless they are within one of the mathematical units below)
- before a mathematical unit such as
 - fractions (and within the fraction consider the numerator and denominator as units)
 - functions
 - radicals
 - items with modifiers such as superscripts or bars
 - shapes or arrows
 - anything enclosed in print or braille grouping symbols
 - a number and its abbreviation or coordinates

Usually the best place to break is before a comparison sign or an operation sign. Breaking between braille pages should be avoided.

2.4 Time

5:30 pm

⠠⠼⠦⠨⠠⠏⠎⠎

5.30

⠠⠼⠨⠠⠼⠦⠨

08.00

⠠⠠⠠⠠⠠⠠⠠⠠

1300

⠠⠠⠠⠠⠠⠠

6-7 a.m.

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

6:15-7:45

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

2.5 Ordinal numbers

1st

⠠⠠⠠⠠⠠

2nd or 2d

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

3rd or 3d

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

4th

⠠⠠⠠⠠⠠⠠

1er

⠠⠠⠠⠠⠠⠠⠠

Follow print for order, spacing, capitalisation and punctuation of abbreviations. (If it is unclear in print whether there is a space between a number and its unit, or if print spacing is inconsistent, then it is recommended that a space is inserted in the braille.)

Where should I write the dollar sign, US\$ or \$US?

US\$ \$US US\$ \$US US\$ \$US US\$ \$US US\$ \$US

30 cents can be written as \$0.30, 30c or 30¢.

\$0.30 30c 30¢ \$0.30 30c 30¢ \$0.30 30c 30¢

In South Africa, this would cost R13.51.

R13.51 R13.51 R13.51 R13.51 R13.51 R13.51 R13.51 R13.51

Before decimalisation, £1.75 was £1 15s so half of it was 17s 6d or 17/6.

£1.75 £1 15s 17s 6d 17/6 £1.75 £1 15s 17s 6d 17/6 £1.75 £1 15s 17s 6d 17/6

Half a yard is 1 ft 6 in or 1' 6" which is about 45 cm or 0.45 m.

1 ft 6 in 1' 6" 45 cm 0.45 m 1 ft 6 in 1' 6" 45 cm 0.45 m 1 ft 6 in 1' 6" 45 cm 0.45 m

1 L of water weighs 1000 g which is about 2 lbs 4 oz.

1000 g 2 lbs 4 oz 1000 g 2 lbs 4 oz 1000 g 2 lbs 4 oz 1000 g 2 lbs 4 oz

Is the speed limit 30 mph or 50 km/h?

30 mph 50 km/h 30 mph 50 km/h 30 mph 50 km/h 30 mph 50 km/h

Water freezes at 0°C or 32°F.

0°C 32°F 0°C 32°F 0°C 32°F 0°C 32°F 0°C 32°F

3 Signs of operation, comparison and omission

Operation signs:

	+	plus
	-	minus (when distinguished from hyphen)
	x	times (multiplication cross)
	÷	divided by (horizontal line between dots)
	±	plus or minus (plus over minus)
	∓	minus or plus (minus over plus)
	·	multiplication dot

Comparison signs:

	=	equals
	<	less than, or opening angle bracket
	>	greater than, or closing angle bracket
	≤	less than or equal to
	≥	greater than or equal to
	≠	not equal to (line through an equals sign)
	≈	approximately equal to (tilde over horizontal line)
	≈	approximately equal to (tilde over tilde)

Less common signs of comparison:

	«	is much less than
	»	is much greater than
	≅	tilde over equals sign (approximately equal)
	≐	equals sign dotted above and below (approximately equal)
	≑	equals sign with bump in top bar (difference between or approximately equal)
	≐	equivalent to (three horizontal lines)
	∝	is proportional to

Ratio

	:	ratio sign (represented by a colon as in print)
--	---	---

A scale of 1:200

⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠

(although the ratio sign is used to compare two numbers, it is best treated as an operation sign for purposes of spacing)

2 : 4 = 6 : 12

⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠

3.2 Algebraic Examples

In the algebraic examples below note the use of the grade 1 indicator whenever a letter is "standing alone" according to the definition in Section 1.2 and so could read as a contraction. In the last example, the colon itself could read as the cc contraction.

If $y \propto x$ then $y = kx$

⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠

Find θ if $0 \leq \theta \leq 2\pi$

⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠

$y = x + 4$

⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠

$2y = 2c - 4$

⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

$d + ab = ac$

⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠

The ratio $x : y$

⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠

3.3 Use of the braille hyphen

If the minus sign and hyphen are indistinguishable in print then the braille hyphen can be used for both. However most maths and science texts show the minus sign as slightly longer than a hyphen in print so the dot 5 form is best used throughout.

interest-rate – inflation-rate

4 Spatial Layout and Diagrams

4.1 Spatial calculations

⠠⠠⠠⠠⠠⠠⠠⠠	begin horizontal line mode
⠠⠠⠠⠠	vertical line segment
⠠⠠⠠⠠	spaced numeric indicator
⠠⠠⠠⠠⠠⠠	numeric passage indicator
⠠⠠⠠⠠⠠⠠	numeric passage terminator

Where horizontal lines are needed within children's sums, horizontal line mode should be used. The layout of the calculation can follow print, though feedback from teachers working with students should also be taken into account. These guidelines can also be applied for other spatial arrangements such as financial statements or accountancy texts.

Columns to be added should not contain numeric indicators or operation signs. This can be achieved by aligning numeric indicators vertically - a numeric indicator followed by a space still initiates numeric mode.

Alternatively use the numeric passage indicator and the numeric terminator which set numeric mode and grade 1 mode for the enclosed text. In a numeric passage numeric indicators are not used, and any lowercase letter a to j is preceded by a grade 1 indicator.

The line above and below spatial calculations should either be blank, or should only contain the numeric passage indicator or terminator.

4.1.1 Addition or subtraction

$$\begin{array}{r} 456 \\ + 34 \\ \hline 490 \end{array}$$

$$\begin{array}{r} \text{⠠⠠⠠⠠⠠⠠} \\ \text{⠠⠠⠠⠠⠠⠠} \\ \text{⠠⠠⠠⠠⠠⠠} \\ \text{⠠⠠⠠⠠⠠⠠} \\ \text{⠠⠠⠠⠠⠠⠠} \end{array}$$

4.1.3 Division

The spaced vertical line segment (dots 456) can be used to represent the curved or straight line used in print to denote "5 into 15". A single space may also be acceptable. The layout of division calculations can be adjusted to suit local teaching practices.

$$5 \overline{)15} = 3$$

Below, the version on the left follows print layout, while the version on the right is an Australian example which has been adjusted to make it easier for the student to replicate.

$$\begin{array}{r} \underline{\underline{93}} \\ 5 \overline{)465} \\ \underline{45} \\ 15 \\ \underline{15} \end{array}$$

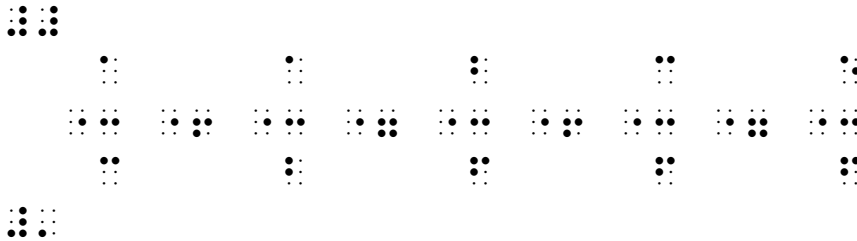
$$\begin{array}{r} \underline{\underline{93}} \\ 5 \overline{)465} \\ \underline{45} \\ 15 \\ \underline{15} \end{array}$$

