Spatial Arrangement

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Focus

- when is spatial arrangement used
- spatial arrangement in addition
- spatial arrangement in subtraction
- spatial arrangement in multiplication
- spatial arrangement in division
- cancellation in spatial arrangement
- formatting in spatial arrangement

When Is Spatial Arrangement Used?

Spatial arrangement is required with material arrayed on more than one line in print, as in addition, subtraction, multiplication, division, and matrices.

$$\begin{array}{r} {\scriptstyle 1} \\ 54 \\ +\ 76 \\ \hline 130 \end{array}$$

$$\begin{array}{r} {\scriptstyle 9} \\ {\scriptstyle 2\ \cancel{10}\ 13} \\ \cancel{3}\ \cancel{0}\ \cancel{3} \\ -\ 1\ 9\ 5 \\ \hline 1\ 0\ 8 \end{array}$$

$$\begin{array}{r} 345 \\ \times\ \ 25 \\ \hline 1725 \\ 690 \\ \hline 2415 \end{array}$$

$$\begin{array}{r} 98 \\ \hline 2\overline{)197} \\ 18 \\ \hline 17 \\ 16 \\ \hline 1 \end{array}$$

$$\begin{bmatrix} \cos a & \sin a & 0 \\ -\sin a & \cos a & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Rules for Spatial Arrangements

Rules: GTM 4.1

- The line above and below spatial calculations should either be blank or should only contain the numeric passage indicator ⠼⠼ or terminator ⠼⠼.
- Align numeric indicators vertically.
- Columns to be added should only contain numerals or omission symbols.
- Use the numeric passage indicator and the numeric terminator for a series of spatial problems
- 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

Blank lines with Spatial Arrangements

- One blank line must be left above and below a spatial arrangement, even when it directly precedes or follows the line indicating a new ink-print page.
- If a running head is used, a blank line must be left between it and the spatial arrangement.
- No blank line is required if the spatial arrangement begins at the top or ends at the bottom of the braille page if a running head is not used.

NOTE: The blank line can be replaced with the numeric passage indicator ⠼⠼ or terminator ⠼⠼

Numeric Passage Indicator and Numeric Terminator (1)

