Section 1: General Principles

Note: For the purpose of this guidance, "technical expression" or simply "expression" signifies any group of mathematical or scientific symbols. It may be a single term or a longer group of mathematical or scientific symbols, such as an equation, which is not broken by ordinary text. Words may form part of a technical expression but ordinary text defines the beginning and end of the expression.

1.7 Choice and placement of grade 1 indicators

⠰ grade 1 symbol indicator

⠰⠰ grade 1 word indicator

⠰⠰⠰ grade 1 passage indicator

⠰⠄ grade 1 terminator

1.7.1 Grade 1 indicators will not be needed for simple arithmetic problems involving numbers, operation signs, numerical fractions and mixed numbers.

Example:

Evaluate the following: $3 - 2\frac{1}{2} =$

"Evaluate the following: 3 minus 2 and one half equals"

⠠⠑⠧⠁⠇⠥⠁⠞⠑ ⠞⠓⠑ ⠋⠕⠇⠇⠕⠺⠊⠝⠛⠒ ⠼⠉ ⠍⠊⠝⠥⠎ ⠼⠃ ⠁⠝⠙ ⠕⠝⠑ ⠓⠁⠇⠋ ⠑⠟⠥⠁⠇⠎

1.7.2 Simple algebraic equations which include letters but no fraction or superscript indicators may need grade 1 symbol indicators where letters stand alone or follow numbers. (See Section 1.2 for the underlying rules.)

Example:

$y = x + 4c$

"y equals x plus 4c"

⠰⠽ ⠀⠶ ⠀⠰⠭ ⠬ ⠼⠙⠉

1.7.3 Technical expressions in braille consist of one or more symbols-sequences. (A symbols-sequence is an unbroken string of one or more braille signs, whether alphabetic or non-alphabetic, preceded and followed by space, see RUEB 2.1.)

Guide to grade 1 indicator usage for technical expressions:

Note: grade 1 symbol indicators used with lowercase a-j following a number are not counted in the reckoning for (a) and (b) below.

(a) For each symbols-sequence allow one grade 1 symbol indicator, or, if more than one grade 1 symbol indicator is required, use a grade 1 word indicator.

Note: The grade 1 word indicator is placed at the beginning of the symbols-sequence.

Examples:

x^2

"x squared"

⠰⠭⠘⠼⠃

$x \to \infty$

"x right arrow infinity"

⠰⠭⠳⠒⠕⠰⠾

$\frac{x}{y}$

"x over y"

⠰⠭⠌⠽⠰⠄

[rather than] ⠰⠭⠸⠌⠽⠰⠄

(b) Use a grade 1 passage indicator (with grade 1 terminator) if the entire expression contains three or more symbols-sequences which require either a grade 1 symbol or grade 1 word indicator.

Note: Begin a grade 1 passage at the start of the technical expression and place the grade 1 terminator at the end of the last symbols-sequence in the expression. The terminator follows any punctuation even if not part of the expression itself.

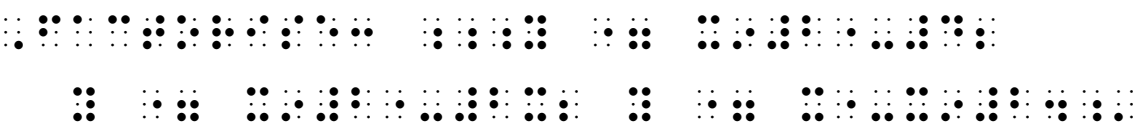
Examples:

$x_a = x_b = x_c$

"x subscript a equals x subscript b equals x subscript c"

Factorise: $y = x^2 - 4; y = x^2 - 2x; y = x - x^2$.

"Factorise: y equals x squared minus 4; y equals x squared minus 2x;
y equals x minus x squared."



1.7.4 For longer expressions, entire worked examples or sets of exercises, a grade 1 passage may be used with the indicators placed on separate lines.