4.1.4 Spatial fractions for teaching purposes

$$\frac{2}{3}$$



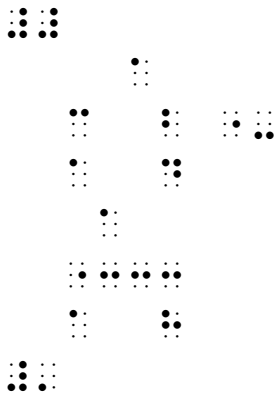
$$\frac{1}{3} + \frac{1}{2} = \frac{2}{6} + \frac{3}{6} = \frac{5}{6}$$



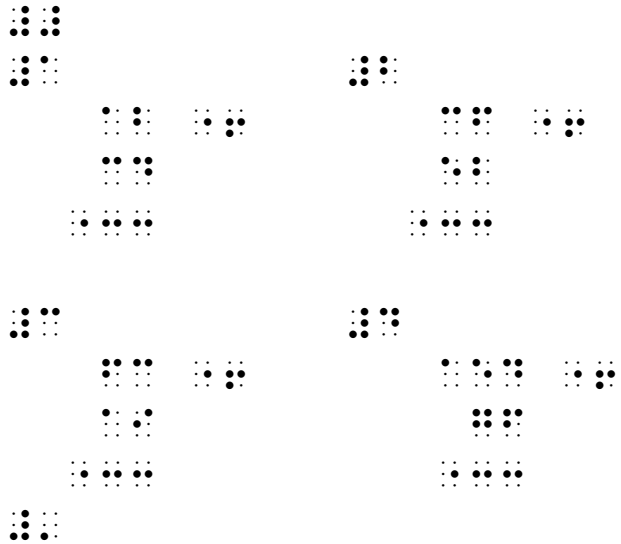
4.1.5 Carryovers

Insert spaces between the digits in braille so that the small numbers can be placed on their own row above or below the central calculation. The layout of this type of example can be adjusted to suit local teaching practices.

$$\begin{array}{r} 3 \text{ } ^1 2 \\ \underline{1 \text{ } 4} \\ 1 \text{ } 8 \end{array}$$



1	$\begin{array}{r} 12 \\ +34 \\ \hline \end{array}$	2	$\begin{array}{r} 36 \\ +52 \\ \hline \end{array}$
3	$\begin{array}{r} 63 \\ +19 \\ \hline \end{array}$	4	$\begin{array}{r} 154 \\ +76 \\ \hline \end{array}$

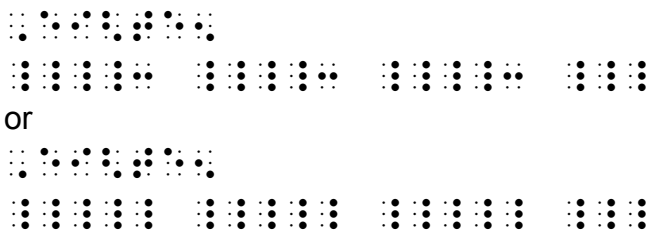


4.2 Tally marks

- ⠠⠠⠠⠠⠠ tally mark (vertical line segment)
- ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ 4 tally marks with strike through (representing 5 items)

The horizontal or diagonal strike-through represents the counting of a fifth item. This can either be shown as a fifth tally mark in braille or the " 4 tally marks with strike-through" symbol can be used. Ex:

Eighteen
 HHH HHH HHH III

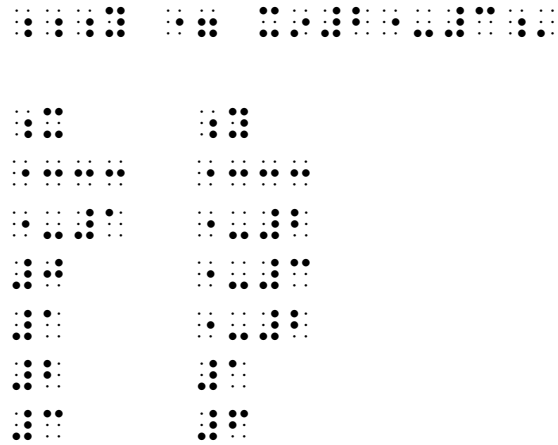


4.3 Tables

Horizontal line mode is used to underline the column headings. Two spaces are left between columns. If numbers are to be added they should be right adjusted. Ex:

$$y = x^2 - 3$$

x	y
-1	-2
0	-3
1	-2
2	1
3	6



It is also acceptable to include a boxing line above and below the table.

4.4 Diagrams

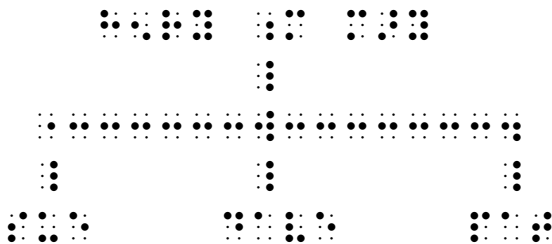
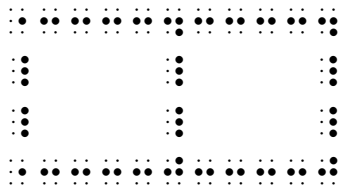
This section does not attempt to give advice on the design of tactile diagrams or on the range of production methods available.

4.4.1 Horizontal Line Mode

Most transcribers have experimented with the use of braille symbols for drawing simple box shapes or family trees. Although these are often not as readable as a raised line drawing, they still have their uses.

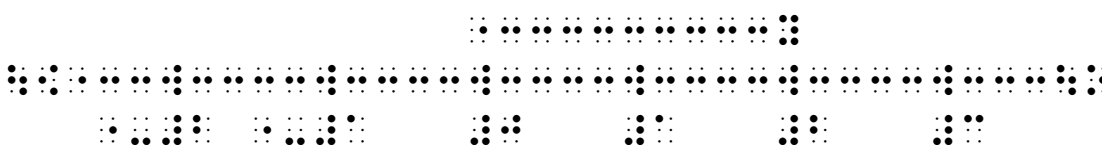
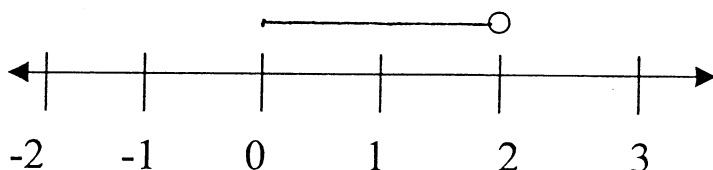
If an unbroken braille line begins with the horizontal line mode indicator $\mathbf{\cdot\cdot\cdot}$ then all the other cells in that line will be read as shapes rather than symbols.

If vertical lines are also shown using the vertical line segment $\mathbf{\cdot\cdot}$ then a back translation process or a tuned in reader can be clear that this is a diagram rather than a string of text.

