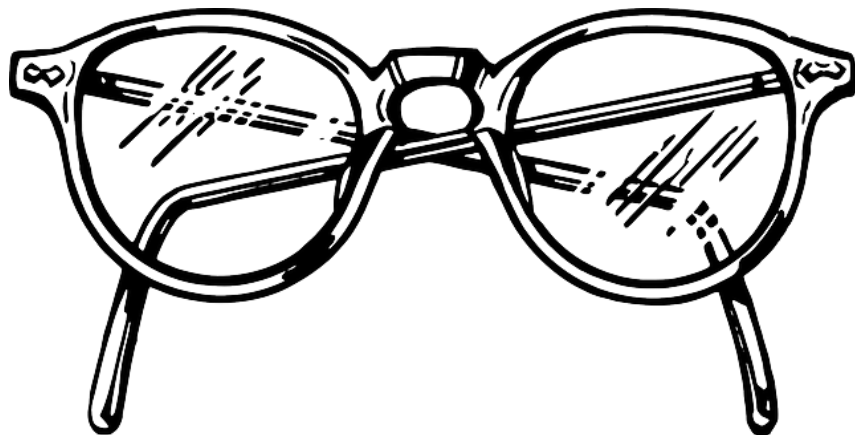


# Unified English Braille For Math

For Sighted Learners



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## UEB Braille for Math

Previously braille readers used the Nemeth code for math and literary braille code numbers for most other things. With the implementation of UEB, numbers will remain the same regardless of subject and are positioned in the upper section of the braille cell.

Braille numbers are written by putting a number sign in front of the first 10 letters of the alphabet.

#	1	2	3	4	5	6	7	8	9	0

Examples: 359      1472      9,804

### Math Symbols

+	-	×	÷	=
dots 5, 2-3-5	dots 5,3-6	dots 5, 2-3-6	dots 5, 3-4	dots 5, 2-3-5-6

Note:

- The number sign must appear before each number. The number sign no longer carries through a hyphen or equation.
- The addition, subtraction, multiplication, division and equal sign are two cells each. For young students, there is a space before and after each of these math symbols (Manitoba Variation).

Examples:

50+10 = 60

3×8=24

17 + 12 = 29

$$92 - 68 = 24$$

$$92 - 68 = 24$$

$$51 \div 3 = 17$$

$$51 \div 3 = 17$$

$$25 \times 4 = 100$$

$$25 \times 4 = 100$$

**PRACTICE 1** – Interline the following.

$$92 - 68 = 24$$

$$51 \div 3 = 17$$

$$25 \times 4 = 100$$

$$92 - 68 = 24$$

$$92 - 68 = 24$$

$$51 \div 3 = 17$$

$$25 \times 4 = 100$$

$$92 - 68 = 24$$

**PRACTICE 2** - Braille the following.

$$2 - 1 = 1 \quad 7,500 - 500 = 7,000$$

$$6 \div 3 = 2 \quad 24 \div 6 = 4$$

$$3 \times 7 = 21 \quad 2 \times 9 = 18$$

$$25 + 9 = 34 \quad 4 + 10 = 14$$

## Decimals

The Decimal is now represented with dots 2-5-6, the same as a period. ⠼⠠

1.25



I need 2-3.5 cups of flour.



.8 is a decimal between 0-1.



## Dollar Sign

The Dollar Sign is represented with dots 4, 2-3-4. ⠠⠠⠠

\$3.45



US\$



## Spatial Addition

$$\begin{array}{r}
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot
 \end{array}
 \begin{array}{r}
 \cdot\cdot\cdot \\
 \cdot\cdot\cdot \\
 \cdot\cdot\cdot
 \end{array}
 \quad +
 \begin{array}{r}
 \cdot\cdot\cdot \\
 \cdot\cdot\cdot \\
 \cdot\cdot\cdot
 \end{array}$$

Decimals (dots 2-5-6) must be lined up.

Numbers are always lined up to the right unless there is a decimal; number signs are lined up on the left.

