



Spatial Problems

RULES AND ADVICE

Presented by:
Kyle DeJute
Created by:
NBA UEB Technical
Committee





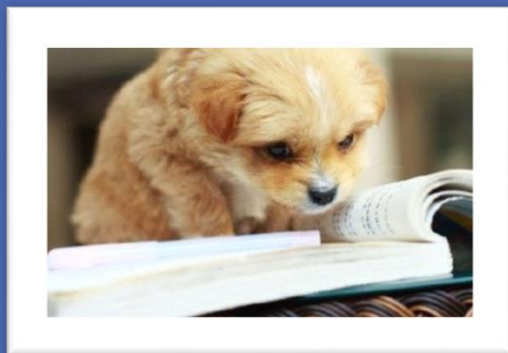
National Braille Assoc.

Rules for Spatial



Bullets from GTM 4.1

- Above and below each spatial calculation the braille line should be either blank or contain only ⠠⠠ or ⠠⠠⠠
- Columns to be added should only contain numerals or omission symbols
- An individual numeric indicator can be followed by a space and still turn on numeric mode
- For sum lines and other horizontal lines, use horizontal line mode ⠠⠠⠠
- Horizontal lines (e.g., sum lines) are as wide as the longest item to which they apply



Do what works
for the student.



National Braille Assoc.

General Advice



General Advice

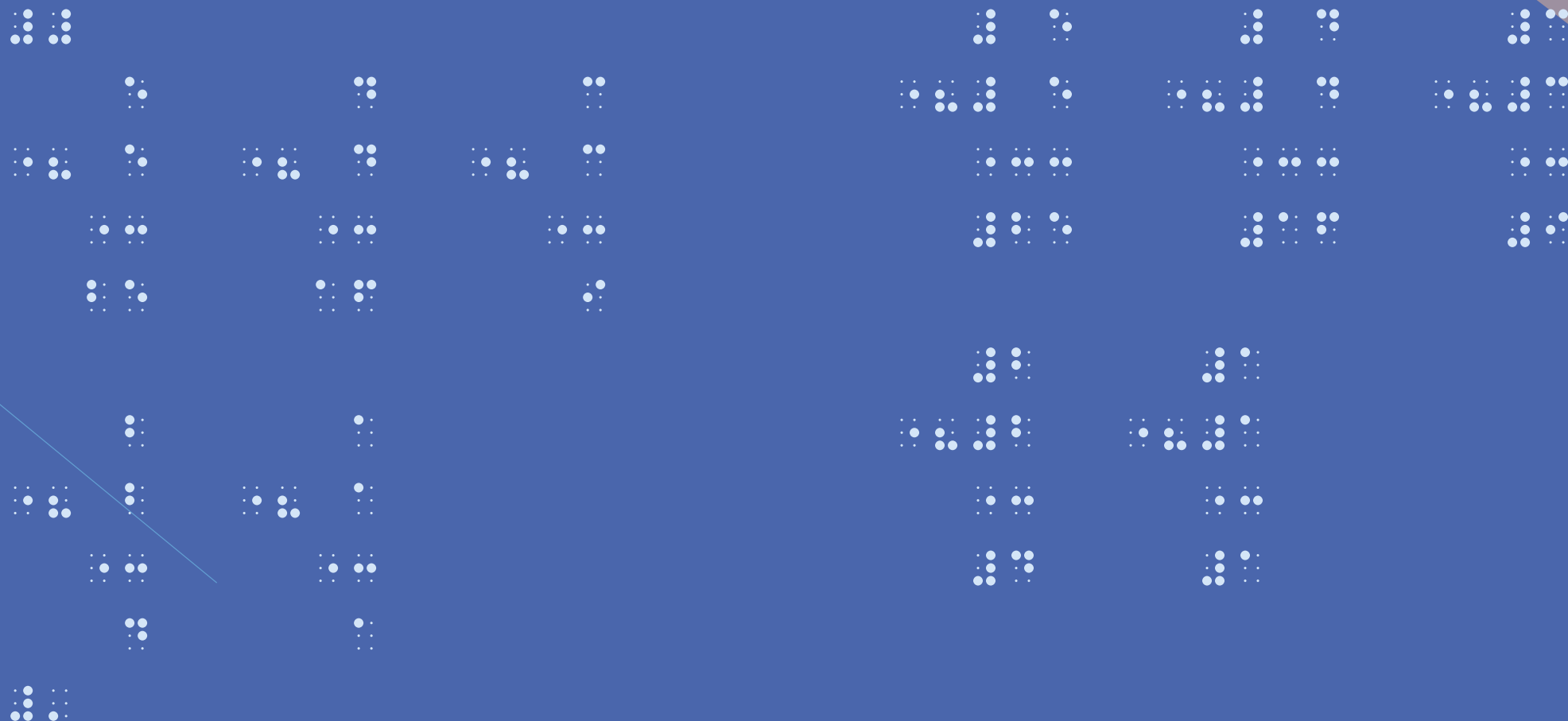
- Use a numeric passage for a series of spatial problems
- Repeat individual numeric indicators for each question number, even within a numeric passage
- For shapes that indicate omission:
 - If there is one shape (e.g., a box), follow print
 - If there are multiple shapes (e.g., an empty rectangle for each of the missing digits), use the visible space symbol
- Use consistent spacing after identifiers and between problems
 - Between the rightmost cell of an identifier and the leftmost cell of the arrangement, leave one column of cells blank
 - Between the rightmost cell of one arrangement and the leftmost cell of the next problem or problem identifier, leave a consistent two or three blank cells

Numeric Passage

What is it good for?



Numeric Passage for a Series Example



Numeric Passage

What is it good for?

A numeric passage makes it so we do not need individual numeric indicators.

This can reduce the number of symbols needed for a spatial problem, and it can simplify the process of aligning the pieces of a problem.