⠼ Numeric Passage Indicator

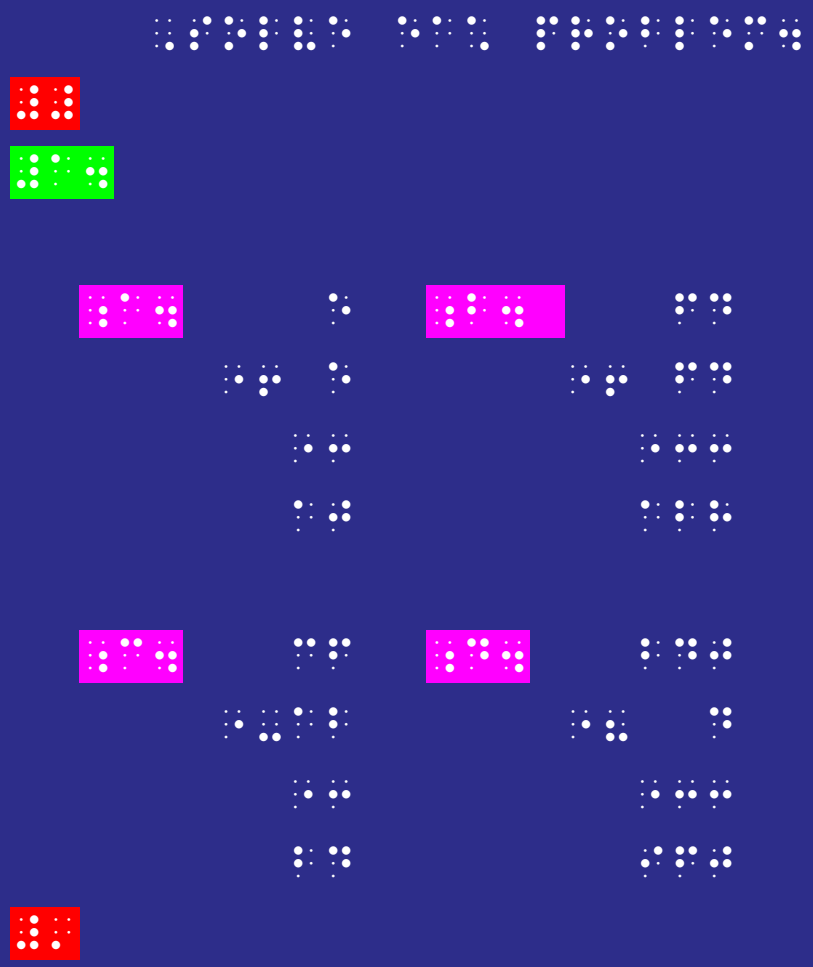
⠼ Numeric Terminator Indicator

Numeric Passage and Numeric Terminator (2)

- Use a numeric passage and terminator for a series of spatial problems.
- Numeric passage indicator set numeric mode and grade 1 mode for the enclosed text.
- Numeric indicator followed by a space still initiates numeric mode.
- Repeat individual numeric indicators for each question number, even within a numeric passage.
- In a numeric passage, any lowercase letter a to j is preceded by a grade 1 indicator

Note: Use of numeric passage reduces the number of symbols needed for a spatial problem.

Numeric Passage and Numeric Terminator (3)



Solve each problem.

1.

a. 5
+ 5
10

b. 64
+ 64
128

c. 36
-12
24

d. 240
x 4
960

Spatial Arrangements: Addition and Subtraction

Spatial Arrangement: Addition and Subtraction (1)

In a spatial arrangement for addition and subtraction:

- use horizontal line mode ⠐⠒⠒⠒ where horizontal lines are shown in print.
- The numeric symbols, the corresponding digits, commas, decimal points, fractions, abbreviations, and interior signs of operation or comparison must be vertically aligned with digits under digits, commas under commas, decimal points under decimal points, fractions under fractions, abbreviations under abbreviations, signs of operation under signs of operation, signs of comparison under signs of comparison.
- For single-digit addition or subtraction problems in a numeric passage, begin the horizontal line one cell to the right of the signs of operation 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.

Spatial Arrangements: Addition and Subtraction (2)

1. 8
   -3
   5

2. $15.44
   + 3.22
   $18.66

3. 7x+14y- 3z
   - 4x- 4y+20z
   3x+10y+17z

Spatial Arrangements: Addition and Subtraction (3)