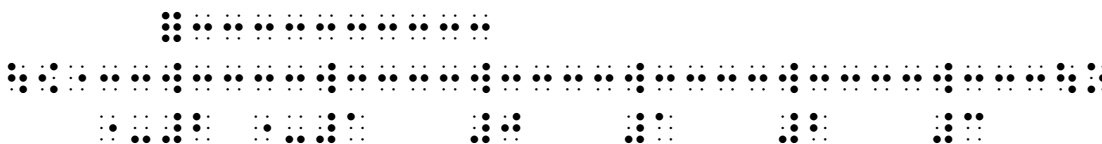
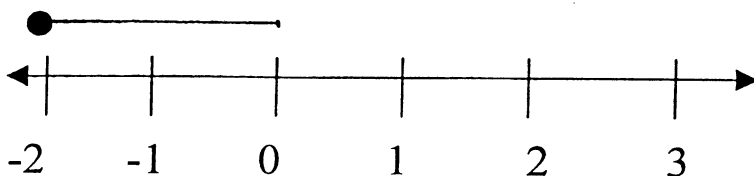


Refer to the *Line Drawing Rule* for a list of useful cell patterns to use within horizontal line mode. Special mention is made of arrow symbols which can be used without terminating horizontal line mode. The following two examples illustrate the use of arrow symbols and also include unlisted dot patterns for the shapes of the hollow and solid circles used in print to represent the open or closed end of an interval.

In the print example below a number line is graduated from -2 to 3 and an interval is marked above it starting at 0 and finishing with an open circle at 2. In the braille version, UEB arrow mode is used for the left and right pointing arrows (See Section 13) and horizontal line mode is used between them. The interval itself is shown as a line finishing with the dot pattern $\begin{smallmatrix} \cdot & \cdot \\ \cdot & \cdot \end{smallmatrix}$ for the empty circle.



In the second example below the interval starts with a solid circle at -2 and finishes at 0. In the braille version, the dot pattern $\begin{smallmatrix} \cdot & \cdot \\ \cdot & \cdot \end{smallmatrix}$ has been used for the solid circle.



Note that in this second braille example, the horizontal line mode indicator $\begin{smallmatrix} \cdot & \cdot \\ \cdot & \cdot \end{smallmatrix}$ could not precede the circle symbol without obscuring the position of that start point on the number line. In any diagram, tactual clarity may be deemed more important than technical ambiguity.

Always bear in mind that a well executed raised line drawing will generally be more readable than a diagram created using braille cell patterns.

See Section 16 for examples of chemistry structures drawn using horizontal line mode and vertical and diagonal line segments.

4.4.2 Labelling diagrams

This section does not attempt to give advice on how to effectively label a diagram in braille so that it is clear to the reader which part of the diagram each label refers to. Rather, it lists code accommodations which can be made within the content of certain labels when space is at a premium.

- When labelling points, lines etc with single letters, these can be consistently shown as two cells by omitting the grade 1 indicator for all capital letters and including it for all lowercase letters including a, i and o.
- When graduating an axis with negative numbers, the hyphen could be used instead of the minus sign (ie the dot 5 prefix could be omitted). Include a transcriber's note.
- When writing coordinates such as (2, -3), any of the following could be considered: omitting the space; omitting the dot 5 prefix from the round brackets; omitting the dot 5 prefix from the minus sign. Include a transcriber's note.
- When labelling a line or curve with its equation, the space either side of the equals sign could be omitted.
- When labelling angles, the degree sign could be omitted. Include a transcriber's note.

5 Grouping Devices (Brackets)

$($	opening round parenthesis
$)$	closing round parenthesis
$[$	opening square bracket
$]$	closing square bracket
$\{$	opening curly brace
$\}$	closing curly brace
$<$	opening angle bracket
$>$	closing angle bracket
$ $	vertical bar (open or close absolute value or modulus)

$($	big (multi-line) opening round parenthesis
$)$	big (multi-line) closing round parenthesis
$[$	big (multi-line) opening square bracket
$]$	big (multi-line) closing square bracket
$\{$	big (multi-line) opening curly brace
$\}$	big (multi-line) closing curly brace
$ $	big (multi-line) vertical bar

Print brackets are usually unspaced from the items they enclose and the same should be done in braille. See Section 15 for the layout of matrices and vectors.

Let the midpoint of $A(3, -5)$ and $B(0, 4)$ be the point (x, y)

$(\frac{3+0}{2}, \frac{-5+4}{2}) = (\frac{3}{2}, \frac{-1}{2})$

$$[2(x+y)] \div 4 < 10$$

$[2(\frac{3}{2} + \frac{-1}{2})] \div 4 < 10$

$$|-6| = |6| = 6 \text{ (absolute value)}$$

$|-6| = |6| = 6$

Consider the sequence $\langle T_n \rangle$.

$\langle T_n \rangle = \langle \frac{1}{n^2} \rangle$

7 Superscripts and subscripts

⠠⠠⠠⠠	level change down (subscript)
⠠⠠⠠⠠⠠	level change up (superscript or exponent)
⠠⠠⠠⠠⠠⠠	expression directly below
⠠⠠⠠⠠⠠⠠⠠	expression directly above
⠠⠠⠠⠠	braille grouping open
⠠⠠⠠⠠	braille grouping close


7.1 Definition of an item


The scope of any of the four level change indicators, that is, the symbol(s) affected by it, is the next "item". An item is defined as any of the following groupings if immediately after the level change indicator:


1. An entire number, i.e. the initiating numeric symbol and all succeeding symbols within the numeric mode thus established (which would include any interior decimal points, commas, separator spaces, or simple numeric fraction lines).
2. An entire general fraction, enclosed in fraction indicators (see Section 6).
3. An entire radical expression, enclosed in radical indicators (see Section 8).
4. An arrow (see Section 13).
5. An arbitrary shape (see Section 14).
6. Any expression enclosed in matching pairs of round parentheses, square brackets or curly braces (see Section 5).
7. Any expression enclosed in the braille grouping indicators.
8. If none of the foregoing apply, the item is simply the next individual symbol.

7.4 Multiple levels

Note that a superscript which itself has a superscript does not fit the above definition of an item. In such cases braille grouping symbols are required.


$$e^{x^2} \quad (\text{e to the x squared})$$



$$e^{(x^2)} \quad (\text{e to the open parenthesis x squared close parenthesis})$$



$$P_{x_i} \quad (\text{P with an x sub i in the subscript position})$$


7.5 Negative superscripts

Negative superscripts must be enclosed in braille grouping symbols. (This is because a minus sign can be an item in its own right, as in 7.6 below)

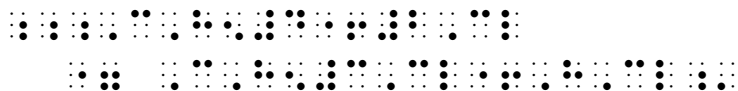
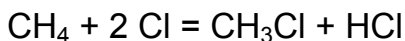
$$0.0045 = 4.5 \times 10^{-3} \quad (0.0045 = 4.5 \text{ times } 10 \text{ to the minus } 3)$$


$$v = 60 \text{ ms}^{-1} \quad (v = 60 \text{ ms to the minus } 1)$$


$$a^{-2b} \quad (\text{a to the minus } 2b \text{ power})$$


7.6 Examples from Chemistry

See Section 16 for more examples.