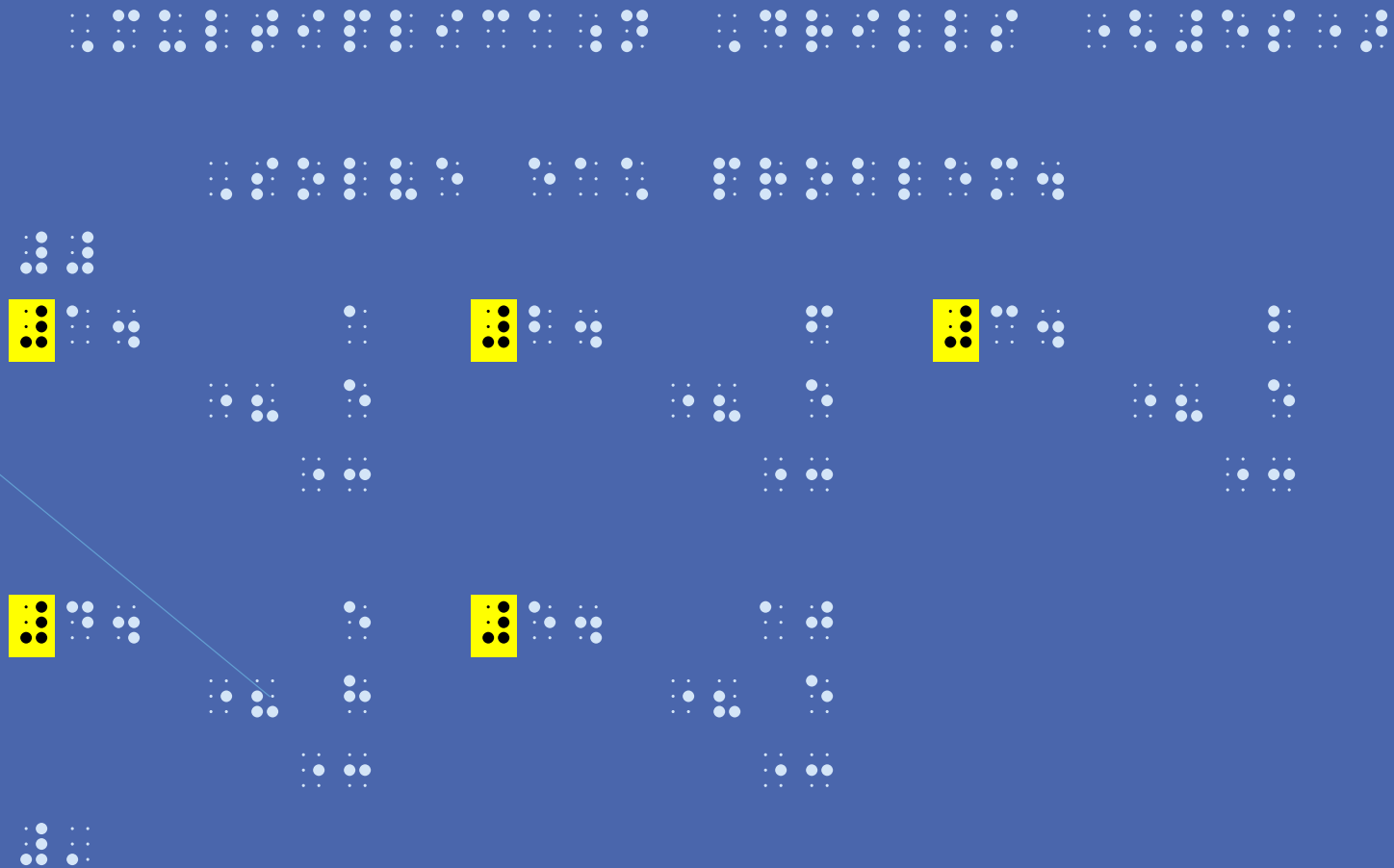


Item Identifiers

Advice:

Use a numeric indicator for each identifier, whether inside or outside of a numeric passage

Numeric Passage for an Itemized Series Example



Item Identifiers

Advice:

Use a numeric indicator for each identifier, whether inside of or outside of a numeric passage

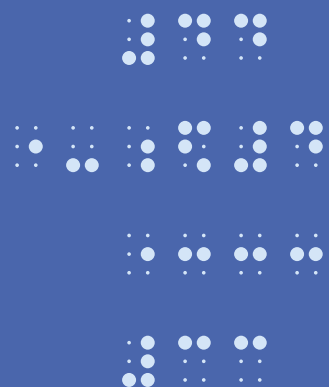
Insert a numeric indicator before every item identifier (aka question number) in order to distinguish item identifiers from numbers within a spatial problem, especially within a numeric passage.

Omission, Single

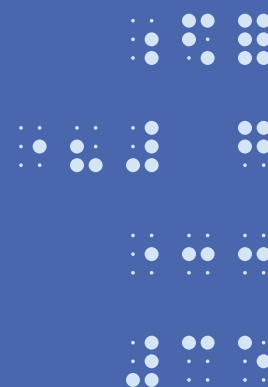
Advice:

For a single shape that indicates omission, follow print, using the appropriate braille shape symbol

Single Omission Shape Examples

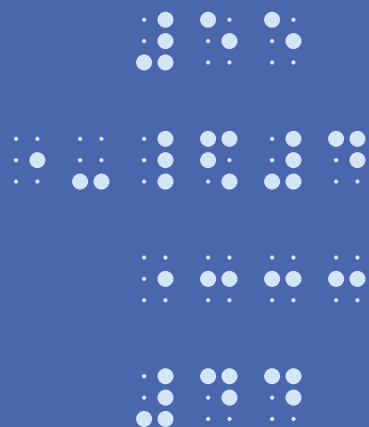


$$\begin{array}{r} 44 \\ - \square \\ \hline 33 \end{array}$$



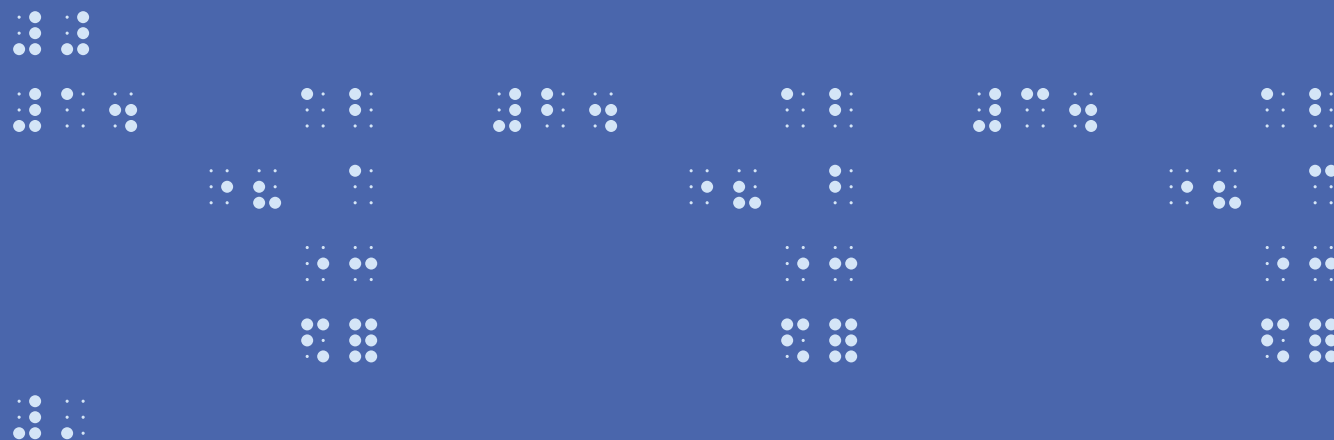
$$\begin{array}{r} \bigcirc \\ \times \frac{7}{35} \end{array}$$