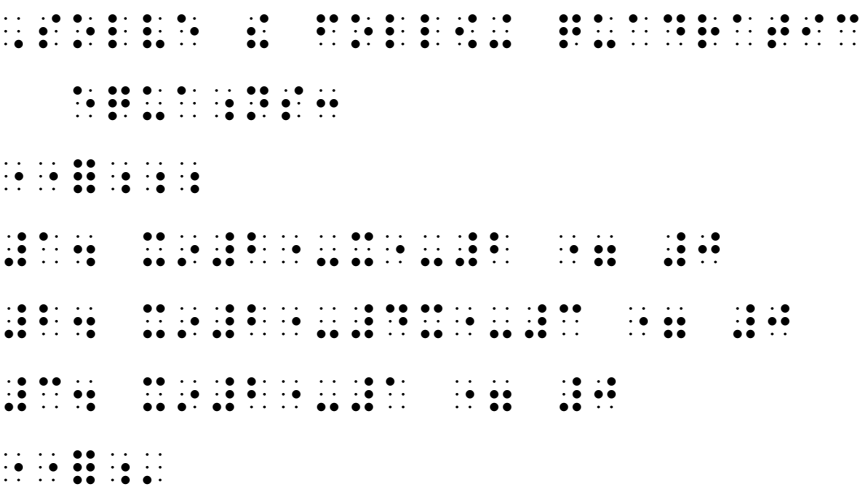
Note: The grade 1 passage indicator and grade 1 terminator are preceded by the dot locator for "use" when placed on a line of their own.

Example:

Solve the following quadratic equations:

1. $x^2 - x - 2 = 0$
2. $x^2 - 4x - 3 = 0$
3. $x^2 - 1 = 0$

"Solve the following quadratic equations:
1. x squared minus x minus 2 equals 0
2. x squared minus 4x minus 3 equals 0
3. x squared minus 1 equals 0"



1.7.5 When word(s) form part of the technical expression itself, follow the guidelines below to improve readability.

Note: Mathematical function abbreviations such as sin, arctan and min are not considered words.

(a) For each symbols-sequence containing word(s), allow two grade 1 symbol indicators where doing so will result in the word(s) appearing in their usual contracted form.

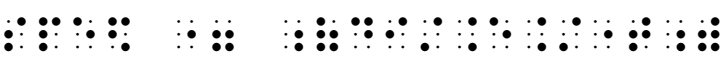
Note: If more than two grade 1 symbol indicators are required then use a grade 1 word indicator.

Note: If three or more symbol-sequences in the entire expression require either a grade 1 symbol or grade 1 word indicator then use a grade 1 passage.

Example:

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

"speed equals distance over time"

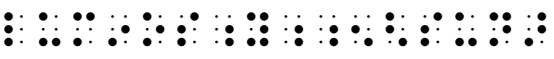


(b) Place a grade 1 word indicator just prior to the first symbol which could be misread as a contraction if this allows word(s) earlier in the symbols-sequence to appear contracted.

Example:

$\text{luminosity}_{\text{sun}}$

"luminosity subscript sun"



[rather than] 

(c) Place a grade 1 passage indicator at the beginning of the first symbols-sequence that needs a grade 1 indicator if this allows preceding word(s) to appear contracted.

Example:

$$\text{speed} = \frac{\text{distance}}{\text{time}} = \frac{30{,}000\,\text{m}}{60\,\text{s}} = 500\,\text{m/s}$$

"speed equals distance over time equals 30,000 m over 60 s equals 500 m/s"

⠠⠠⠠ ⠠⠠ ⠠⠠⠉⠕⠝⠎⠊⠎⠞⠑⠝⠞ ⠁⠏⠏⠗⠕⠁⠉⠓ ⠞⠕ ⠞⠓⠑
⠠⠠ ⠥⠎⠑ ⠕⠋ ⠛⠗⠁⠙⠑ ⠁ ⠊⠝⠙⠊⠉⠁⠞⠕⠗⠎
⠠⠠ ⠺⠓⠑⠝ ⠞⠗⠁⠝⠎⠉⠗⠊⠃⠊⠝⠛

1.7.6 Use a consistent approach to the use of grade 1 indicators when transcribing a particular text in order to maintain clarity for the reader.