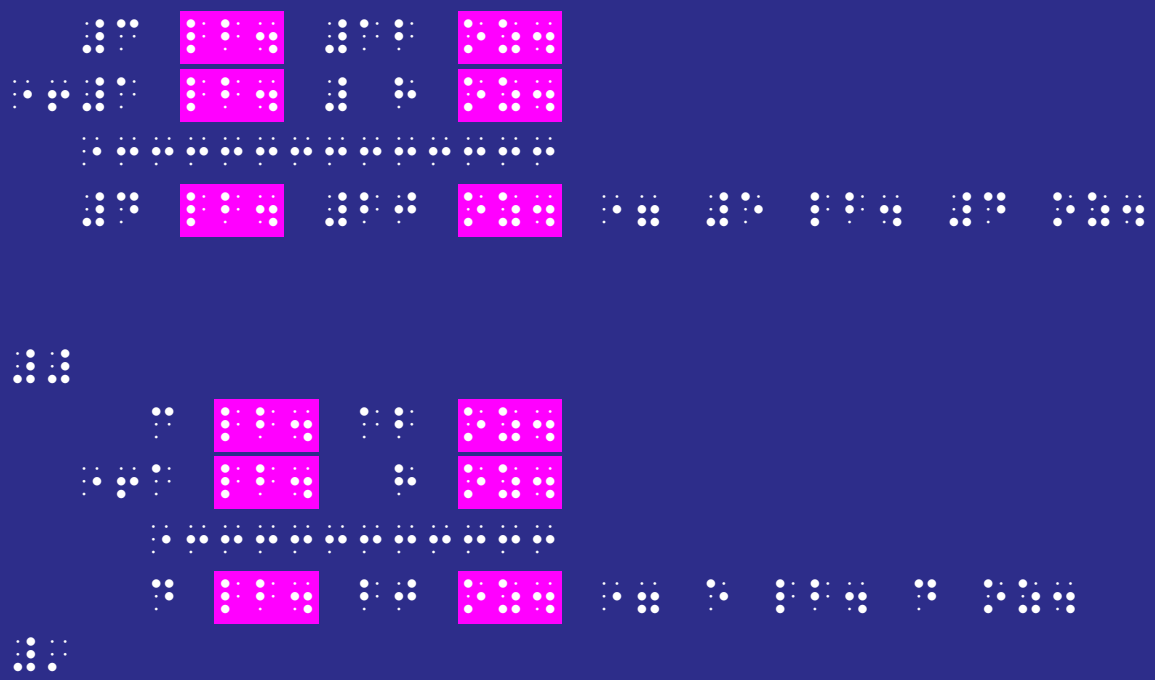
1. 8
   -3
   5

2. $15.44
   + 3.22
   $18.66

3. 7x+14y- 3z
   - 4x- 4y+20z
   3x+10y+17z

Addition and Subtraction containing Abbreviations

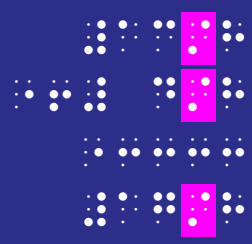
- When abbreviations occur in spatially arranged addition and subtraction, they are vertically aligned.



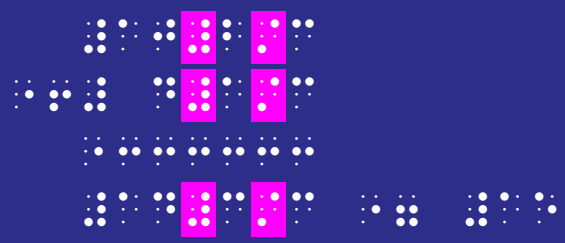
```
  3 lb. 12 oz.
+ 1 lb.  8 oz.
  4 lb. 20 oz. = 5 lb. 4 oz.
```

Addition and Subtraction containing Fractions

- In a spatial addition or subtraction arrangement containing simple fractions, the simple numeric fraction lines must be vertically aligned.
- The corresponding parts of fraction indicators must be vertically aligned.
- The whole number parts of mixed numbers must be vertically aligned.



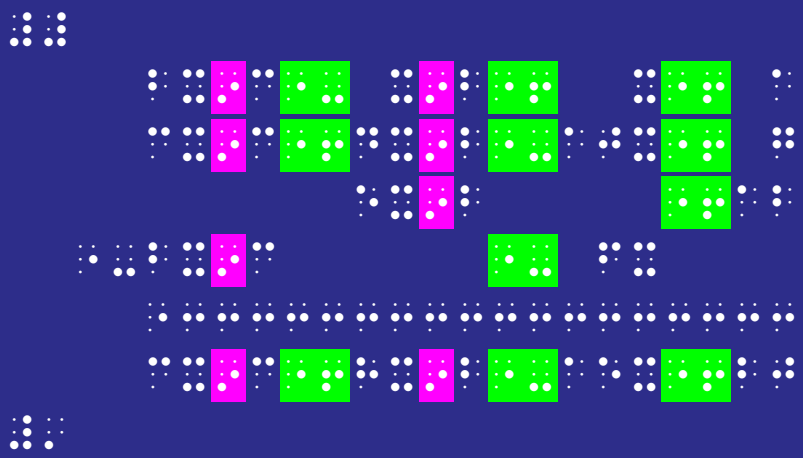
$$\begin{array}{r} \frac{13}{8} \\ +\ \frac{4}{8} \\ \hline \frac{17}{8} \end{array}$$



$$\begin{array}{r} 10\frac{2}{3} \\ +4\frac{1}{3} \\ \hline 14\frac{3}{3} \end{array} = 15$$

Addition and Subtraction in polynomials

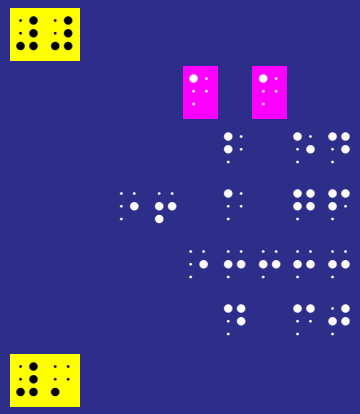
In polynomials arranged spatially for addition or subtraction, each term, including its signs of operation, coefficients, letters, superscript, subscript must be vertically aligned.