Operations symbols (+ - x etc) can appear to the immediate left of the last listed number, or at the top right or left of the top number with one empty cell between. When you are braille for your student, choose the placement they prefer, and use it consistently.

$$\begin{array}{r}
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot
 \end{array}
 \begin{array}{r}
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot
 \end{array}
 \begin{array}{r}
 \cdot\cdot\cdot \\
 \cdot\cdot\cdot \\
 \cdot\cdot\cdot \\
 \cdot\cdot\cdot \\
 \cdot\cdot\cdot
 \end{array}$$

Separator lines extend the length of the numbers, dots 5, 2-5.

$$\begin{array}{r}
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot
 \end{array}
 \begin{array}{r}
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot
 \end{array}
 \begin{array}{r}
 + 47 \\
 44 \\
 \cdot\cdot\cdot \\
 \cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot
 \end{array}$$

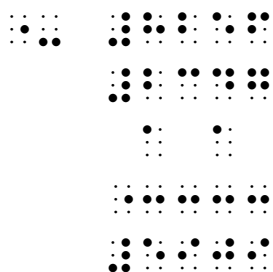
A line is often left as room to indicate carry over between the question and the answer.

When you braille math for your student, you only need to braille the basic question, without the separation line. Your student will add the separation line, additional lines and answer as they work through the question.

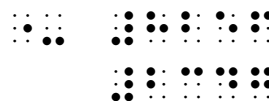
i.e.

$$\begin{array}{r}
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot
 \end{array}
 \begin{array}{r}
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot \\
 \cdot\cdot\cdot\cdot\cdot
 \end{array}$$

## Spatial Subtraction with Cancellations/Borrowing



On the braille page, the question appears like this:



The student adds the borrowing indicators, separation line and answer.

$$\begin{array}{r}
 - 8256 \\
 2347 \\
 \hline
 11 \\
 \hline
 5909
 \end{array}$$

In UEB, a note is made below the question, above the answer to indicate borrowing. As the user advances to each place value, they will need to check for a borrowing indicator and subtract, if required.

# Spatial Multiplication



Should it not be practical to place number signs in front of every number in a spatial layout, numeric passage indicators may be used to show that the following selection is entirely numbers. Spatial multiplication and division will often use numeric passage indicators.

 Numeric Passage Indicator

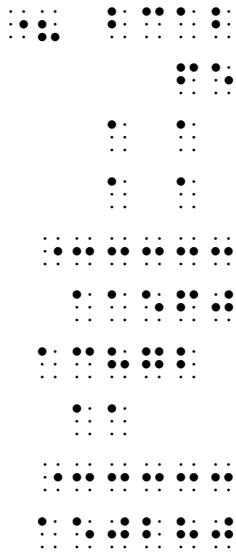
 Numeric Passage Indicator Terminator

A line or more is left between the question and the answer as room to indicate carry over as a result of multiplying.



		2704 x
		<u>12</u>
		line for carryover when multiplying the 2
		line for carryover when multiplying the 1
		5408
		2704
		<u>1</u> carry over from addition
		32448