Note: The default approach is to maintain words in their usual contracted form where possible; follow Section 1.7.5 for technical expressions containing words.

1.7.7 Transcribers may choose to use grade 1 mode for all technical expressions in a text. In making the decision to adopt this approach, careful consideration should be given to factors such as:

- how UEB is taught in the area;
- decisions of the local braille authority;
- level of education of the target audience;
- what the target audience would expect;
- translation tools available;
- in-house production rules based on document type.

1.7.8 When students write work, they may use a different strategy for the grade 1 indicators, particularly if the number of indicators is not known when they begin to write. Students should not be penalised for not adhering exactly to the guidelines, and neither should they be penalised if the omission of a grade 1 indicator leads to technically incorrect braille, but the mathematical meaning is nevertheless clear.

1.7.9 Further examples of preferred grade 1 indicator usage for technical expressions:

$y = x$

"y equals x"

⠠⠽ ⠐⠶ ⠠⠭

$\sqrt{25} = 5$

"square root of 25 equals 5"

⠠⠩⠥⠁⠗⠑ ⠗⠕⠕⠞ ⠕⠋ ⠼⠃⠑ ⠐⠶ ⠼⠑

$\sqrt{x} = 7$

"square root of x equals 7"

⠨⠜⠭⠀⠶⠀⠻

ms^{-1}

"m s to the minus 1"

⠍⠎⠘⠤⠼⠁

[rather than] ⠍⠎⠘⠔⠤⠼⠁⠐⠜ [or] ⠍⠎⠘⠔⠤⠼⠁⠐⠕

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

"y equals x over 2"

⠽⠀⠶⠀⠭⠌⠼⠃

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

"y equals x squared over 2"

⠽⠀⠶⠀⠭⠘⠔⠼⠃⠌⠼⠃

$\frac{x}{y} = \frac{c}{d}$

"x over y equals c over d"

⠭⠌⠽⠀⠶⠀⠉⠌⠙

Coordinate (x, y)

"Coordinate (x, y)"

⠠⠉⠕⠕⠗⠙⠊⠝⠁⠞⠑⠀⠣⠭⠂⠀⠽⠜

Coordinate (x_i, y_i)

"Coordinate (x subscript i, y subscript i)"

⠠⠉⠕⠕⠗⠙⠊⠝⠁⠞⠑⠀⠣⠭⠢⠊⠂⠀⠽⠢⠊⠜

Coordinate (x_i^2, y_i^2)

"Coordinate (x subscript i squared, y subscript i squared)"

⠠⠉⠕⠕⠗⠙⠊⠝⠁⠞⠑⠀⠣⠭⠢⠊⠘⠔⠼⠃⠂⠀⠽⠢⠊⠘⠔⠼⠃⠜

$\overline{B}$

"B with bar over"

⠰⠠⠤⠠⠆

$\overleftrightarrow{M}$

"M with left right arrow directly above"

⠰⠠⠪⠠⠒⠠⠫⠠⠕

$\overleftrightarrow{AZ}$

"AZ with left right arrow directly above"

⠰⠠⠁⠠⠵⠠⠒⠠⠫⠠⠕

[rather than] ⠰⠠⠁⠵⠠⠒⠠⠫⠠⠕

$^{27}_{13}Al$

"subscript 13 superscript 27 Al"

⠰⠠⠌⠂⠼⠁⠉⠠⠔⠼⠃⠛⠠⠁⠇

O^{2-}

"O superscript [2 minus]"