Single Omission Shape with Remarkable Characteristics Example



$$\begin{array}{r} 55 \\ - \text{ } \\ \hline 44 \end{array}$$

Single Omission Shape in an Itemized Series Example



1.
$$\begin{array}{r} 12 \\ \times 1 \\ \hline \bigcirc \end{array}$$

2.
$$\begin{array}{r} 12 \\ \times 2 \\ \hline \bigcirc \end{array}$$

3.
$$\begin{array}{r} 12 \\ \times 3 \\ \hline \bigcirc \end{array}$$

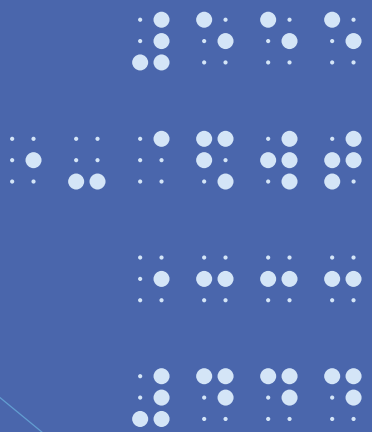
Omission, Single

Advice:

For a single shape that indicates omission, follow print, using the appropriate braille shape symbol

Simply following print is a shortcut to keeping everyone (reader, transcriber, teacher, administrator, parent, etc.)

“on the same page” so long as following print will not interfere with alignment of a spatial problem.



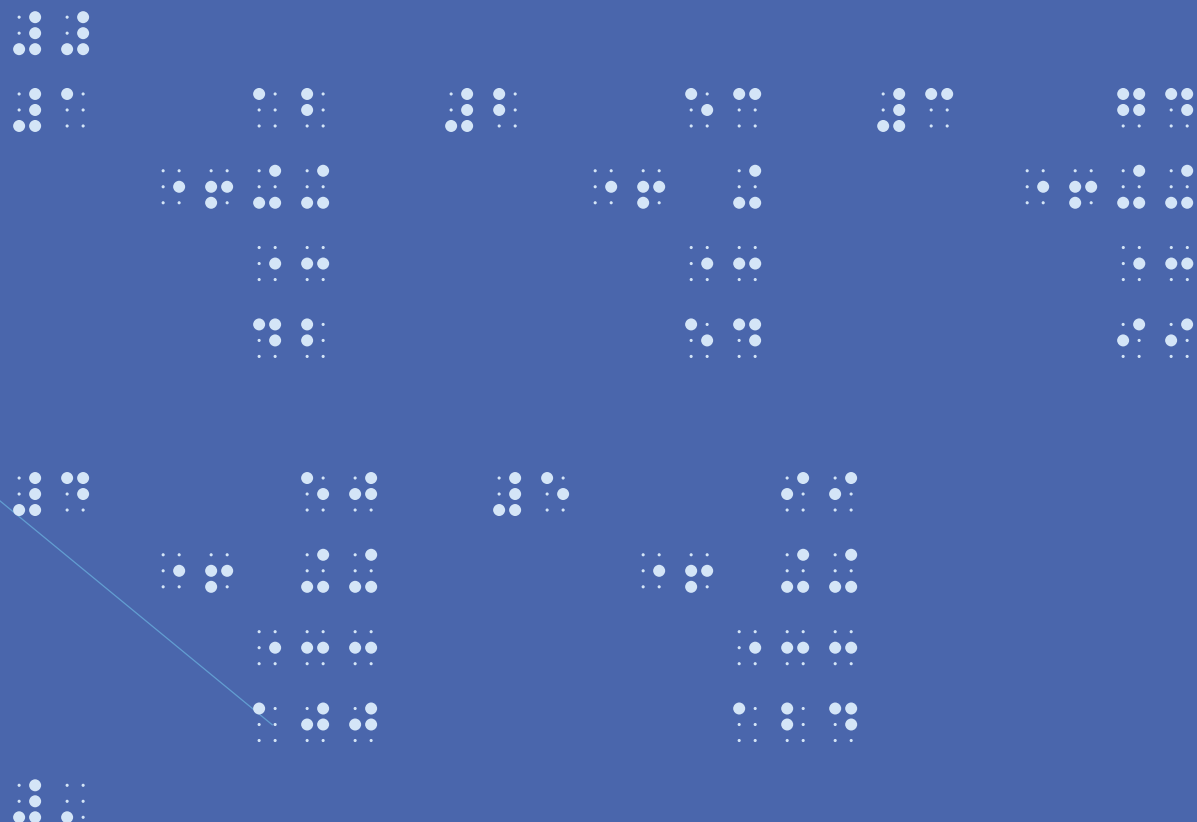
Omissions, Multiple

Advice:

For multiple omission shapes,
use the visible space



Multiple Omission Shapes in an Itemized Series Example



$$\begin{array}{r} 1 \quad 12 \\ + \square \square \\ \hline 42 \end{array}$$

$$\begin{array}{r} 2 \quad 53 \\ + \square \\ \hline 54 \end{array}$$

$$\begin{array}{r} 3 \quad 74 \\ + \square \square \\ \hline 99 \end{array}$$

$$\begin{array}{r} 4 \quad 50 \\ + \square \square \\ \hline 100 \end{array}$$

$$\begin{array}{r} 5 \quad 99 \\ + \square \square \\ \hline 124 \end{array}$$

Omissions, Multiple

Advice:

For multiple omission shapes,
use the visible space

The visible space ⋮ may be used as a
general sign of omission to either
facilitate vertical layout or save
considerable space.

Use a transcriber note to explain this use.

Watch out for the possibility that
different print shapes have different
meanings.



Non-shape Omissions

What about print objects, other than shapes, that indicate omission (e.g., asterisks, question marks, etc.)?