Ions H^+ , Cl^- and Ca^{2+}

7.7 Simultaneous superscripts and subscripts

If more than one superscript or subscript apply, work from bottom to top, or left to right. If the print indicates by the placing of the subscript that it is being applied after the superscript then the order can be reversed.

$$x_1^2 = y_2^3 \quad (\text{x sub 1 squared equals y sub 2 cubed})$$

$$x_k^2 \quad (\text{x squared sub k})$$

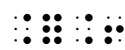
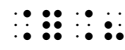
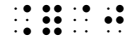











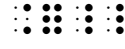










7.8 Left-displaced superscripts or subscripts

Sometimes in print a superscript or subscript is written to the left of the base symbol instead of to the right. These are handled simply by using the corresponding ordinary index expression prior to the base symbol.

$${}_{92}^{238}\text{U} \quad (\text{U with 92 written below left and 238 written above left})$$


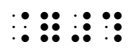





$$^{-}2 + ^{-}3 = ^{-}5 \quad (\text{minus 2 + minus 3 = minus 5 with minus signs in the superscript position})$$

10 Set Theory, Group Theory and Logic

	\cup	union (upright U shape)
	\cap	intersection (inverted U shape)
	\emptyset	null set (slashed zero)
	'	complement (prime sign)
	\in	is an element of (variant epsilon)
	\ni	contains as an element (reverse variant epsilon)
	\subset	contained in, is a subset of (U open to right)
	\supset	contains, is a superset of (U open to left)
	\subseteq	contained in or equal to
	\supseteq	contains or equal to
	\subsetneq	contained in, but not equal to (proper subset)
	\supsetneq	contains, but is not equal to (proper superset)
	\triangleleft	is a normal subgroup of (closed "less than")
	\triangleright	inverse "is normal subgroup" (closed "greater than")
	\trianglelefteq	is normal subgroup of or equal (closed "less than", line under)
	\trianglerighteq	inverse "normal subgroup or equal" (closed "greater than", line under)
	$\triangleleft\cancel{=}$	normal subgroup but not equal (closed "less than", cancelled line under)
	$\triangleright\cancel{=}$	inverse "normal subgroup but not equal" (closed "greater than", cancelled line under)
	\vee	or (upright v shape)
	\wedge	and (inverted v shape)
	\neg	"not" sign (line horizontal, then down at right)
	\vDash	assertion ("is a theorem" sign; "T" lying on left side)
	\vDash	reverse assertion ("T" lying on right side)
	$\vDash\!\!\vDash$	"is valid" sign (assertion with double stem on "T")
	$\vDash\!\!\vDash$	reverse "is valid" sign

11 Miscellaneous Symbols

⠠⠠⠠⠠	∫	integral sign
⠠⠠⠠⠠⠠	∮	closed line integral (small circle halfway up)
⠠⠠⠠⠠⠠	∂	partial derivative (curly d)
⠠⠠⠠⠠⠠	∇	del, nabla (inverted capital delta)
⠠⠠⠠⠠	'	prime (when distinguished from apostrophe in print)
⠠⠠⠠⠠⠠⠠	∝	is proportional to (varies as)
⠠⠠⠠⠠⠠	~	tilde (swung dash)
⠠⠠⠠⠠⠠	^	caret (hat)
⠠⠠⠠⠠⠠	*	asterisk
⠠⠠⠠⠠⠠	◦	hollow dot
⠠⠠⠠⠠⠠		vertical bar
⠠⠠⠠⠠⠠	∞	infinity
⠠⠠⠠⠠	!	factorial sign (exclamation mark in print)
⠠⠠⠠⠠⠠	∠	angle sign
⠠⠠⠠⠠⠠⠠	∟	measured angle sign
⠠⠠⠠⠠⠠⠠	⊥	measured right angle sign
⠠⠠⠠⠠⠠		parallel to
⠠⠠⠠⠠⠠	⊥	perpendicular to
⠠⠠⠠⠠⠠	∴	"therefore" (three dots in upright pyramid)
⠠⠠⠠⠠⠠	∵	"since" (three dots in inverted pyramid)
⠠⠠⠠⠠⠠	∃	"there exists" (reverse E)
⠠⠠⠠⠠⠠	∀	"for all" (inverted A)
⠠⠠⠠⠠⠠	@	at sign
⠠⠠⠠⠠⠠	\	backslash
⠠⠠⠠⠠⠠	_	underscore
⠠⠠⠠⠠⠠	#	cross hatch
⠠⠠⠠⠠⠠	&	ampersand
⠠⠠⠠⠠⠠		broken vertical bar

	first transcriber-defined print symbol
	second transcriber-defined print symbol
	third transcriber-defined print symbol
	fourth transcriber-defined print symbol
	fifth transcriber-defined print symbol
	sixth transcriber-defined print symbol
	seventh transcriber-defined print symbol

11.1 Spacing

In general, the spacing of symbols can follow print. However if a symbol is clearly being used as a sign of operation or comparison, follow the guidelines in Section 1.1.

11.2 Unusual Print symbols

If a print symbol is not defined in UEB, it can be represented either using one of the seven transcriber defined print symbols above, or by using the transcriber defined shape symbols in Section 14. (See example 11.5.9 below)

11.3 Grade 1 indicators

If the braille version of a print symbol also has a grade 2 meaning, and grade 1 mode is not already in force, then grade 1 indicators will be needed. Symbols in the list above for which this applies are the integral sign, the prime sign and the therefore sign.

11.4 Symbols which have more than one meaning in print

One of the underlying design features of UEB is that each print symbol should have one and only one braille equivalent. For example the vertical bar is used in print to represent absolute value, conditional probability and the words "such that", to give just three examples. The same braille symbol should be used in all these cases.

11.5 Examples

11.5.1

If $y = f(x)$ then the derivative is $\frac{dy}{dx}$ or $f'(x)$ and the partial derivative is $\frac{\partial y}{\partial x}$.

(If $y = f(x)$ then the derivative is dy over dx or f dash x and the partial derivative is curly d y over curly d x)

$\frac{dy}{dx}$ or $f'(x)$ and the partial derivative is $\frac{\partial y}{\partial x}$.

11.5.2

$$\begin{aligned} & \int_2^3 (2x+1)dx \\ &= [x^2 + x]_2^3 \\ &= (3^2 + 3) - (2^2 + 2) \\ &= 12 - 6 = 6 \end{aligned}$$

(the integral from 2 to 3 of $(2x+1) dx = [x^2 + x]$ sub 2 super 3 = $(3^2 + 3)$ minus $(2^2 + 2) = 12 - 6 = 6$)

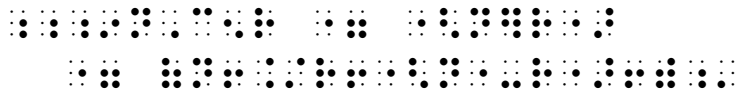
$\int_2^3 (2x+1)dx = [x^2 + x]_2^3 = (3^2 + 3) - (2^2 + 2) = 12 - 6 = 6$

Note: the spacing of the integral sign in print can be unclear or inconsistent. In braille it is best to have the integral sign unspaced from the function and treat its limits as subscripts and superscripts. The dx at the end means "integrate with respect to x ", and can also be written unspaced.