$$
\begin{array}{rrrrr}
 & 2x^3 & -\ x^2 & +\ x & +\ 1 \\
 & 3x^3 & +\ 4x^2 & -\ 10x & +\ 7 \\
 & & 5x^2 & & +\ 12 \\
- & 2x^3 & & -\ 6x & \\
\hline
 & 3x^3 & +\ 8x^2 & -\ 15x & +\ 20
\end{array}
$$

Carried numbers with Addition [4.1.5]

- When print uses a tiny number to "carry" a value, place that carried number on the line above the column to which it belongs and align by place value.
- the number then becomes one more entry to be added within that column.



$$\begin{array}{r} {\scriptstyle 1\ 1} \\ 254 \\ +\ 176 \\ \hline 430 \end{array}$$

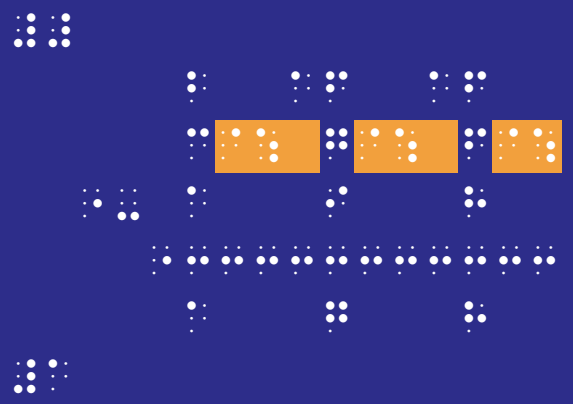
Cancellation in Subtraction Problem [4.1.6] (1)

⠨⠨⠨⠨ Line through previous item

- Use "line through previous item" ⠨⠨ for cancellation
- "Line through previous item" ⠨⠨ is shown after the affected term.
- When using the "line through previous item" ⠨⠨ indicator to reproduce print's crossing out (usually for "borrowing" in subtraction), use braille grouping indicators as necessary.
- Align digits as in print
- The carried number is aligned over its cancelled number by place value.

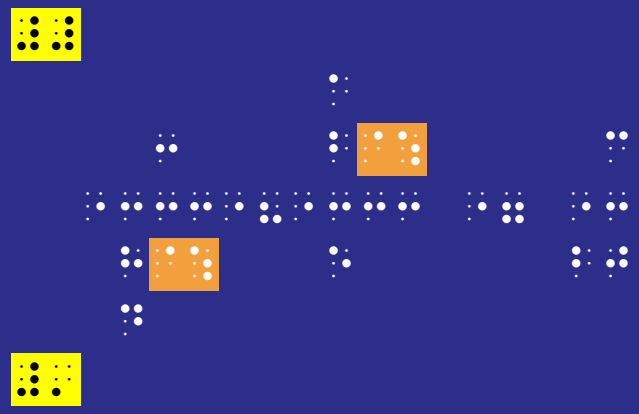
Cancellation in Subtraction Problem [4.1.6]

⠹⠛⠊⠝⠑ Line through previous item



	2	16	16
	~~3~~	~~7~~	~~6~~
–	1	9	8
	1	7	8

Cancellation in Fractions [4.1.6]



$$\frac{3}{\cancel{8}_{4}} \times \frac{\cancel{2}^{1}}{5} = \frac{3}{20}$$

Omission (1)

Omission (2)

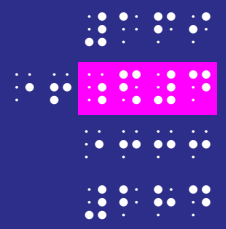
- For shapes that indicate omission:
  - If there is one shape (e.g., a rectangle or a square), follow print.
  - If there are multiple shaped omission (e.g., an empty rectangle for each of the missing digits), use the visible space symbol.