As a guiding principle, **if print alignment can be reasonably reproduced** in braille, then follow print for the sign used to indicate omission. **If print alignment cannot be reasonably reproduced** in braille, use a visible space for each printed object that indicates omission.



Non-shape Omissions, Following Print Example



$$\begin{array}{r} 243 \\ \times 12 \\ \hline 4*6 \\ 24* \\ \hline 29*6 \end{array}$$

Non-shape Omissions, Using Visible Space Example



$$\begin{array}{r}
 351 \\
 \times 74 \\
 \hline
 *404 \\
 2457 \\
 \hline
 259*4
 \end{array}$$



Question Mark Omissions Following Print Examples



$$\begin{array}{r} 33 \\ + 7? \\ \hline 105 \end{array}$$

$$\begin{array}{r} 55 \\ - ?? \\ \hline 44 \end{array}$$

$$\begin{array}{r} 88 \\ - ?5 \\ \hline 33 \end{array}$$

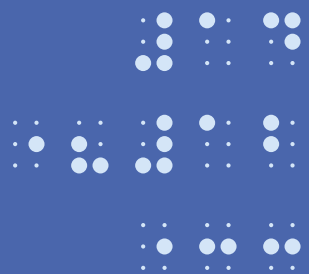
Blank for Missing Answer

Advice:

When an **answer** is simply missing,
use no symbol for the empty area



Blank for Missing Answer Example



$$\begin{array}{r} 14 \\ \times 12 \\ \hline \end{array}$$

Blank for Missing Answers in Numeric Passage Example

1. 1.2

2. 1.2

3. 1.2

4. 1.2

5. 1.2

6. 1.2

7. 1.2

8. 1.2

9. 1.2

10. 1.2

11. 1.2

12. 1.2

13. 1.2

14. 1.2

15. 1.2

16. 1.2

17. 1.2

Blank for Missing Answer

Advice:

When an **answer** is simply missing,
use no symbol for the empty area

An expression with simply
nothingness to indicate a missing sum,
quotient, product, difference, etc.
does not need a visible space or any
other symbol of omission for the
space where the answer would go.



National Braille Assoc.





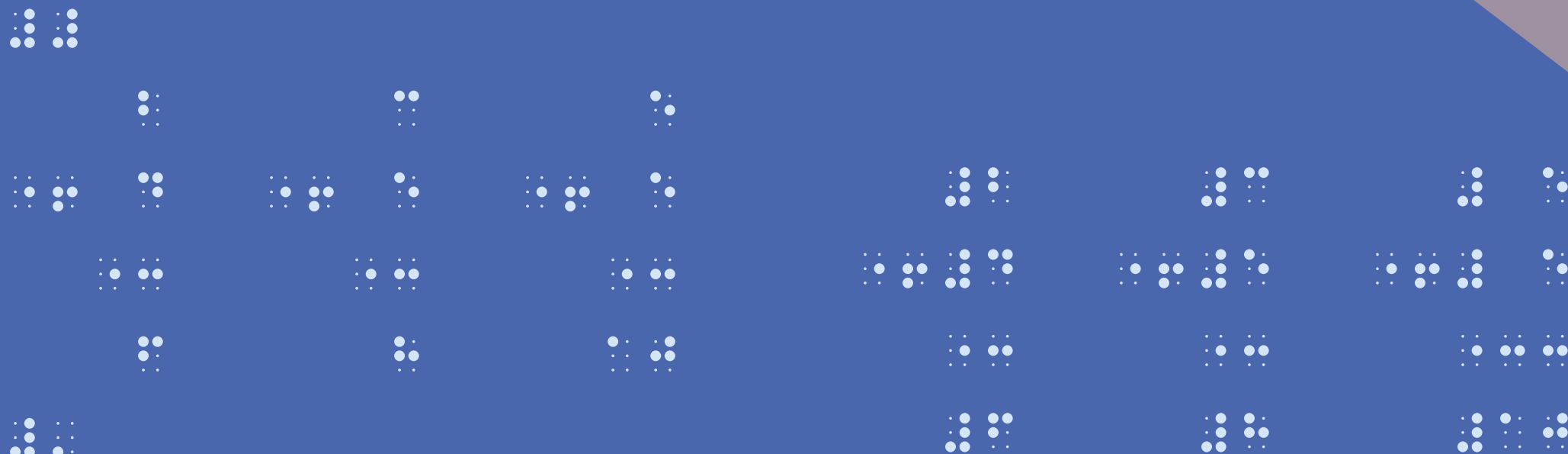
Single-digit Problems

Advice:

Let the column above dot 5 be empty

For single-digit addition problems in a numeric passage, begin the summation line one cell to the right of the plus sign with one-digit numbers starting one more cell to the right so that the column above the dot 5 of the horizontal line is empty.

Single-digit Problem in Numeric Passage Example





Tiny Numbers

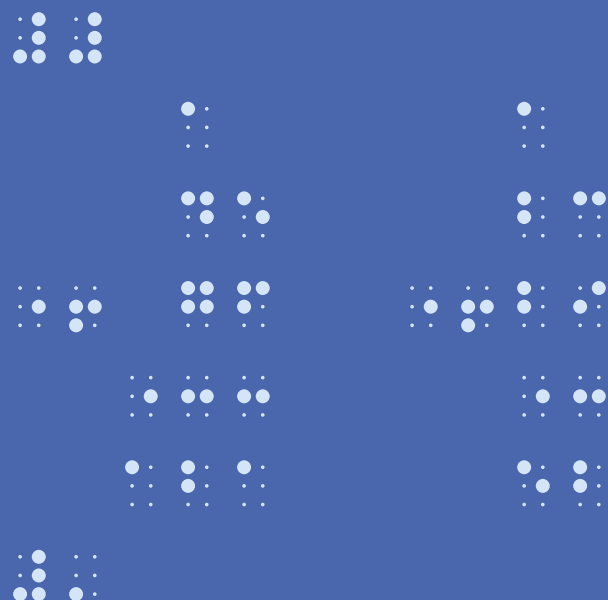
Advice:

Insert the tiny number on the line above,
and align by place value

When print uses a tiny number to “carry” a value, place that carried number on the line above the column to which it belongs.

The number then becomes one more entry to be added within that column.