x 2312  
65  
11  
11  
-----  
11560  
13872  
11  
-----  
150280

carryover when multiplying the 5  
carryover when multiplying the 5

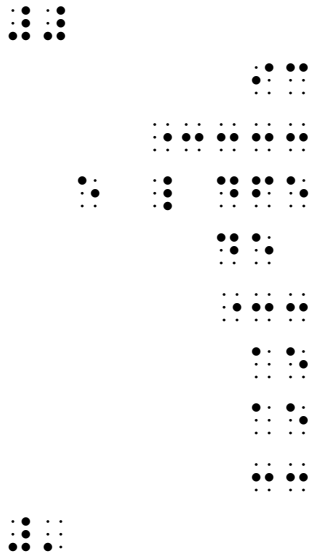
carryover when adding





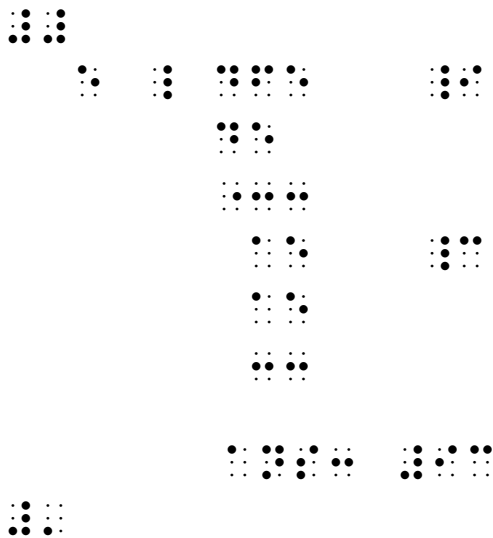
# Spatial Division

Method 1



$$\begin{array}{r}
 93 \\
 5 \overline{)465} \\
 \underline{45} \\
 15 \\
 \underline{15} \\
 0
 \end{array}$$

Method 2



$$\begin{array}{r}
 5 \mid 465 \mid 9 \\
 \underline{45} \\
 15 \mid 3 \\
 \underline{15} \\
 0
 \end{array}$$

Ans : 93

**PRACTICE 3 – Interline the following.**

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

⠠⠠⠠	
	⠠⠠⠠
	⠠⠠⠠⠠⠠⠠
⠠	⠠⠠⠠⠠⠠
	⠠⠠⠠
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
⠠⠠⠠

(Yes, the student got the answer wrong! Our job here is only to interline for the teacher.)

**PRACTICE 4 – Braille the following. Braille the operation signs at the top left of the question.**

26	43	98	
<u>x15</u>	<u>+ 85</u>	<u>- 64</u>	4) <u>12</u>

## Omitted Numbers

An Omission mark shown as an underscore is represented by dots 4-6, 3-6 

The underscore will be the most common form of omission you will likely see in classroom materials.


**PRACTICE 5** - Braille using the underscore.

$5 + 8 = \_ \quad 10 \times \_ = 50 \quad \_ - 5 = 92$

$12 - 2 = \_ \quad 8 + \_ = 15 \quad \_ \times 6 = 24$

**PRACTICE 6** - Interline the following.











## Fractions

The Simple Fraction Line is represented with dots 3-4. 

$\frac{5}{8}$  of the class are boys.



$\frac{11}{2}$        $\frac{2}{6}$        $\frac{5}{8}$        $\frac{9}{4}$





A mixed number is considered like “two numbers” for use of the number sign.

I need  $2\frac{1}{2}$  cups of flour.



$3\frac{1}{2}$        $4\frac{1}{4}$



When a fraction is written in a linear fashion, an ordinary slash mark (an oblique stroke) is used, dots 4-5-6, 3-4,  and a second number sign is added after the oblique stroke.

$\frac{3}{8}$  of the class are girls.





Two Grade 1 Indicators means the whole word should be read as uncontracted braille.

One Grade 1 Indicators means only the next cell should be read as uncontracted braille.

Any fraction more complicated than the previous examples or which includes letters or words requires the use of a General Fraction Line instead of a simple fraction line and General Fraction Opening and Closing Indicators. General Fraction Indicators can be confused with the contractions for “of” or “with” so as you braille for your student, consider whether you will need one or more grade 1 indicator at the beginning of a fraction containing letters.

 General Fraction Line, dots 4-6, 3-4.

 General Fraction Open indicator, dots 1-2-3-5-6

 General Fraction Close indicator, dots 2-3-4-5-6

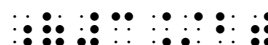
$$\frac{x}{y}$$



$$\frac{1}{x}$$



$$\frac{3}{b}$$

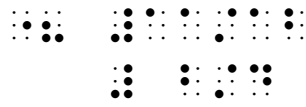


$$\frac{\text{distance}}{\text{time}}$$



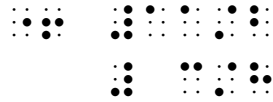
If a number sign immediately follows the General Fraction Open Indicator only one Grade 1 Indicator is needed at the beginning to designate that this passage is dealing with numbers and uncontracted braille.