⠰⠠⠕⠠⠔⠼⠃⠤⠠⠇

$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

"2 H subscript 2 (g) plus O subscript 2 (g) right arrow 2 H subscript 2 O(l)"

⠰⠠⠼⠃⠠⠓⠠⠌⠂⠼⠃⠠⠔⠠⠣⠠⠛⠠⠜⠠⠖⠠⠼⠃⠠⠓⠠⠌⠂⠼⠃⠠⠔⠠⠕⠠⠣⠠⠇⠠⠜

⠰⠠⠼⠃⠠⠓⠠⠌⠂⠼⠃⠠⠔⠠⠕⠠⠣⠠⠇⠠⠜

$y = mx + c$

"y equals mx plus c"

⠰⠠⠽⠠⠶⠠⠍⠠⠭⠠⠖⠠⠉

$A = \pi r^2$

"A equals pi r squared"

⠰⠠⠁⠠⠶⠠⠏⠠⠗⠠⠘⠠⠆

$E = mc^2$

"E equals m c squared"

⠠⠑ ⠶ ⠍ ⠉ ⠘⠆

$x^2 - 2x + 1 = (x - 1)^2$

"x squared minus 2x plus 1 equals (x minus 1) squared"

⠭ ⠘⠆ ⠤ ⠼⠃ ⠭ ⠖ ⠼⠁ ⠶ ⠣ ⠭ ⠤ ⠼⠁ ⠜ ⠘⠆

$x_n = 1 + \frac{-1^n}{n}$

"x subscript n equals 1 plus the fraction: minus 1 to the n over n"

⠭ ⠢ ⠝ ⠶ ⠼⠁ ⠖ ⠆ ⠤ ⠼⠁ ⠘⠔ ⠝ ⠳ ⠝ ⠻

$x_n = \frac{2^n}{n^2}$

"x subscript n equals 2 to the n all over n squared"

⠭ ⠢ ⠝ ⠶ ⠆ ⠘⠔ ⠝ ⠘⠆ ⠻

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

"x equals the fraction: minus b plus-or-minus the square root of b squared minus 4ac end root all over 2a"

⠭ ⠶ ⠆ ⠤ ⠃ ⠘⠖ ⠩ ⠃ ⠘⠆ ⠤ ⠼⠙ ⠁ ⠉ ⠻ ⠳ ⠼⠃ ⠁ ⠆

$x\sqrt{\sin\theta}$

"x square root of sin theta"

⠭ ⠩ ⠎ ⠊ ⠝ ⠨ ⠹ ⠻

[rather than] ⠭ ⠎ ⠊ ⠝ ⠨ ⠹

Version[1b]

"Version superscript [1b]"

⠧ ⠑ ⠗ ⠎ ⠊ ⠕ ⠝ ⠰ ⠼⠁ ⠃

[rather than] ⠧ ⠑ ⠗ ⠎ ⠊ ⠕ ⠝ ⠔ ⠼⠁ ⠃

$W = Fs$

"W equals Fs"

⠠⠺ ⠶ ⠠⠋⠎

work = force × distance

"work equals force times distance"

⠠⠺⠁⠗⠅ ⠶ ⠋⠕⠗⠉⠑ ⠦ ⠙⠊⠎⠞⠁⠝⠉⠑

$\therefore \text{force} = \dfrac{\text{work}}{\text{distance}}$

"therefore force equals work over distance"

⠫⠐⠕⠗⠑ ⠋⠕⠗⠉⠑ ⠶ ⠺⠕⠗⠅ ⠳ ⠙⠊⠎⠞⠁⠝⠉⠑

$\text{acceleration} = \dfrac{\Delta\text{speed}}{\Delta\text{time}}$

"acceleration equals capital delta speed over capital delta time"

⠁⠉⠉⠑⠇⠑⠗⠁⠞⠊⠕⠝ ⠶ ⠠⠙⠎⠏⠑⠑⠙ ⠳ ⠠⠙⠞⠊⠍⠑

$\text{frequency} = \dfrac{1}{\text{time}}$

"frequency equals 1 over time"