11.5.3

$${}^n C_r = \binom{n}{r} = \frac{n!}{r!(n-r)!}$$

(super n capital C sub r = enlarged brackets enclosing n at the top and r at the bottom = fraction n factorial over r factorial times (n minus r) factorial end fraction)



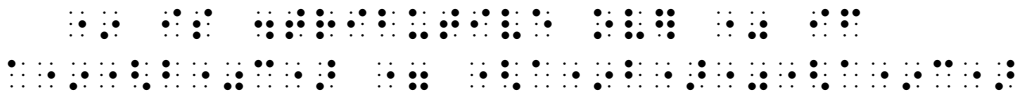
Note: the binomial coefficient works better as a shape than a vector (refer to 14.3.3).

11.5.4

* is distributive over ◦ if

$$a*(b\circ c) = (a*b)\circ(a* c)$$

(asterisk is distributive over hollow dot if
 a asterisk (b hollow dot c) = (a asterisk b) hollow dot (a asterisk c))



Note: the hollow dot should not be used to represent the abbreviation for degrees, which is covered in Section 3.

11.7 Greek letters

Greek letters are used heavily in Mathematics. The alphabet is listed below. Refer also to the Rule on Letters and their modifiers.

⠠⠠⠠⠠⠠⠠	α Greek alpha	⠠⠠⠠⠠⠠⠠	A capital Greek alpha
⠠⠠⠠⠠⠠⠠	β Greek beta	⠠⠠⠠⠠⠠⠠	B capital Greek beta
⠠⠠⠠⠠⠠⠠	γ Greek gamma	⠠⠠⠠⠠⠠⠠	Γ capital Greek gamma
⠠⠠⠠⠠⠠⠠	δ Greek delta	⠠⠠⠠⠠⠠⠠	Δ capital Greek delta
⠠⠠⠠⠠⠠⠠	ϵ Greek epsilon	⠠⠠⠠⠠⠠⠠	E capital Greek epsilon
⠠⠠⠠⠠⠠⠠	ζ Greek zeta	⠠⠠⠠⠠⠠⠠	Z capital Greek zeta
⠠⠠⠠⠠⠠⠠	η Greek eta	⠠⠠⠠⠠⠠⠠	H capital Greek eta
⠠⠠⠠⠠⠠⠠	θ Greek theta	⠠⠠⠠⠠⠠⠠	Θ capital Greek theta
⠠⠠⠠⠠⠠⠠	ι Greek iota	⠠⠠⠠⠠⠠⠠	I capital Greek iota
⠠⠠⠠⠠⠠⠠	κ Greek kappa	⠠⠠⠠⠠⠠⠠	K capital Greek kappa
⠠⠠⠠⠠⠠⠠	λ Greek lambda	⠠⠠⠠⠠⠠⠠	Λ capital Greek lambda
⠠⠠⠠⠠⠠⠠	μ Greek mu	⠠⠠⠠⠠⠠⠠	M capital Greek mu
⠠⠠⠠⠠⠠⠠	ν Greek nu	⠠⠠⠠⠠⠠⠠	N capital Greek nu
⠠⠠⠠⠠⠠⠠	ξ Greek xi	⠠⠠⠠⠠⠠⠠	Ξ capital Greek xi
⠠⠠⠠⠠⠠⠠	\omicron Greek omicron	⠠⠠⠠⠠⠠⠠	O capital Greek omicron
⠠⠠⠠⠠⠠⠠	π Greek pi	⠠⠠⠠⠠⠠⠠	Π capital Greek pi
⠠⠠⠠⠠⠠⠠	ρ Greek rho	⠠⠠⠠⠠⠠⠠	P capital Greek rho
⠠⠠⠠⠠⠠⠠	ς or σ Greek sigma	⠠⠠⠠⠠⠠⠠	Σ capital Greek sigma
⠠⠠⠠⠠⠠⠠	τ Greek tau	⠠⠠⠠⠠⠠⠠	T capital Greek tau
⠠⠠⠠⠠⠠⠠	υ Greek upsilon	⠠⠠⠠⠠⠠⠠	Y capital Greek upsilon
⠠⠠⠠⠠⠠⠠	ϕ Greek phi	⠠⠠⠠⠠⠠⠠	Φ capital Greek phi
⠠⠠⠠⠠⠠⠠	χ Greek chi	⠠⠠⠠⠠⠠⠠	X capital Greek chi
⠠⠠⠠⠠⠠⠠	ψ Greek psi	⠠⠠⠠⠠⠠⠠	Ψ capital Greek psi
⠠⠠⠠⠠⠠⠠	ω Greek omega	⠠⠠⠠⠠⠠⠠	Ω capital Greek omega

12 Bars and dots etc. over and under

⠠⠠⠠⠠	bar over previous item
⠠⠠⠠⠠⠠	bar under previous item
⠠⠠⠠⠠⠠⠠	line through previous item (cancellation, "not")
⠠⠠⠠⠠⠠⠠⠠	simple right-pointing arrow over previous item
⠠⠠⠠⠠⠠⠠⠠⠠	simple right-pointing arrow under previous item
⠠⠠⠠⠠⠠⠠⠠	dot over previous item
⠠⠠⠠⠠⠠⠠⠠⠠	dot under previous item
⠠⠠⠠⠠⠠⠠⠠⠠	tilde over previous item
⠠⠠⠠⠠⠠⠠⠠⠠⠠	tilde under previous item
⠠⠠⠠⠠⠠⠠⠠	hat over previous item
⠠⠠⠠⠠⠠⠠⠠⠠	hat under previous item
⠠⠠⠠⠠⠠⠠⠠⠠	arc over previous item

12.1 *The definition of an item*

The definition of an item below is the same as that given for superscripts and subscripts in Section 7.1.

As in Section 7, an item is defined as any of the following groupings:

1. An entire number, i.e. the initiating numeric symbol and all succeeding symbols within the numeric mode thus established (which would include any interior decimal points, commas, separator spaces, or simple numeric fraction lines).
2. An entire general fraction, enclosed in fraction indicators (see Section 6).
3. An entire radical expression, enclosed in radical indicators (see Section 8).
4. An arrow (see Section 13).
5. An arbitrary shape (see Section 14).
6. Any expression enclosed in matching pairs of round parentheses, square brackets or curly braces (see Section 5).
7. Any expression enclosed in the braille grouping indicators
8. If none of the foregoing apply, the item is simply the next individual symbol.

13 Arrows

13.1 Simple arrows

		arrow indicator
		bold arrow indicator
	→	simple right pointing arrow (east)
	←	simple left pointing arrow (west)
	↑	simple up pointing arrow (north)
	↓	simple down pointing arrow (south)
	↗	simple up and right pointing arrow (northeast)
	↘	simple down and right pointing arrow (southeast)
	↖	simple up and left pointing arrow (northwest)
	↙	simple down and left pointing arrow (southwest)

A simple arrow has a standard barbed tip at one end (like a v on its side, pointing away from the shaft). The shaft is straight and its length and thickness are not significant. These arrows are represented by an opening arrow indicator and the appropriate closing arrow indicator. Notice that all these terminating symbols have three dots, arranged in a consistent pattern that best describes the direction.

Note that unless you are already in grade 1 mode, the arrow indicator will need a grade 1 symbol indicator. The bold arrow indicator will not need one, as this two cell symbol does not have a grade 2 meaning. Both arrow indicators set arrow mode so no further grade 1 indicators will be needed.

