

Chapter 4: Spatial Arrangements and Number Lines Used in Grades K-6

New Symbols Introduced

⋮⋮⋮⋮ [dots 2-3-5-6, dots 2-3-5-6, dots 2-3-5-6, dots 2-3-5-6] Carried number indicator (length varies; no print equivalent)

⋮⋮⋮⋮ [dots 2-5, dots 2-5, dots 2-5, dots 2-5] Separation line used in spatially aligned addition, subtraction, and multiplication, and division problems as well as in conjunction with the divided into sign (_____)

⋮ [dots 1-3-5] Division sign or divided into ($\overline{)$)

Number line symbols

⋮ [dots 2-4-6] Left-pointing arrowhead

⋮ [dots 2-5] Line (axis line)

⋮ [dots 1-2-3-5] Coordinate scale mark (tick mark)

⋮ [dots 1-3-5] Right-pointing arrowhead

⋮ [dots 1-2-3-4-5-6] Solid or filled-in circle above the number line (point)

New BANA Terms

- **Spatial arrangement:** A math problem that is written vertically (one number over the other) is called a spatial arrangement.

Key Points

- In a vertically aligned problem (spatial arrangement), the **addition** or **subtraction sign** goes one cell to the left of the widest number in the problem.
- A **separation line** is used in a vertically aligned problem. It is one cell longer on the left and one cell longer on the right than the widest part of the problem.

- When brailleing a vertically aligned problem, make a **window** around the problem. This means you leave a blank line above and below the problem and 1-2 blank cells to the left and right of the problem.
- When vertically aligned problems are placed next to each other **in a row**, there must be 1 blank cell (although you may use 2 blank cells) between the separation lines of the problems.
- When brailleing **money** amounts in a vertically aligned problem, align the decimal points. Follow the print for placement of the addition or subtraction sign in relation to the dollar sign.
- In a vertically aligned problem, the **multiplication sign** is placed in the cell immediately to the left of the multiplier (the bottom number of the problem).
- When vertically aligned problems are **numbered**, there must be one cell between the end of the number and the beginning of the separation line.
- **Division problems** are considered spatial when more than the divisor and dividend are shown.
- In a spatially aligned division problem, place the **division sign** between the divisor and dividend. The **separation line** begins above the division sign and extends one cell to the right of the problem.
- The **carried number indicator** does not have a print equivalent. In a vertically aligned problem, it is placed above the top number in the problem and is the same length as the separation line.
- **Number lines** can be created in braille with Nemeth Code symbols using a braillewriter. Leave a blank line above and below a number line.
- On number lines, **numeric indicators** are not used. Numbers must be equally spaced along the axis.

Spatial Arrangements for Addition and Subtraction of Whole Numbers

Students are usually introduced to vertically aligned addition and subtraction problems in kindergarten or first grade. This format is very helpful when students calculate or compute the answer. In Nemeth Code, vertically aligned problems are also called **spatial arrangements**.

Numeric indicators are not used in spatial arrangements, and single line spacing is used throughout the problem, even for young students (Rule II, §11b).

The line under the second addend is called a **separation line**. It is created in Nemeth Code with a line of dots 2-5.

—————
⠠⠠⠠⠠⠠

The separation line extends one cell to the left and one cell to the right of the widest arrangement in the problem (Rule XXIV, §178c).

In the vertically aligned problem, the plus sign is placed one cell to the left of the widest number above the separation line (Rule XXIV, §178c).

Example 4.1 contains an addition problem written vertically, that is going down the page instead of horizontally across a single line. The first addend is directly above the second addend in the problem.

Example 4.1

6
+2
——
⠠⠠⠠⠠⠠
⠠⠠⠠⠠⠠
⠠⠠⠠⠠⠠

When problems are written vertically in print, they are written vertically in Nemeth Code. It is essential that young students learn how to read and write spatially aligned problems as they will see spatially aligned problems in their textbooks and standardized assessments.

Before writing a spatially aligned problem on a braillewriter, it is important to determine in which braille cell each line of the problem will begin.