Tiny Numbers in Carryover Examples



¹ 45	¹ 23
+76	+29
<hr/>	<hr/>
121	52



Operation Symbols

Horizontal Line and Operation Symbols

Advice:

Take on feedback and be consistent

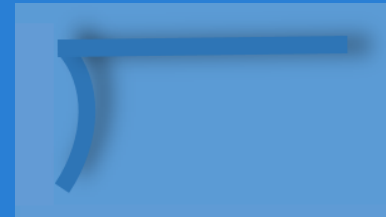
Do what you can continue to do.

In the absence of other instruction, place the operation sign one cell to the left of the horizontal line related to it instead of above a part of that horizontal line.

And remember, GTM tells us repeatedly to do what is best for the student.



National Braille Assoc.

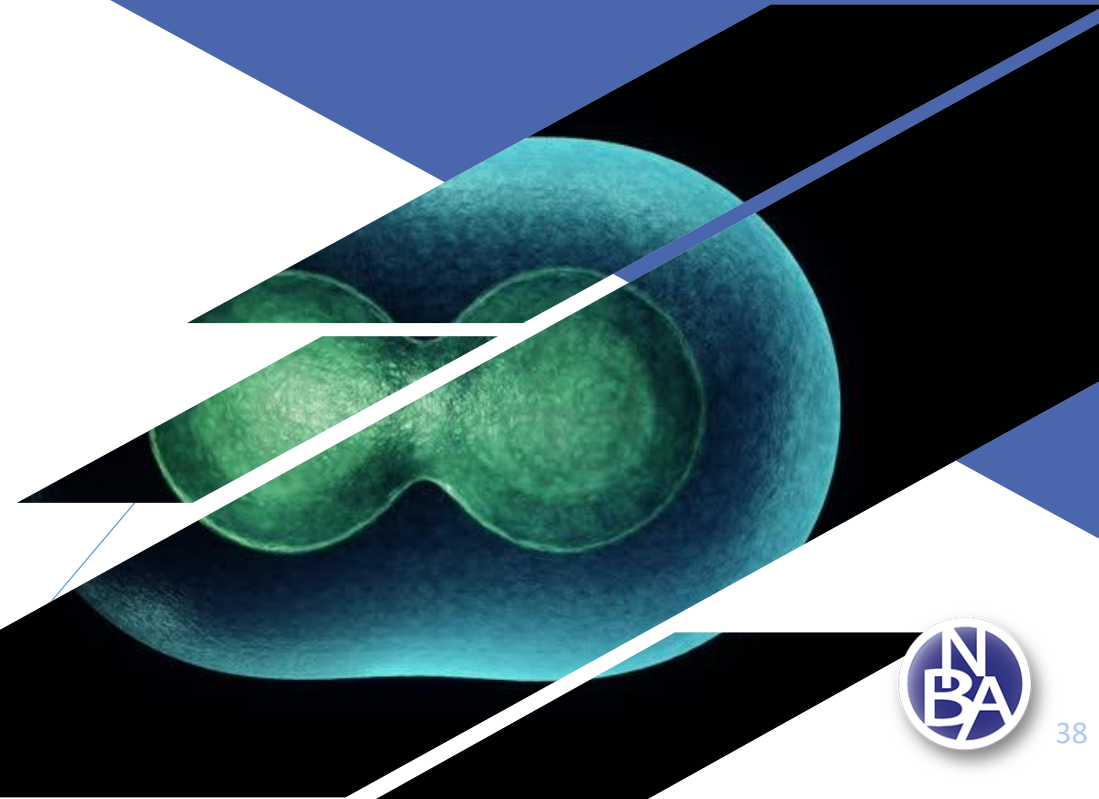


Division



⋮ for Division Symbol

The spaced vertical line segment (dots 456) can be used to represent the curved or straight line used in print. –GTM 4.1.3



Spaced Vertical Line Segment for Curved or Straight Division Line Example



$$\begin{array}{r} 12 \\ 4 \overline{) 48} \end{array}$$

$$\begin{array}{r} 12 \\ 4 \overline{) 48} \end{array}$$

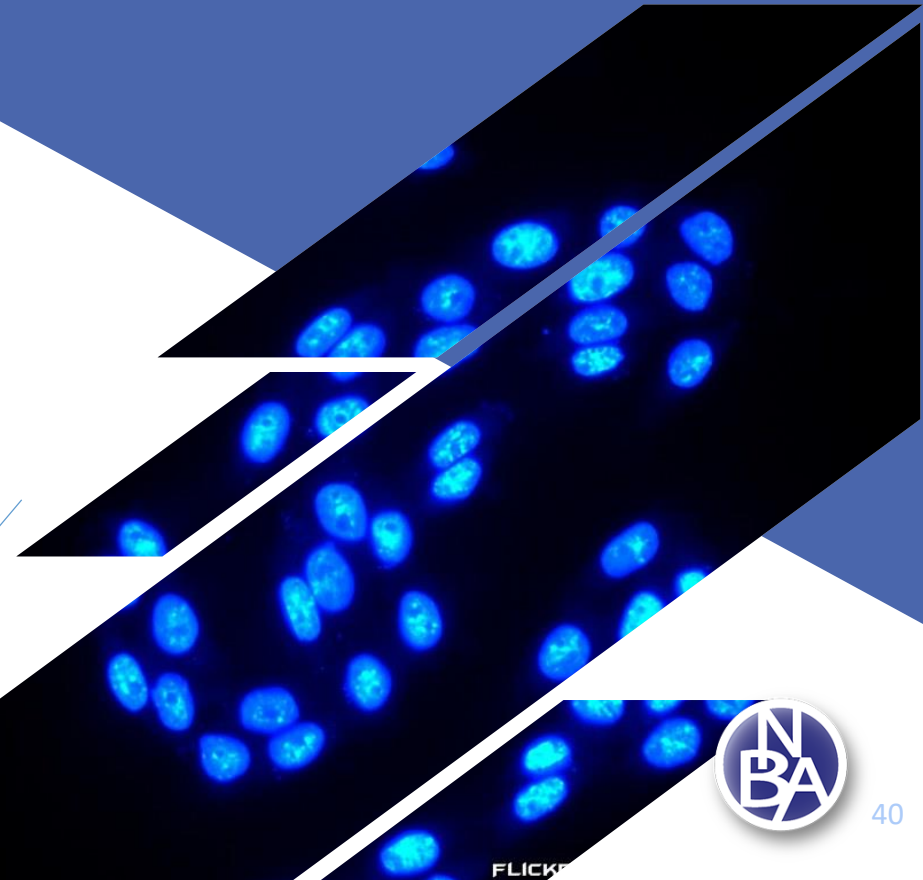


Numeric Passage and Spatial Division

Advice:

Use a numeric passage for spatial division

Avoiding the use of individual numeric indicators makes it easier to align the multiple subtraction problems that make up a spatial division problem (long division).