Arrows are signs of comparison so should usually be spaced. An exception is when they are written below the limit function (see Section 9.6).

Do not use arrow indicators when a simple right pointing arrow is the only modifier above or below an item. See "arrow over previous item" and "arrow below previous item" in Section 12.

← - - - - (long, broken left pointing arrow)
 ⠠⠠⠠⠠⠠⠠⠠⠠

↓ ↓ ↓ (short, medium and long down pointing simple arrows)
 ⠠⠠⠠ ⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠

13.3 Arrows with unusual tips

Barb symbols:

⠠⠠⠠	regular barb, full, in line of direction
⠠⠠⠠	regular barb, full, counter to line of direction
⠠⠠⠠⠠	regular barb, upper half, counter
⠠⠠⠠⠠	regular barb, lower half, counter
⠠⠠⠠⠠	regular barb, upper half, in line
⠠⠠⠠⠠	regular barb, lower half, in line
⠠⠠⠠	curved, full, counter
⠠⠠⠠	curved, full, in line
⠠⠠⠠⠠	curved, upper half, counter
⠠⠠⠠⠠	curved, lower half, counter
⠠⠠⠠⠠	curved, upper half, in line
⠠⠠⠠⠠	curved, lower half, in line
⠠⠠⠠	straight, full, (directionless)
⠠⠠⠠⠠	straight, upper half, (directionless)
⠠⠠⠠⠠	straight, lower half, (directionless)

If an arrow has unusual tips, decide which is the head before you choose the direction of your closing indicator. The complete rules for deciding arrow direction are:

1. If there are directional tips, and all lead in the same direction, the head is the end that lies in that direction.
2. If there are no directional tips, but one end has a tip and the other does not, the end with the tip is the head.
3. In all other cases, the head of the arrow is deemed to be the end at the right, or in the case of strictly vertical arrows, at the top.

The tip(s) and shaft segment(s) are transcribed between the opening and closing indicators. These items are expressed in logical order, that is starting with the arrow tail and progressing towards the head, even if that runs counter to the physical order (as in the case of a left pointing arrow). Certain elements are omitted, corresponding to these reader rules:

1. If no tip is transcribed, it is understood that an ordinary full barbed tip occurs at the arrow head, and there is no other tip.
2. If no shaft is transcribed, it is understood that the shaft is a straight line of medium length. In this case, if no tip is transcribed, rule (1) also applies; if one tip is transcribed, it is at the head; if two tips are transcribed, the first is at the tail and the second at the head.

→ (otherwise ordinary right arrow, with curved head)
 ⠠⠠⠠⠠⠠⠠⠠⠠

↔ (common horizontal bidirectional arrow)
 ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

↗ (horizontal bidirectional arrow, tilted from lower left to upper right)
 ⠠⠠⠠⠠⠠⠠⠠⠠

➤ (otherwise ordinary right arrow, with tail and head tips)
 ⠠⠠⠠⠠⠠⠠⠠⠠

➔ (otherwise ordinary right arrow, with two head tips)
 ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

← (otherwise ordinary left arrow, with tail and head tips)
 ⠠⠠⠠⠠⠠⠠⠠⠠

↔ (otherwise ordinary left arrow, with two head tips)
 ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

↳ (right arrow with a straight tail tip and a normal head tip)



↑↓

(bold arrow up, followed by ordinary arrow down)



↔ (common right arrow over common left arrow –
see Section 14.3c regarding vertical juxtaposition)



⇌ (half-barbed left arrow over half-barbed right arrow –
reversible chemical reaction)



See Section 16 for equilibrium arrows that occur in Chemistry.

14 Shape Symbols and Composite Symbols

Listing of shape indicators:

⠠⠠⠠	shape indicator
⠠⠠⠠⠠	filled (solid) shape indicator
⠠⠠⠠⠠	shaded shape indicator
⠠⠠⠠⠠	transcriber-assigned shape indicator
⠠⠠⠠⠠⠠	transcriber-assigned filled (solid) shape indicator
⠠⠠⠠⠠⠠	transcriber-assigned shaded shape indicator
⠠⠠⠠	shape terminator

Listing of specific shapes:

⠠⠠⠠⠠⠠	regular (equilateral) triangle
⠠⠠⠠⠠⠠	square
⠠⠠⠠⠠⠠	regular pentagon
⠠⠠⠠⠠⠠	regular hexagon
⠠⠠⠠⠠⠠	regular heptagon
⠠⠠⠠⠠⠠	regular octagon (etc. for all regular polygons)
⠠⠠⠠⠠	circle
⠠⠠⠠⠠⠠⠠	parallelogram

Composite Symbols:

⠠⠠⠠	superposition indicator
⠠⠠⠠	horizontal juxtaposition indicator
⠠⠠⠠	vertical juxtaposition indicator
⠠⠠⠠	physical enclosure indicator

14.3.2 Superposition, ⋮⋮

Note that this structure should not be used for negation. See "line through previous item" in Section 12.

\Re (R with superimposed x - prescription symbol)

⋮⋮⋮⋮⋮⋮

\oint

(Integral sign with a small circle superimposed half way up – closed integral defined in Section 11.1)

⋮⋮

\int

(integral sign with a small square superimposed half way up - the termination could be omitted if there was a following space)

⋮⋮⋮⋮⋮⋮⋮⋮⋮

14.3.3 Vertical Juxtaposition, ⋮⋮

The upper symbol should be given first, followed by the vertical juxtaposition indicator, then the lower symbol.

This structure should not be used for bars, arrows, dots, tildes or hats over or under other symbols (see Section 12). Neither should it be used for superscripts or subscripts written directly over or under (see Section 7).

$\overset{\circ}{=}$ (a hollow dot with an equal sign underneath)

⋮⋮⋮⋮⋮⋮

$\binom{n}{r}$ binomial coefficient (refer Section 11.5)

⋮⋮⋮⋮⋮⋮⋮⋮

14.3.4 Horizontal Juxtaposition, ⋮⋮

"Horizontal juxtaposition" is to be invoked only when two symbols are written in close proximity and it is clear from the usage that a new single symbol, distinct from the elementary symbols considered in sequence, is intended. Otherwise, symbols written one after the other should simply be brailled accordingly.

15 Matrices and vectors

15.1 Enlarged grouping symbols

When enlarged brackets are used in print for vectors, matrices, systems of equations, function definitions etc., the appropriate enlarged grouping symbols should be used in braille. These are the usual grouping symbols preceded by a dot 6. See the full list in Section 5. These should be placed directly under each other. Blank lines before and after such arrangements may be needed for clarity.

15.2 Matrices

The columns should be left adjusted except for minus signs which should be brailled to stand out. One column of blank cells should be left between columns. Material outside the matrix, such as signs of operation and comparison, should be placed on the top line, even if they are centered in print.

$$I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix},$$

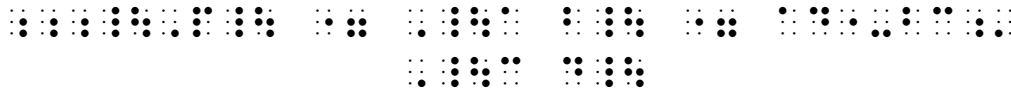
$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \begin{bmatrix} 1 & 2 \\ -3 & 4 \\ 5 & -6 \end{bmatrix}$$

$$\begin{pmatrix} a & -b \\ -c & d \end{pmatrix}$$

15.3 Determinants

These have the same structure as matrices but are normally enclosed in print with enlarged vertical bars.