For non-shape omissions (e.g. asterisks etc):

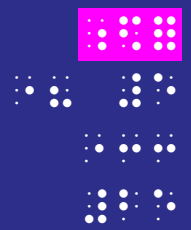
- As a guiding principle, **if print alignment can be reasonably reproduced** in braille, then follow print for the sign used to indicate omission. **If print alignment cannot be reasonably reproduced** in braille, use a visible space for each printed object that indicates omission.

Omission (3)

Single omission shape, follow print with appropriate braille symbol.



$$\begin{array}{r} 169 \\ +\ \square \\ \hline 284 \end{array}$$

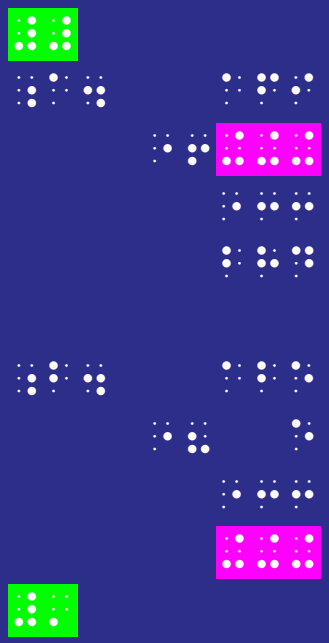


$$\begin{array}{r} \bigcirc \\ \times\ 5 \\ \hline 25 \end{array}$$

Omission (4)

⠐⠛⠐ Visible space symbol

Use the visible space symbol ⠐ for each of the missing digits shown by a shape.

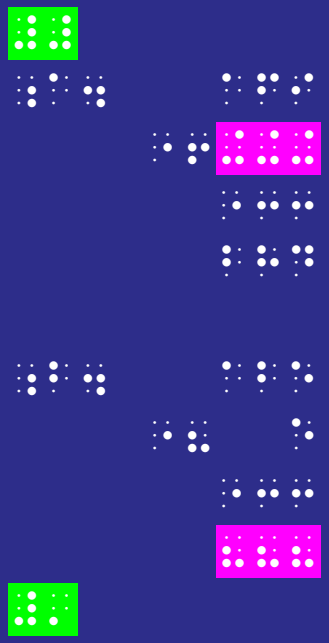


a.
```
  1 6 9
+ ■ ■ ■
-------
  2 8 4
```

b.
```
  1 2 5
x     5
-------
  ○○○
```

Omission (5)

Use the visible space symbol ⠀ for each of the missing digits shown by a non-shape omission.



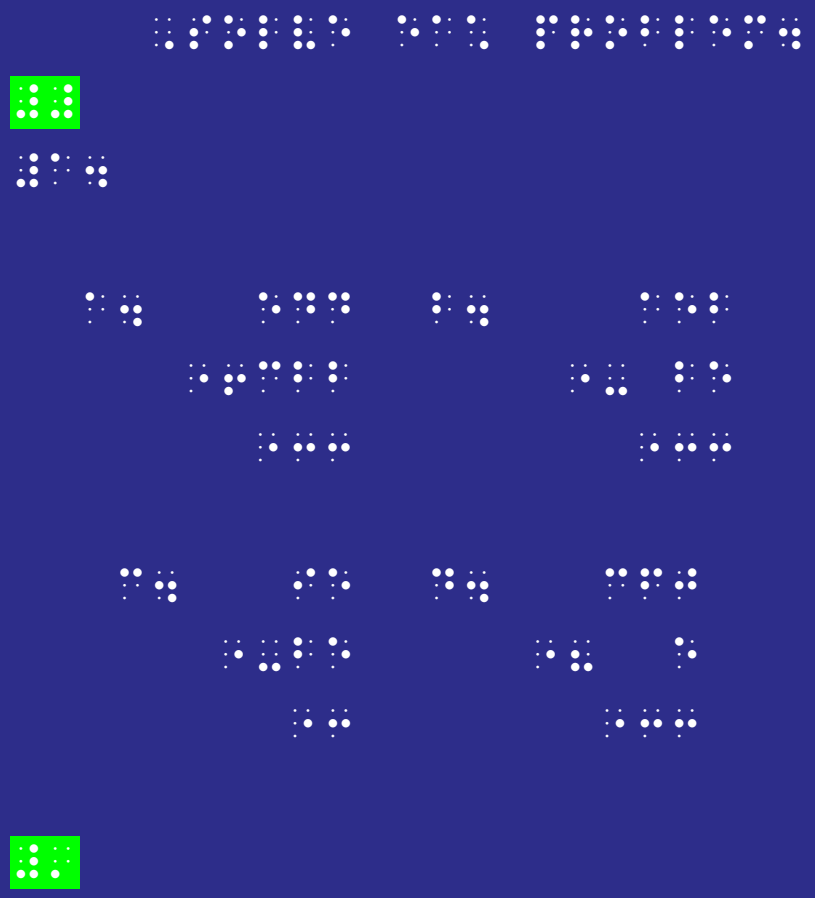
```
a.   1 6 9
   + * * *
   -------
     2 8 4
```

```
b.  1 2 5
    x   5
   -------
     ???
```