Numeric Passage for Long Division Example

12

12

12

12

12

12

12

12

12

12

12



Operation Symbols Within Division


Advice:



Position operation symbols relative to the calculation to which they belong




Other than the division symbol itself (spaced vertical line segment), place the operation symbols one cell to the left of the widest line of the problem to which they apply.

Minus Symbols in Long Division example







National Braille Assoc.



Subtraction



Cancellation

Advice:

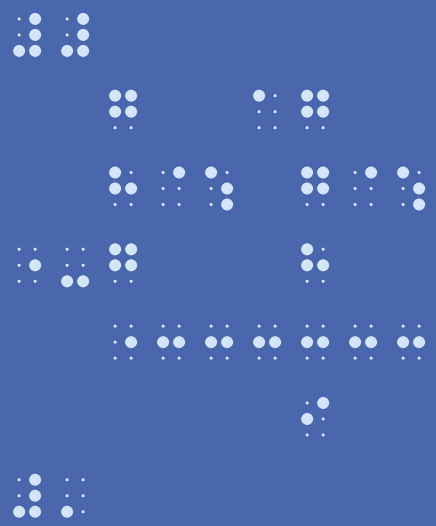
Use ⠠⠠⠠ for cancellation, and align digits as in print

When using the “line through previous item” symbol to reproduce print’s crossing out (usually for “borrowing” in subtraction), use braille grouping indicators as necessary.

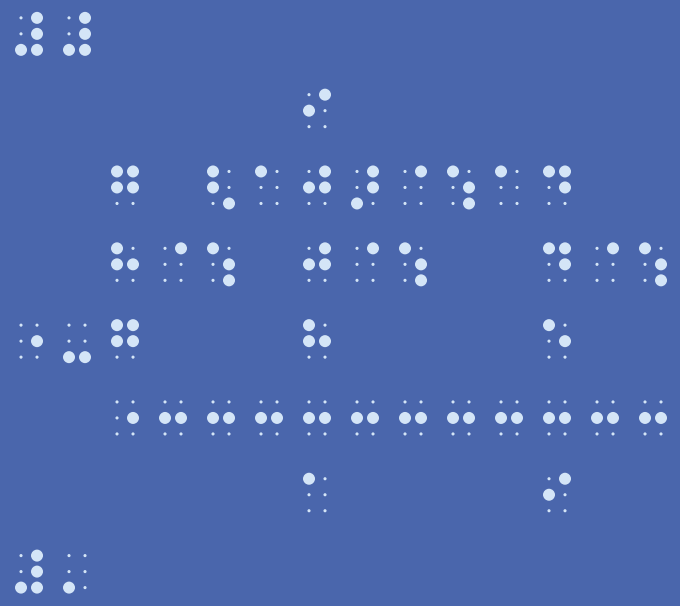




Cancellation in Subtraction Problem Examples



$$\begin{array}{r} 7 \ 17 \\ \cancel{8} \ \cancel{7} \\ - 78 \\ \hline 9 \end{array}$$

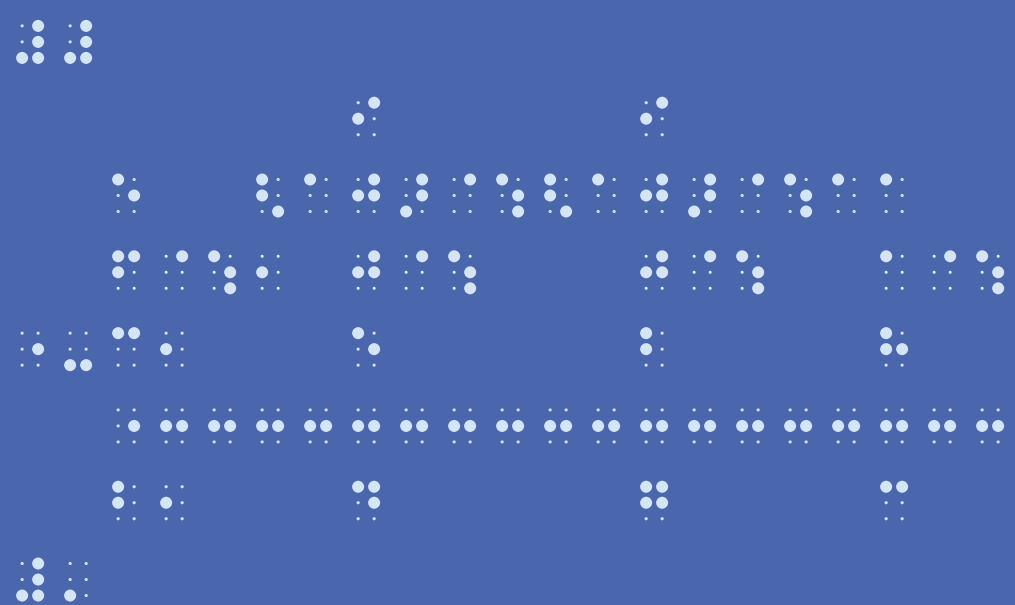


$$\begin{array}{r} 9 \\ 7 \ 10 \ 14 \\ \cancel{8} \ \cancel{0} \ \cancel{4} \\ - 785 \\ \hline 19 \end{array}$$

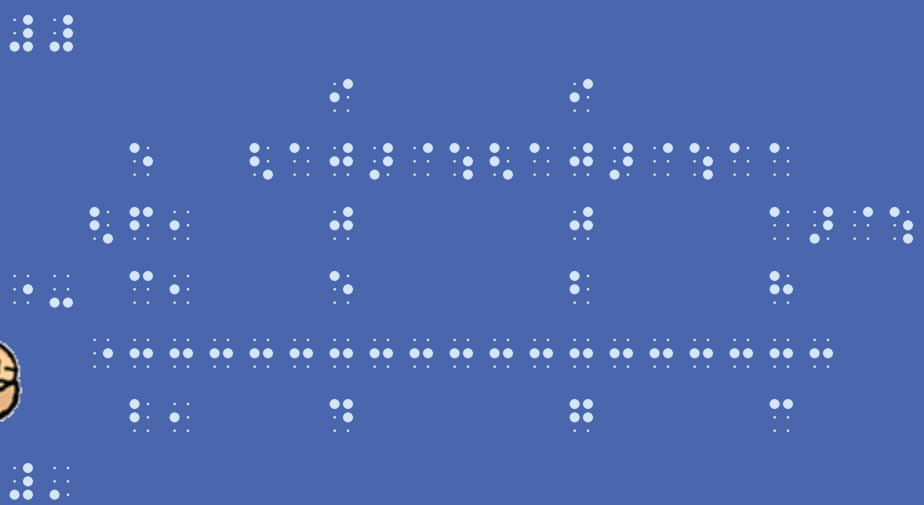


Cancellations in Subtraction Problem Example

$$\begin{array}{r} 9 \quad 9 \\ 5 \quad \cancel{10} \quad \cancel{10} \quad 11 \\ \cancel{6}, \cancel{0} \cancel{0} \cancel{1} \\ - 3,528 \\ \hline 2,473 \end{array}$$