# Spatial Fractions



x 11/12

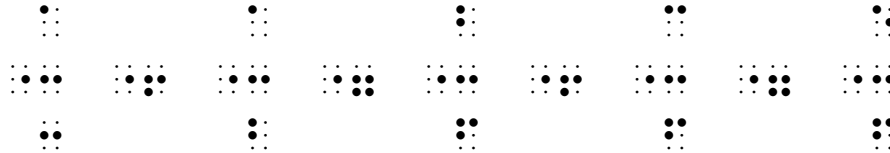
2/4



+ 11/2

3/8

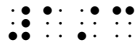
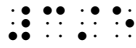
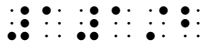

These are examples of fractions aligned spatially.


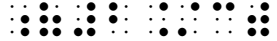



$$\frac{1}{3} + \frac{1}{2} = \frac{2}{6} + \frac{3}{6} = \frac{5}{6}$$

This is a spatial fraction. This format can be very useful when a student is first learning.

**PRACTICE 7** – Interline the following.

**PRACTICE 8** – Braille the following.

$\frac{2}{3}$      $\frac{x}{b}$      $\frac{8}{x}$     fun     $\frac{1}{z}$     23    9/16  
 3    b    x    work    z    100

## Exponents/Superscripts

An exponent or superscript has a special symbol in front of it so the braille reader knows that it is "up in the air." That symbol is written using dots 3-5 followed by the number. ⠠⠨

If the symbol is following a letter, a grade 1 indicator is needed to ensure that the letter and indicator are not read as a word. e.g. read as b12 instead of b<sup>2</sup>

5<sup>2</sup>

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

x<sup>2</sup>

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

## Subscript

Subscript is represented with dots 2-6. ⠠⠨

As with superscripts, if the subscript symbol follows a letter, a grade 1 indicator is needed to ensure the letter and indicator are not read as a word. e.g. read as Hen2O instead of H<sub>2</sub>O

H<sub>2</sub>O

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

CO<sub>2</sub>

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠





## Algebra - Putting it all together

Example:

EXAMPLE 6. Factor  $12x^2 + 7xy - 10y^2$ .




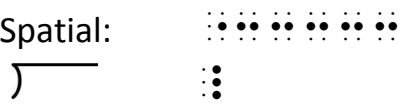





















The plus, minus, and equals signs are shown in red. The superscript indicator is shown in green.

$$12x^2 + 7xy - 10y^2 = (3x + 5y)(4x - 2y)$$

Grade 1 passage indicator is used in this example:

$$3x - 4y + y^2 = x^2$$

## UEB Braille Notes

Addition +	dot 5, 2-3-5 	
Subtraction -	dot 5, 3-6 	
Division	Linear: $\div$ dot 5, 3-4 	Spatial: 
Multiplication x	dot 5, 2-3-6 	
Equals =	dot 5, 2-3-5-6 	
Separation line 	dot 5, 2-5 	Used to separate spatial math questions from work and answers.
Vertical line segment for spatial work	dot 4-5-6 	
Decimal .	dot 2-5-6 	
Omission	Underscore _____ dots 4-6, 3-6 	
Fraction lines	Simple dots 3-4 	General 
General Fraction indicators	Opening  Closing 	
Grade 1 Indicator dots 5-6	Symbol  Word 	Passage  Terminator 
Parenthesis	Opening (  dots 5, 1-2-6	Closing )  dots 5, 3-4-5
Superscripts, Exponents & Subscripts	Superscript & Exponents 	Subscript 
Greater than >	dot 4, 1-2-6 	
Less than <	dot 4, 3-4-5 	