Blank for Missing Answer

An expression with blank space to indicate a missing sum, quotient, product, difference, etc. does not need a visible space.

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



Solve each problem.

1.

a. 544
+322

b. 152
- 25

c. 95
-25

d. 360
x 5

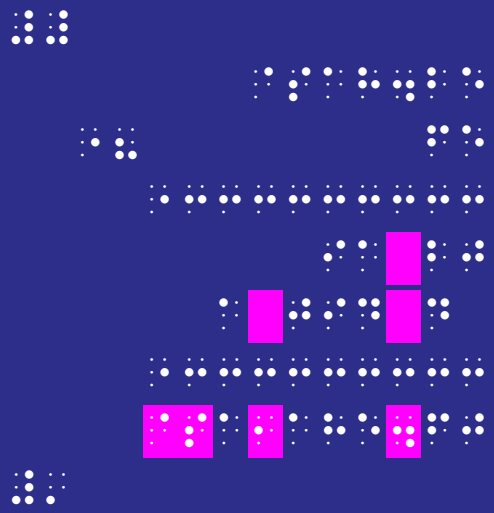
Spatial Arrangement: Multiplication (1)

Spatial Arrangement: Multiplication (2)

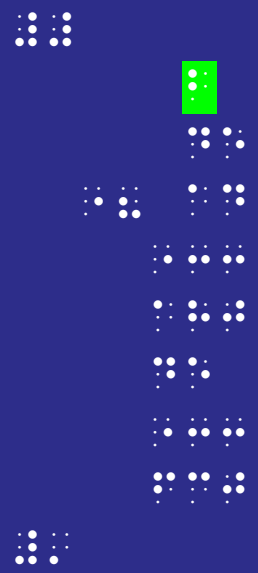
- Separation lines in a multiplication problem can be of different lengths.
- If a comma or a decimal point appears in the answer of a multiplication arrangement, the corresponding cells in the partial products above it should be left blank.
- When print uses a tiny number to show the tens value of a two-digit product being carried, insert the tiny number on the line above, and align columns for calculation.

Multiplication (3)

	$18.25
x	65
	9120
	10944
	$1,185.60



Multiplication (4)



```
  2
  45
x 14
 180

 45
 630
```

Spatial Arrangement: Division

Spatial Arrangement: Division [4.1.3]

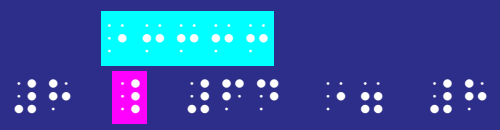
- Use a numeric passage for spatial long division.
- The spaced vertical line segment ⠇ can be used to represent the curved or straight line used in print.
- The dividend and the partial products and differences must be aligned as in print. The quotient must also be aligned with the dividend.
- Separation lines in a division problem can be of different lengths.
- When commas, decimal points, or carets occur in a dividend, corresponding blank cells should be left throughout the body of the division, except in the separation line