Example 4.2 contains two subtraction problems in spatial format. Notice that:

- Similar to the plus sign, the minus sign is placed one cell to the left of the widest number in the problem and directly above the separation line (Rule XXIV, §178c).
- In the first problem, the second line of the problem is the widest line in the arrangement. It takes two braille cells to write the minus sign and the digit 3.

- In the second problem, the second line of the problem is also the widest part of the arrangement. It takes two braille cells to write the minus sign and the digit 1.
- In both problems the separation line is 4 cells long. It begins in cell 1.
- In the second problem, the answer is included because it is included in print.

Example 4.2

$$\begin{array}{r} 4 \\ -3 \\ \hline \end{array}$$

$$\begin{array}{r} 7 \\ -1 \\ \hline 6 \end{array}$$

Practice 4.1

Interline the spatially aligned problems.

$$\begin{array}{r} 4 \\ -3 \\ \hline \end{array}$$

$$\begin{array}{r} 7 \\ -1 \\ \hline 6 \end{array}$$

$$\begin{array}{r} 12 \\ +34 \\ \hline 46 \end{array}$$

$$\begin{array}{r} 12 \\ +34 \\ \hline 46 \end{array}$$

$$\begin{array}{r} 12 \\ +34 \\ \hline 46 \end{array}$$

$$\begin{array}{r} 12 \\ +34 \\ \hline 46 \end{array}$$

Use your braillewriter to write the spatially aligned problems.

$$\begin{array}{r} 8 \\ -3 \\ \hline \end{array}$$

$$\begin{array}{r} 2 \\ -1 \\ \hline \end{array}$$

$$\begin{array}{r} 4 \\ +4 \\ \hline \end{array}$$

$$\begin{array}{r} 9 \\ +5 \\ \hline \end{array}$$

$$\begin{array}{r} 3 \\ -2 \\ \hline \end{array}$$

$$\begin{array}{r} 7 \\ +6 \\ \hline \end{array}$$

By the time students finish fourth grade, they should be able to efficiently add and subtract multi-digit whole numbers (Common Core State Standards Initiative, 2010). Example 4.3 contains an addition problem with a two-digit addend. Notice that:

- The plus sign is placed one cell to the left of the widest number in the problem, 10.
- The first line of the problem begins in cell 3, and the second line of the problem begins in cell 2.
- The separation line begins in cell 1.

Example 4.3

$$\begin{array}{r} 10 \\ +5 \\ \hline \end{array}$$

Example 4.4 contains five multi-digit addition and subtraction problems. Notice that:

- The numbers in each problem are aligned according to their place value.
- When a comma is included within a number in print, a mathematical comma is included within the number in braille.
- There is a blank line above and below each problem.

Example 4.4

$$\begin{array}{r} 47 \\ 20 \\ +13 \\ \hline \end{array}$$

$$\begin{array}{r} 46 \\ +18 \\ \hline \end{array}$$

$$\begin{array}{r} 295 \\ - 63 \\ \hline \end{array}$$

$$\begin{array}{r} 2,000 \\ - 62 \\ \hline \end{array}$$

$$\begin{array}{r} 89,105 \\ + 3,289 \\ \hline \end{array}$$

For addition and subtraction problems written in spatial format, the answer is written below the separation line. The digits in the answer must be aligned with the digits in the numbers above the separation line.

Example 4.5 contains two examples in which the answer is included with the problem.

Example 4.5

$$\begin{array}{r} 814 \\ - 25 \\ \hline 789 \end{array}$$

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

$$\begin{array}{r} 7 \\ 9 \\ +2 \\ \hline 18 \end{array}$$

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

Practice 4.2

Interline the spatially aligned problems.