⠋⠗⠑⠟⠥⠑⠝⠉⠽ ⠶ ⠼⠁ ⠳ ⠞⠊⠍⠑

frequency = 1/time

"frequency equals 1 slash time"

⠋⠗⠑⠟⠥⠑⠝⠉⠽ ⠶ ⠼⠁ ⠸⠌ ⠞⠊⠍⠑

$V_{\text{cone}} = \dfrac{1}{3}\pi r^2 h$

"V subscript cone equals one third pi r squared h"

⠠⠧⠩⠉⠕⠝⠑ ⠶ ⠼⠁⠉ ⠏⠊ ⠗ ⠘⠆ ⠓

[rather than]

⠠⠧ ⠶ ⠼⠁⠉ ⠏⠊ ⠗ ⠘⠆ ⠓

$V = \int \pi y^2 \mathrm{d}x$

"V equals the integral of pi y squared dx"

⠠⠧ ⠶ ⠮⠀⠏⠊ ⠽ ⠘⠆ ⠙⠭

[rather than]

$$\text{period} = 2\pi\sqrt{\frac{l\cos\alpha}{g}}$$

"period equals 2 pi square root of fraction: l cos alpha all over g"

Assume $g = 9.81\,\text{ms}^{-2}$

"Assume g equals 9.81 m s to the minus 2"

$v_1 = x\ \text{ms}^{-1}$

"v subscript 1 equals x m s to the minus 1"

$P = \{t, u, v\}$

"P equals open curly bracket t, u, v close curly bracket"

[rather than]

$x_a = x_b = x_c = x_d$

"x subscript a equals x subscript b equals x subscript c equals x subscript d"

[rather than]

$x^2 \times x^3 = x^{2+3} = x^5$

"x squared times x cubed equals x to the [2 plus 3] equals x to the 5th"

Laws of indices:

$a^m \times a^n = a^{m+n}$

$(a^m)^n = a^{mn}$

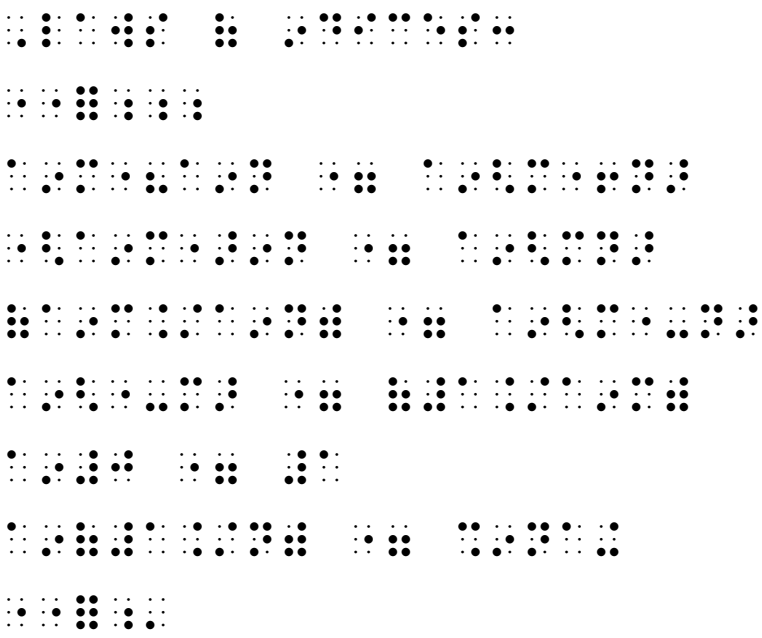
$\frac{a^m}{a^n} = a^{m-n}$

$a^{-m} = \frac{1}{a^m}$

$a^0 = 1$

$a^{\frac{1}{n}} = \sqrt[n]{a}$

"Laws of indices:
a to the m times a to the n equals a to the [m plus n]
(a to the m) all to the n equals a to the [mn]
a to the m all over a to the n equals a to the [m minus n]
a to the minus m equals 1 over a to the m
a to the 0 equals 1
a to the [1 over n] equals the nth root of a"