Spatial Arrangement: Division

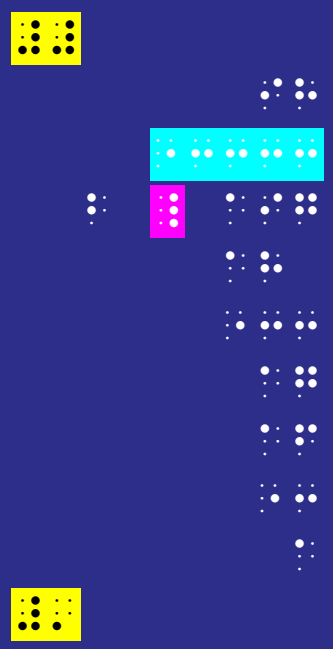
⠸⠸⠸ Vertical line segment

⠸⠸⠸⠤⠤⠤⠤⠤ horizontal line mode

8)64 = 8



```
   98
2)197
  18
   17
   16
    1
```



Matrices (1)

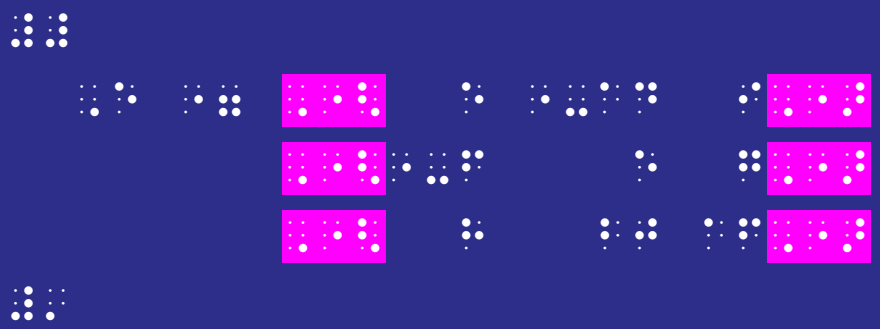
Matrices (2)

- Multi-line grouping symbols are used in braille for enlarged grouping signs in print.
- Within each arrangement, each entry must be left-justified except for minus sign.
- 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.

Matrices (3)

⠸⠸⠸⠸ Big (multi-line) opening round parenthesis
⠸⠸⠸⠸ Big (multi-line) closing round parenthesis

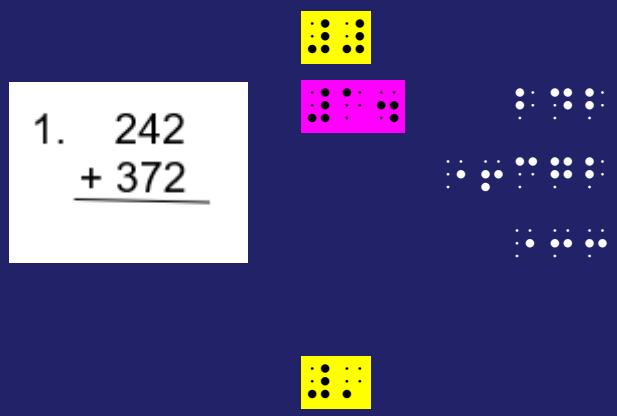
$$E = \begin{pmatrix} 5 & -14 & 9 \\ -6 & 5 & 7 \\ 8 & 20 & 16 \end{pmatrix}$$

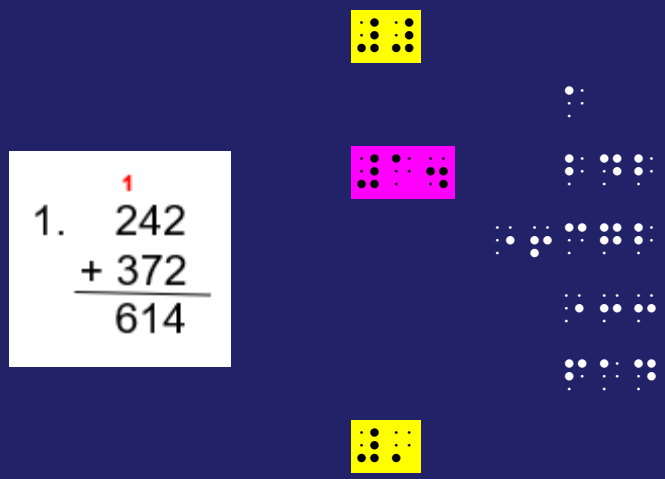


Formats

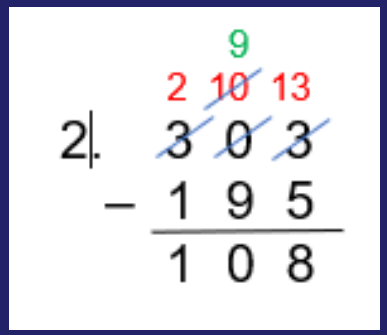
- Place identifiers as follows:
  - Addition: with the augend
  - Subtraction: with the minuend
  - Multiplication: with the multiplicand
  - Division: with the divisor and dividend
- In all cases, there must be one column of blank cells between the identifier and the left-most symbol of the arrangement including separation lines.