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

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

$$\begin{array}{r}
 12345 \\
 6789 \\
 \hline
 19123456789
 \end{array}$$

$$\begin{array}{r}
 123456789 \\
 101112131415 \\
 \hline
 223456789101112131415
 \end{array}$$

$$\begin{array}{r}
 123 \\
 456 \\
 \hline
 579 \\
 1011
 \end{array}$$

Use your braillewriter to write the problems in spatial format.

$$\begin{array}{r}
 17 \\
 4 \\
 \hline
 +9
 \end{array}$$

$$\begin{array}{r}
 56 \\
 \hline
 +21
 \end{array}$$

$$\begin{array}{r}
 2,376 \\
 \hline
 - 63
 \end{array}$$

$$\begin{array}{r}
 100,000 \\
 \hline
 - 20,000
 \end{array}$$

When vertically aligned problems are placed side-by-side in print, there must be at least one blank cell between the separation lines in braille (Rule XXV, §185c). For some students, it is easier to read the problems when there are two blank cells between the separation lines. There should always be a blank line above and below spatially aligned problems (Rule XXV, §185).

Teaching Tip: Spatially aligned problems have a “window” around them. This means there is a blank line above and below the problem.

If more than one spatially aligned problem is on the same line, there must be at least one blank cell between the problems.

Example 4.6 includes a row of three spatially aligned problems transcribed in two different ways. The first transcription includes one blank cell between the separation lines. The second transcription includes two blank cells between the separation lines.

Example 4.6

$$\begin{array}{r} 4 \\ -2 \\ \hline \end{array} \qquad \begin{array}{r} 10 \\ -3 \\ \hline \end{array} \qquad \begin{array}{r} 12 \\ -6 \\ \hline \end{array}$$

Practice 4.3

Interline the spatially aligned problems.

Use your braillewriter to write the problems in spatial format. Leave one blank line between the problems. You may elect to use 1 or 2 blank cells between separation lines.

$$\begin{array}{r} 19 \\ -7 \\ \hline \end{array} \qquad \begin{array}{r} 78 \\ -3 \\ \hline \end{array} \qquad \begin{array}{r} 8 \\ -6 \\ \hline \end{array}$$

$$\begin{array}{r} 289 \\ - 5 \\ \hline \end{array} \quad \begin{array}{r} 39 \\ -16 \\ \hline \end{array} \quad \begin{array}{r} 46 \\ - 0 \\ \hline \end{array}$$

Spatial Arrangements When the Problems are Numbered

Math worksheets and tests problems are often numbered. You must take care when numbering a spatially aligned problem because you must leave a “window” around the problem. In addition to the blank line before and after each problem and a blank cell between the problems, there must be one blank cell between the end of each problem number and the start of the separation line (Rule XXV, §185c).

It may be easier for some students to read numbered spatially aligned problems if you leave two blank cells between the problems. In Example 4.7 notice there are two blank cells between the problems.

Example 4.7

$$\begin{array}{r} 1 \\ \dots \\ 289 \\ - 5 \\ \hline \end{array} \quad \begin{array}{r} 2 \\ \dots \\ 39 \\ -16 \\ \hline \end{array} \quad \begin{array}{r} 3 \\ \dots \\ 46 \\ - 0 \\ \hline \end{array} \quad \begin{array}{r} 4 \\ \dots \\ 5 \\ - 6 \\ \hline \end{array}$$

$$\begin{array}{r} 1 \\ \dots \\ 289 \\ - 5 \\ \hline \end{array} \quad \begin{array}{r} 2 \\ \dots \\ 39 \\ -16 \\ \hline \end{array} \quad \begin{array}{r} 3 \\ \dots \\ 46 \\ - 0 \\ \hline \end{array} \quad \begin{array}{r} 4 \\ \dots \\ 5 \\ - 6 \\ \hline \end{array}$$

Practice 4.4

Interline the spatially aligned problems.