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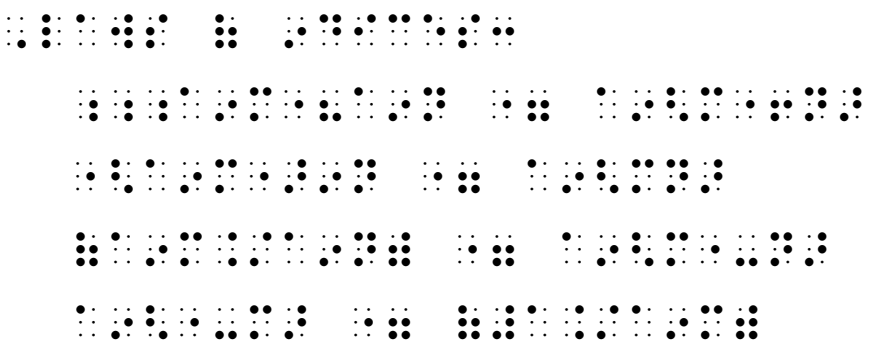

⠁⠔⠼⠚ ⠐⠶ ⠼⠁

⠁⠔⠷⠼⠁⠨⠌⠝⠾ ⠐⠶ ⠩⠔⠝⠁⠬⠰⠄

$B \rightarrow C$

"B right arrow C"

⠰⠰⠰⠠⠃ ⠳⠕ ⠠⠉⠰⠄

[rather than] ⠰⠠⠃ ⠰⠳⠕ ⠰⠠⠉

$x + y = 5$

"x plus y equals 5"

⠭⠐⠖⠽ ⠐⠶ ⠼⠑

[rather than] ⠰⠰⠰⠭⠐⠖⠽ ⠐⠶ ⠼⠑⠰⠄

$CH_4 + 4Cl_2 \rightarrow CCl_4 + 4HCl$

"C H subscript 4 plus 4 Cl subscript 2 right arrow C Cl subscript 4 plus 4HCl"

⠰⠰⠰⠠⠉⠠⠓⠢⠼⠙⠐⠖⠼⠙⠠⠉⠇⠢⠼⠃

⠳⠕ ⠠⠉⠠⠉⠇⠢⠼⠙⠐⠖⠼⠙⠠⠓⠠⠉⠇⠰⠄

${}^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{-1}\beta$

"subscript 6 superscript 14 C right arrow subscript 7 superscript 14 N plus subscript minus 1 superscript 0 beta"

⠰⠰⠰⠢⠼⠋⠔⠼⠁⠙⠠⠉

⠳⠕ ⠢⠼⠛⠔⠼⠁⠙⠠⠝⠐⠖⠢⠣⠐⠤⠼⠁⠜⠔⠼⠚⠨⠃⠰⠄

$\text{reliability} = \frac{\text{number of faults}}{\text{total number of items}} = p$

"reliability equals fraction: number of faults all over total number of items close fraction equals p"

⠗⠑⠇⠊⠁⠃⠊⠇⠰⠽

⠐⠶ ⠰⠰⠰⠷⠝⠥⠍⠃⠑⠗ ⠕⠋ ⠋⠁⠥⠇⠞⠎

⠨⠌⠞⠕⠞⠁⠇ ⠝⠥⠍⠃⠑⠗ ⠕⠋ ⠊⠞⠑⠍⠎⠾ ⠐⠶ ⠏⠰⠄

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For inclusion in About this book section:

In the examples in this document, grade 2 mode is assumed to be in effect, and grade 1 indicators have been included according to the guidelines given in Section 1.7 Choice and placement of grade 1 indicators.