Identifier Placement (1)



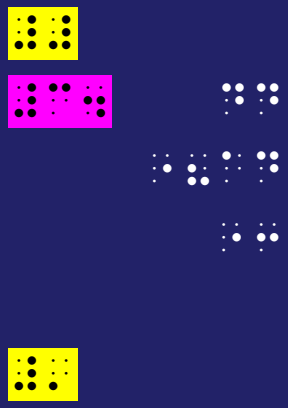


Identifier Placement (2)



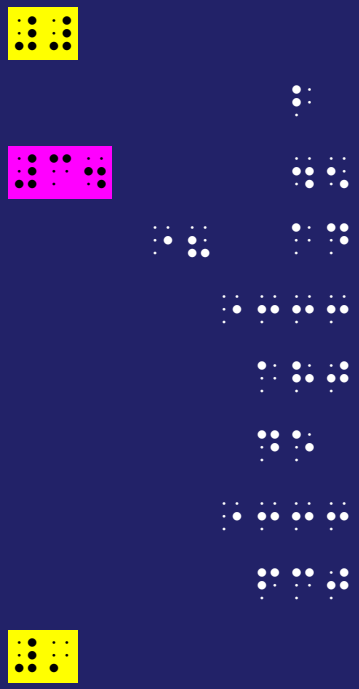
Identifier Placement (3)

3. 45
x 14



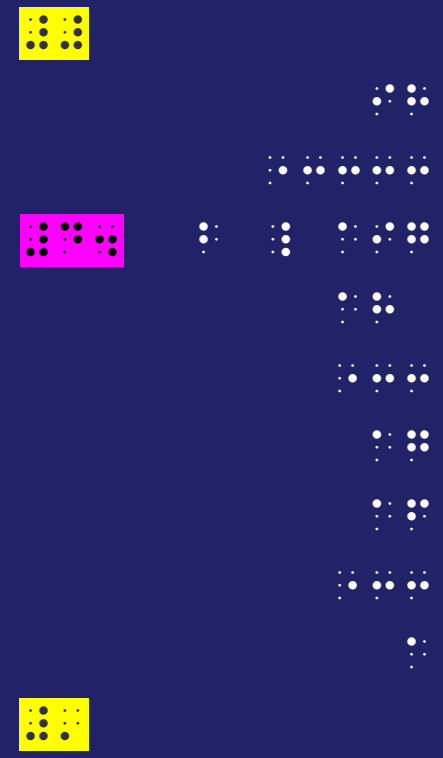
2
3. 45
x 14
180

45
630



Identifier Placement (4)

4. 2)197



```
      98
4. 2)197
     18
      17
      16
       1
```

Summary (1)

- Above and below each spatial arrangement the braille line should be either blank or contain only ⠒⠒ or ⠒⠐.
- Use a numeric passage for a series of spatial problems.
- Repeat individual numeric indicators for each question number, even within a numeric passage.
- Columns to be added or subtracted should only contain numerals or omission symbols.
- An individual numeric indicator can be followed by a space and still turn on numeric mode.
- For shapes that indicate omission: for one single shape, follow print; for multiple shapes, use visible spaces.
- In single-digit addition problems, the column above dot 5 should be left empty.

Summary (2)

- For sum lines and other horizontal lines, use horizontal line mode ⠐⠐⠐
- For cancellation in subtraction problems use "line through previous item" indicator ⠐⠐ and align digits as in print.
- For division, use "vertical line segment" indicator ⠐ for a curved or straight printed line.
- Place identifiers on the braille line where calculation begins.

Reference

- UEB Guidelines for Technical Material, 2008 version updated August 2014

Thank you

- You can email us at transcription@prcvi.org.