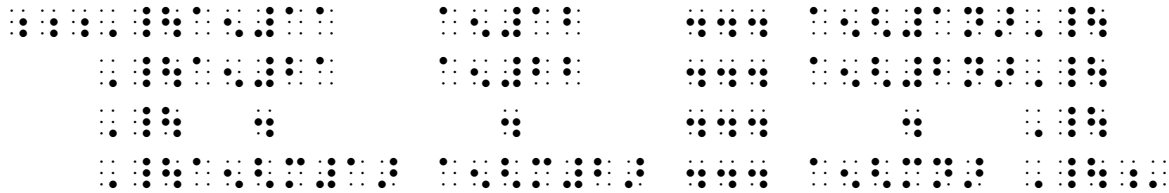
$$|P| = \begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$$



15.4 Omission dots

The placement of dots used to indicate the omission of one or more rows or columns can follow the print.

$$\begin{vmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \cdot & \cdot & \dots & \cdot \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{vmatrix}$$



15.5 Dealing with wide matrices

If a matrix or determinant is too wide for the braille page, runovers within entries may be necessary. If there is not room to indent these runovers, they can be blocked and a blank line left between rows.

$$\begin{pmatrix} a_1x_1 + b_1x_2 + c_1x_3 & a_1y_1 + b_1y_2 + c_1y_3 & a_1z_1 + b_1z_2 + c_1z_3 \\ a_2x_1 + b_2x_2 + c_2x_3 & a_2y_1 + b_2y_2 + c_2y_3 & a_2z_1 + b_2z_2 + c_2z_3 \\ a_3x_1 + b_3x_2 + c_3x_3 & a_3y_1 + b_3y_2 + c_3y_3 & a_3z_1 + b_3z_2 + c_3z_3 \end{pmatrix}$$

The Braille representation shows the matrix with three rows. Each row contains three entries. The first entry in each row is significantly wider than the others. To fit these wide entries, the second and third entries are blocked (indented) and the rows are separated by blank lines. This method ensures the structure of the matrix is clear, though individual entries are less legible due to the blocking.

Another approach is to complete the first column without overruns and then to place the next column below this, indented two cells.

The Braille representation shows the matrix with three rows. The first column is completed across all three rows. The second column is placed below the first, indented two cells. The third column is placed below the second, also indented two cells. This method makes individual entries easier to read, but the overall structure of the matrix is less clear than in the first example.

Notice that in the first example the structure of the matrix is clearer but in the second example the individual entries are easier to read. Notice also the different placement of the enlarged grouping signs in the two examples.

15.7 Grouping of equations

Opening enlarged curly braces are often used to group equations. Print spacing should be followed where possible.

Solve:

$$\begin{cases} x + 2y = 7 \\ 2x - y = -4 \end{cases}$$

The Braille representation of the system of equations is as follows:







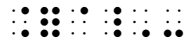



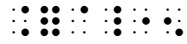
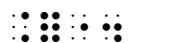

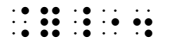
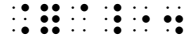



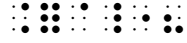
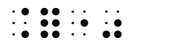
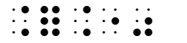
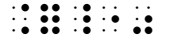

$$\begin{cases} x + 2y = 7 \\ 2x - y = -4 \end{cases}$$

$$f(x) = \begin{cases} 0 & \text{if } x < 0 \\ x^2 & \text{if } x > 0 \end{cases}$$

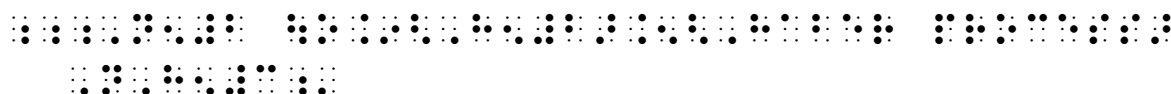
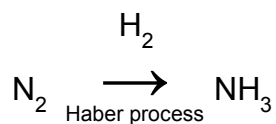
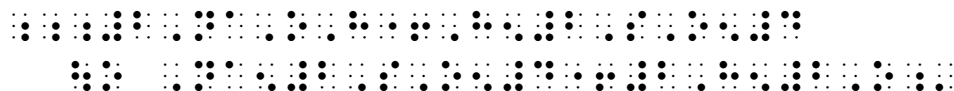
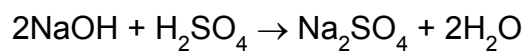
The Braille representation of the piecewise function is as follows:

$$f(x) = \begin{cases} 0 & \text{if } x < 0 \\ x^2 & \text{if } x > 0 \end{cases}$$

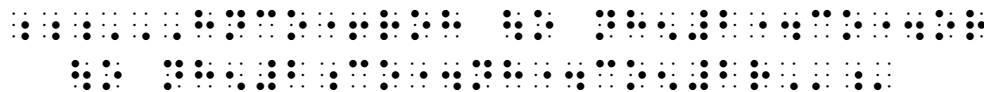
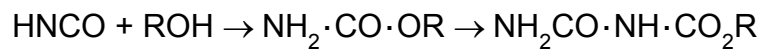
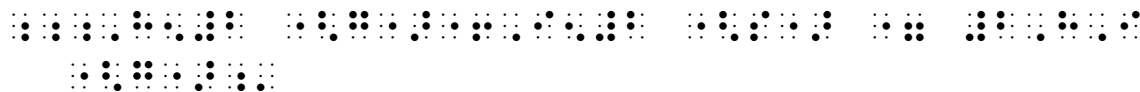
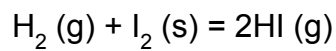
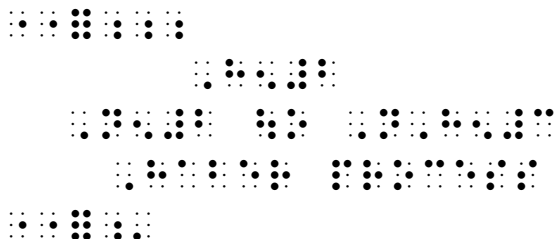
16 Chemistry