Although it is tempting to use a single big ol' cancellation for the second addend, we should do as print does (and as is mathematically logical) and cancel each number separately, using separate "line through previous item" symbols.





Tiny Numbers

Advice:

Insert the tiny number on the line above, and leave columns blank as necessary to let the increased number be two digits long

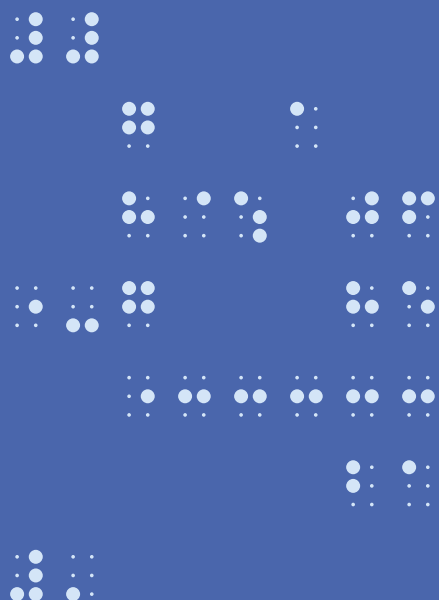
When print uses a tiny number to increase the value of a number by a power of ten (e.g., in “borrowing”) place that number on the line above the number whose value it increases, and align digits by place value.

A lack of :: can tell the reader that the number above is meant to combine with and not replace the number below.





Tiny Numbers in Cancellation Example



$$\begin{array}{r} 7 \\ \cancel{8}^1 0 \ 6 \\ -7 \ 8 \ 5 \\ \hline 2 \ 1 \end{array}$$

A Tiny Bit Different:

Tiny Numbers “Carryover” Example from GTM 4.1.5

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

There are two kinds of tiny numbers happening here. The uppermost 1 increases the value of the 2 by a power of 10, making it 12. The 1 just above the separation line, is one more number to subtract in the tens column.

$$\begin{array}{r} 5 \quad ^1 1 \\ - 2 \quad ^1 6 \\ \hline 2 \quad 5 \end{array}$$



National Braille Assoc.



Multiplication

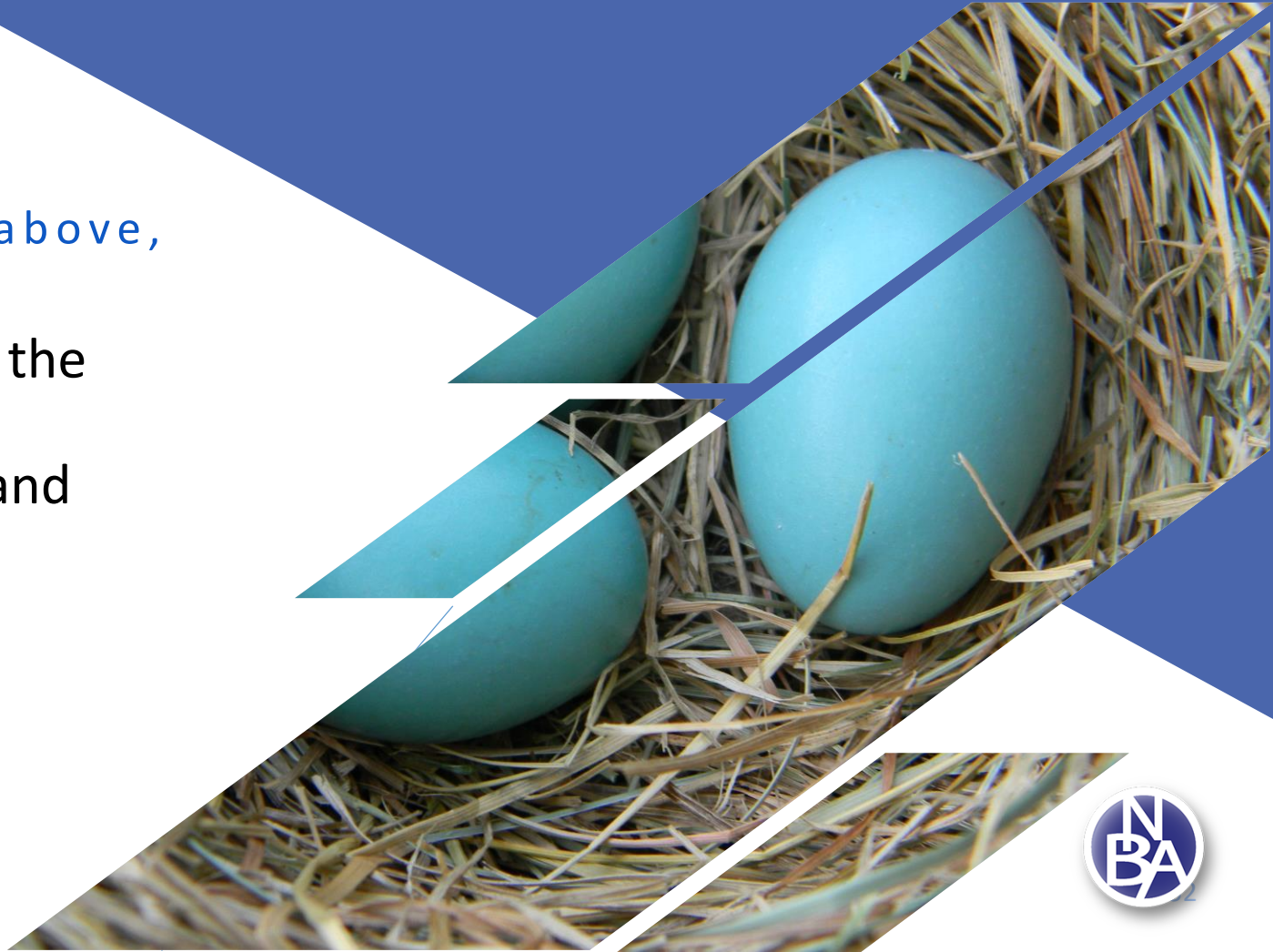


Tiny Numbers

Advice:

Insert the tiny number on the line above,
and align columns for calculation

When print uses a tiny number to show the
tens value of a two-digit product being
carried, place that number one line up and
within the column to the left of the
multipliers that generated it.