$$\begin{array}{r} 1 \\ \dots \\ 289 \\ - 5 \\ \hline \end{array} \quad \begin{array}{r} 2 \\ \dots \\ 39 \\ -16 \\ \hline \end{array} \quad \begin{array}{r} 3 \\ \dots \\ 46 \\ - 0 \\ \hline \end{array} \quad \begin{array}{r} 4 \\ \dots \\ 5 \\ - 6 \\ \hline \end{array}$$

$$\begin{array}{r} 1 \\ \dots \\ 289 \\ - 5 \\ \hline \end{array} \quad \begin{array}{r} 2 \\ \dots \\ 39 \\ -16 \\ \hline \end{array} \quad \begin{array}{r} 3 \\ \dots \\ 46 \\ - 0 \\ \hline \end{array} \quad \begin{array}{r} 4 \\ \dots \\ 5 \\ - 6 \\ \hline \end{array}$$

Use your braillewriter to write the problems in spatial format. Leave one blank line between the rows of problems. There should also be one blank cell between the problem number and the start of each separation line. In addition, you may elect to use 1 or 2 blank cells between each separation line and the next problem number.

$ \begin{array}{r} 91 \\ 1. \quad 4 \\ \hline +13 \\ \hline \end{array} $	$ \begin{array}{r} 112 \\ 2. \quad 35 \\ \hline +36 \\ \hline \end{array} $
$ \begin{array}{r} 8,900 \\ 3. \quad + \quad 35 \\ \hline \end{array} $	$ \begin{array}{r} 397 \\ 4. \quad - \quad 40 \\ \hline \end{array} $

Spatially Aligned Problems that Include Money

Students will continue to read and write math problems that are vertically aligned throughout the elementary grades. In review, vertically aligned problems are called spatial arrangements in the Nemeth Code. Numeric indicators are not used in spatial arrangements, and single line spacing is used throughout the problem (Rule II, §11b).

In addition to spatial arrangements that include addition and subtraction of whole numbers, students need to learn how to read and write spatial arrangements that include decimals, money, fractions, and mixed numbers. Fractions and mixed numbers are introduced in Chapter 5.

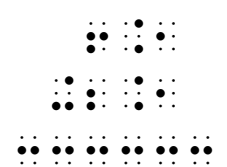
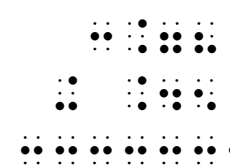
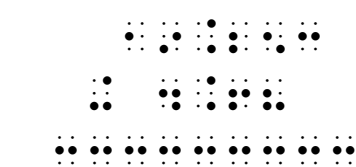
Example 4.8 includes three vertical addition problems. The first addend is written directly above the second addend in each problem. This includes the decimal point.

Furthermore, the plus sign is placed one cell to the left of the widest number above the separation line in the arrangement (Rule XXIV, §178c).

Example 4.8 contains three problems that are side-by-side in print. They are also side-by-side in braille since they will all fit on a line. When the same number of problems can be accommodated on a single braille line, it is often helpful to do so. This will sometimes make it easier and quicker for the student participating in a general education math class to locate a specified problem.

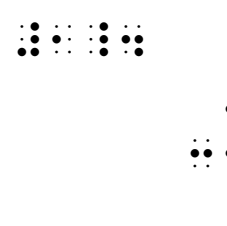
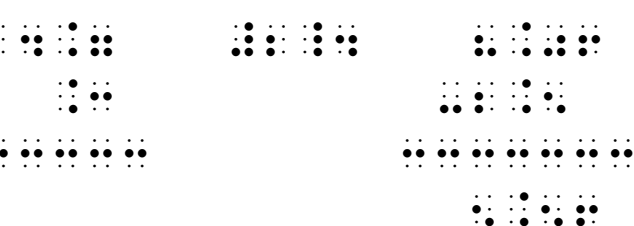
In all three problems the decimal points are aligned in print and therefore are aligned in braille.

Example 4.8

$\begin{array}{r} 6.1 \\ +2.1 \\ \hline \end{array}$	$\begin{array}{r} 3.78 \\ +.45 \\ \hline \end{array}$	$\begin{array}{r} 19.253 \\ + 4.68 \\ \hline \end{array}$
		

Example 4.9 contains two subtraction problems in spatial format. The answer is included in the second problem because it is included in print. The problems are numbered in print, so they are numbered in braille. The decimal points are aligned. Leave one blank cell between the problem number and the start of the separation line (Rule XXV, §185b).