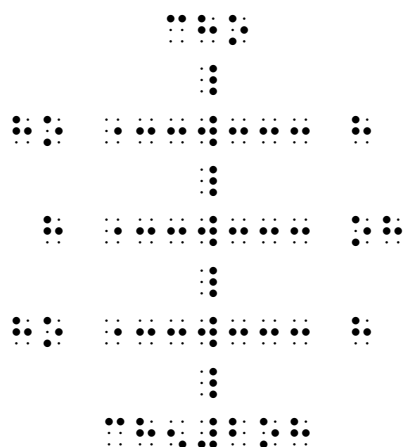
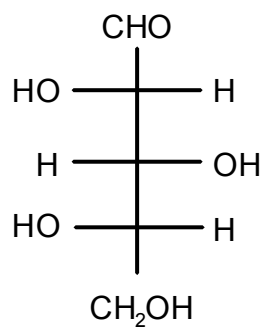
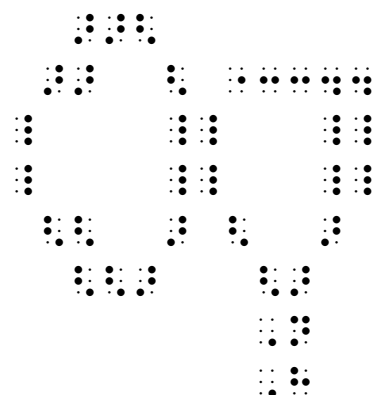
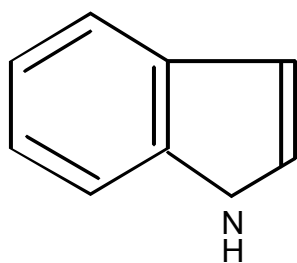
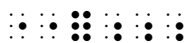
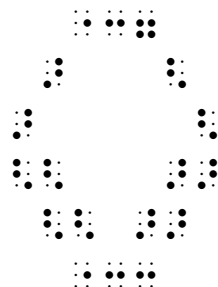
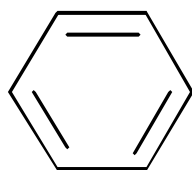
	equilibrium arrow, trend to the left
	equilibrium arrow, trend to the right
	equilibrium arrow (harpoons)
	dash or single line bond
	double line bond
	triple line bond
	quadruple line bond
	single dashed line
	double dashed line
	triple dashed line
	quadruple dashed line
	single dot
	double dot
	triple dot
	quadruple dot
	single cross
	double cross
	triple cross
	quadruple cross
	single small circle
	double small circle
	triple small circle
	quadruple small circle

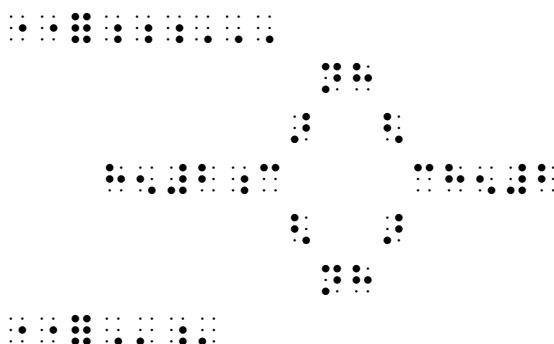
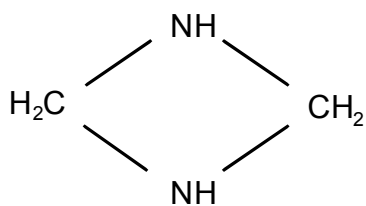
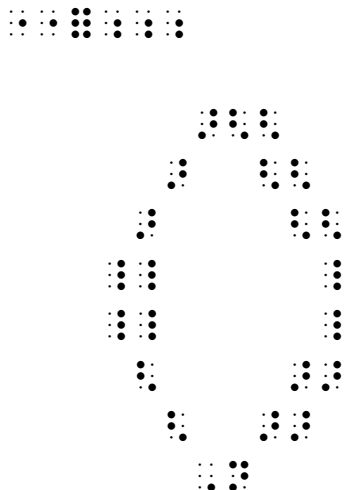
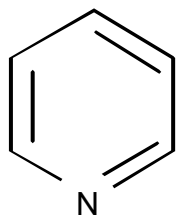
16.5 Chemical Equations

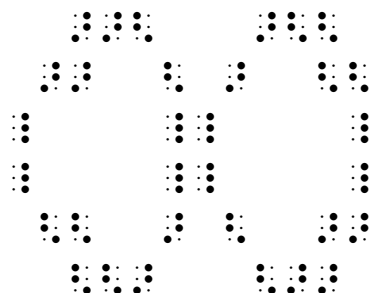
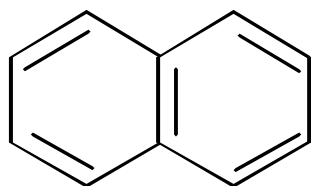


or









Linear Method

A method is available in which structural formulae are represented in a compact linear form in braille. However, as yet this has not been documented as a UEB technique.

17 Computer Notation

⠠⠠⠠⠠	(on a line by itself) cursor indicator
⠠⠠⠠	visible space
⠠⠠⠠⠠	(at end of line) continuation indicator
⠠⠠⠠⠠⠠	(at end of line) continuation indicator with space
⠠⠠⠠⠠⠠⠠	nondirectional double quote (ASCII double quote)

17.1 Definition of computer notation

Computer notation is any text written in a formal syntax that is designed to allow computers to utilize the text directly for technical purposes related to the computer itself. Examples include computer programs written in procedural languages such as Java, C++, COBOL, and various "assembly" languages, nonprocedural scripting and markup languages such as XHTML, and data files prepared to meet the input requirements of specific programs. Even some short items such as email addresses, Web site URLs, and file names qualify as computer notation because of their technical purpose. Other examples might occur within an instruction manual for technical equipment, or within a statistics textbook that gives an example of a spreadsheet formula.

"Displayed" computer notation is presented in one or more lines separate from the surrounding literary text; "inline" computer notation is presented within ordinary literary text -- for example, an email address mentioned within a sentence.

Historically, separate codes have been used for such computer notation. In UEB this is no longer the case, as each print symbol is represented by the same braille symbol, regardless of whether it appears in a literary, mathematical or computer context. Refer to the list of miscellaneous symbols at the start of Section 11 for symbols on the computer keyboard such as the \ (backslash), ~ (tilde), @ (at sign), # (cross hatch), & (ampersand), * (asterisk), _ (underscore) and | (vertical bar).

17.2 Line arrangement and spacing within computer notation

The significance of line breaks within displayed computer notation depends upon the specific formal syntax involved. Unless the transcriber is certain that such line breaks are not significant, it should be assumed that they are, and the line-by-line arrangement preserved in braille. When the limited length of the braille line makes a break necessary in braille that does not correspond to a break in print, a continuation indicator should be inserted and the line continued on the next line. The specific continuation indicator used depends on whether the break in effect replaces a space in the original line (which is preferred, if practical, and in which case use dots 5, 5), or is simply introduced at an

17.3 Grade of braille in computer notation

A displayed computer program or program fragment should normally be transcribed in grade 1 braille; nearby excerpts from a program that is displayed in grade 1 should preferably also be in grade 1, for consistency. Other expressions, such as email addresses, web sites, URLs, filenames, and computer expressions not displayed on separate lines, should normally be transcribed in grade 2 braille.

Example:

Now that you've seen the "Hello World!" application, you might be wondering how it works. Here again is its code:

```
/**
 * The HelloWorldApp class implements an application that
 * simply prints "Hello World!" to standard output.
 */
class HelloWorldApp {
    public static void main(String[] args) {
        System.out.println("Hello World!");    // Display
the string.
    }
}
```

The call to function `system.out.println`, passing it the constant string "Hello World!", does the essential work -- but the other statements and comments also play a role ...

Notes:

The indentation pattern on the left of the page has been followed in braille. The "continuation with space" indicators have been used whenever a print line needed to be broken at a space in braille. Overruns following a continuation indicator are indented in the braille version below, but it is also acceptable to start each overrun in cell 1. Notice that the non directional double quotation marks around "Hello World" are treated as standard quotes in the introductory paragraph but have been brailled exactly as written when they appear in the program itself and in the extract. In the final paragraph, grade 1 indicators were used for the two extracts so it was not felt necessary to also show the change of font.