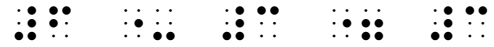
# ANSWERS

**PRACTICE 1** – Interline the following.

$5 \div 1 = 5$



$6 - 3 = 3$



$15 \div 3 = 5$



$3 \times 4 = 12$



$1,200 + 45 = 1,245$



$16 + 6 = 22$



$4 - 4 = 0$



$5 \times 3 = 15$



**PRACTICE 2** - Braille the following.

$2 - 1 = 1$



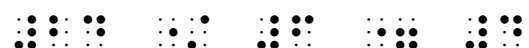
$7,500 - 500 = 7,000$



$6 \div 3 = 2$



$24 \div 6 = 4$



$3 \times 7 = 21$



$2 \times 9 = 18$



$25 + 9 = 34$



$4 + 10 = 14$



**PRACTICE 3 – Interline the following.**

$\begin{array}{r} 24 \\ + 22 \\ \hline 46 \end{array}$	$\begin{array}{r} 51 \\ - 51 \\ \hline 0 \end{array}$	$\begin{array}{r} 23 \\ \times 23 \\ \hline 69 \\ 460 \\ \hline 529 \end{array}$
--	---	--

$\begin{array}{r} 24 \\ + 22 \\ \hline 46 \end{array}$	$\begin{array}{r} 51 \\ - 51 \\ \hline 0 \end{array}$
--	---

24

**PRACTICE 4** – Braille the following.

$$\begin{array}{r} 26 \\ \times 15 \\ \hline \end{array}$$

$$\begin{array}{r} \dots \dots \dots \\ \dots \dots \dots \\ \dots \dots \dots \\ \dots \dots \dots \end{array}$$

$$\begin{array}{r} 43 \\ + 85 \\ \hline \end{array}$$

$$\begin{array}{r} \dots \dots \dots \\ \dots \dots \dots \\ \dots \dots \dots \end{array}$$

$$\begin{array}{r} 98 \\ - 64 \\ \hline \end{array}$$

$$\begin{array}{r} \dots \dots \dots \\ \dots \dots \dots \\ \dots \dots \dots \end{array}$$

$$4 \overline{) 12}$$

$$\begin{array}{r} \dots \dots \dots \dots \dots \\ \dots \dots \dots \dots \dots \\ \dots \dots \dots \dots \dots \end{array}$$

**PRACTICE 5** - Braille using the underscore.

$5 + 8 = \_$

$$\dots \dots \dots \dots \dots \dots \dots \dots \dots \dots$$

$10 \times \_ = 50$

$$\dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots$$

$\_ - 5 = 92$

$$\dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots$$

$12 - 2 = \_$

$$\dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots$$

$8 + \_ = 15$

$$\dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots$$

$\_ \times 6 = 24$

$$\dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots$$

**PRACTICE 6** - Interline the following.

$3 \_ 7 = 10$

$$\dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots$$

$5 + 11 = \_$

$$\dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots$$

$46 - 25 = \_$

$$\dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots$$

$26 \div \_ = 8$

$$\dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots$$

$\_ \times 8 = 72$

$$\dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots$$

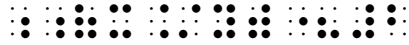
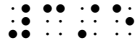
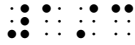
**PRACTICE 7** – Interline the following.

$$\frac{1}{3}$$

$$\frac{3}{5}$$

$$1\frac{1}{2}$$

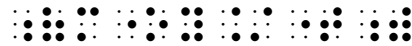
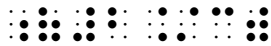
$$\frac{x}{y} \times 2$$



$$2/10$$

$$\frac{2}{c}$$

$$\frac{\text{money}}{\text{time}}$$

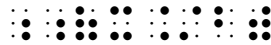


**Practice 8** – Braille the following.

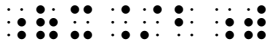
$$\frac{2}{3}$$

$$\frac{x}{b}$$

$$\frac{8}{x}$$



or



fun  
work

1  
z

23  
100



9/16