Tiny Numbers in Multiplication

Carryover Examples

$$\begin{array}{r}
 1 \\
 1. \quad 12 \\
 \times 9 \\
 \hline
 108
 \end{array}$$

$$\begin{array}{r}
 2 \\
 2. \quad 14 \\
 \times 16 \\
 \hline
 84 \\
 14 \\
 \hline
 224
 \end{array}$$



Separation Line Length Within Multiplication

Advice:

It is okay for separation lines in a multiplication problem to be different lengths

The first separation line should be as long as the first line below it, and the second separation line should be as long as the first line below *it*.



Separation Line Length Examples



Separation Line Length Examples (cont.)



Separation Line Length Examples (cont. II)





National Braille Assoc.

Identifier Placement

Identifiers

Advice:

Place the identifiers
where calculation begins

Place identifiers as follows:

- **Addition:** with the augend
- **Subtraction:** with the minuend
- **Multiplication:** with the multiplicand
- **Division:** with the divisor and dividend



Illustrations of Identifier Placement





National Braille Assoc.



Square Roots

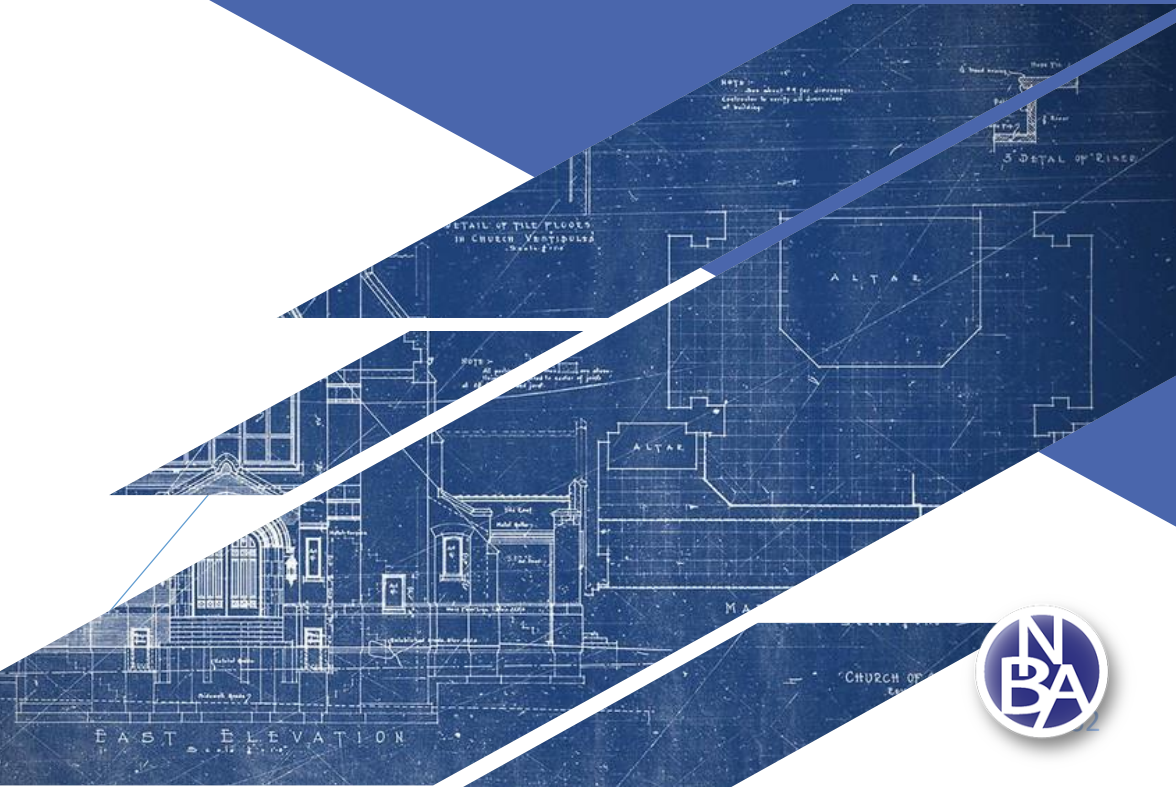


Square Root

Advice:

Follow print for a spatially arranged square root problem

Although square root problems are rarely presented or calculated spatially, if the root appears over the vinculum of the radical, follow print.





National Braille Assoc.

Summaries

Summary of Advice

- Use a numeric passage for a series of spatial problems
- Repeat individual numeric indicators for each question number, even within a numeric passage
- For shapes that indicate omission: for one single shape, follow print; for multiple shapes, use visible spaces
- Use consistent spacing after identifiers and between problems
- In single-digit addition problems, let the column above dot 5 be empty
- Place “tiny numbers” in a place appropriate to the calculation they indicate
- Place operation symbols consistently
- For division, use a numeric passage, and position operation symbols relative to the calculation to which they belong
- For cancellation in subtraction problems use ⠈⠈, and align digits as in print
- It is okay for horizontal lines in a multiplication problem to differ in length
- Place identifiers on the braille line where calculation begins (augend, minuend, multiplicand, dividend)
- For a spatially arranged square root, follow print

Summary of Rules

- Above and below each spatial calculation the braille line should be either blank or contain only $\cdot\cdot\cdot\cdot$ or $\cdot\cdot\cdot\cdot$
- Columns to be added should only contain numerals or omission symbols
- An individual numeric indicator can be followed by a space and still turn on numeric mode
- For sum lines and other horizontal lines, use horizontal line mode $\cdot\cdot\cdot\cdot$
- Horizontal lines (e.g., sum lines) are as wide as the longest item to which they apply
- For division, braille a spaced vertical line segment for a curved or straight printed line



National Braille Assoc.

Thank you!



Kyle DeJute



kdejute@nationalbraille.org



www.nationalbraille.org