Example 4.9

$1. \begin{array}{r} 14.7 \\ - .3 \\ \hline \end{array}$	$2. \begin{array}{r} 8.06 \\ -2.5 \\ \hline 5.56 \end{array}$
	

In a spatially aligned problem, the plus or minus sign should normally be placed one cell to the left of the widest number above the separation line in the arrangement (Rule XXIV, S178b). However, when a dollar sign is also included, the placement of the plus or minus sign may follow print (Rule XXIV, S178b).

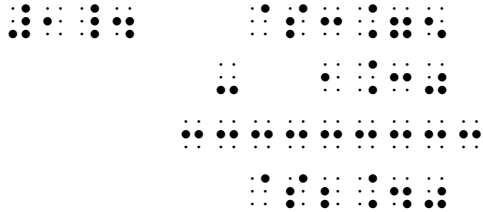
See Example 4.10 below for three examples containing a dollar sign. In the first problem, the minus sign is placed to the left of the dollar sign in print and braille.

In the second problem, the minus sign is placed directly below the dollar sign in print and braille. Notice the minus sign is placed below the second cell of the dollar sign. In both of these problems the answer is included in print, so the answer is included in braille.

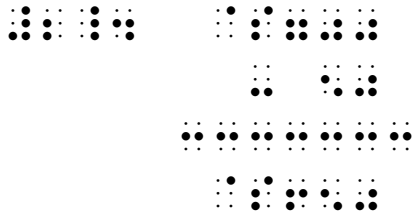
In the third problem, the plus sign is placed to the left of the dollar sign in print and braille.

Example 4.10

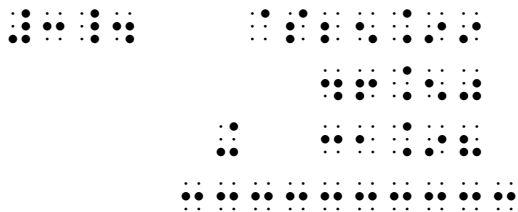
$$\begin{array}{r} \$3.75 \\ 1. - 1.30 \\ \hline \$2.40 \end{array}$$



$$\begin{array}{r} \$700 \\ 2. - 50 \\ \hline \$650 \end{array}$$

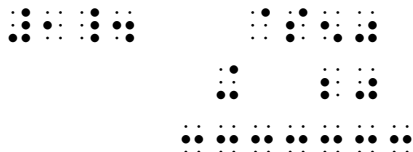


$$\begin{array}{r} \$25.99 \\ 3. 46.50 \\ + 31.98 \\ \hline \end{array}$$



Practice 4.5

Interline the spatially aligned problems.



$$\begin{array}{r} 45 \\ 23 \\ \hline 68 \end{array}$$

$$\begin{array}{r} 12 \\ 34 \\ \hline 46 \end{array}$$

$$\begin{array}{r} 123 \\ 456 \\ \hline 579 \end{array}$$

Use your braillewriter to write the problems in spatial format. Leave one blank line between the problems.

1.
$$\begin{array}{r} \$49.63 \\ - 36.91 \\ \hline \end{array}$$

2.
$$\begin{array}{r} 8.6 \\ +3.4 \\ \hline \end{array}$$

3.
$$\begin{array}{r} \$751 \\ - 80 \\ \hline \end{array}$$

4.
$$\begin{array}{r} \$67.96 \\ + 3.12 \\ \hline \end{array}$$

Spatial Arrangements for Multiplication Problems

Students are introduced to vertically aligned multiplication problems in third grade (Common Core State Standards Initiative, 2010). When the problems are vertically aligned in print, they should be vertically aligned in braille.

The following rules for spatial addition and subtraction problems are the same for spatial multiplication problems.

- When vertically aligned problems are placed side-by-side in print, there must be at least one blank cell between the separation lines in braille (Rule XXV, §185c).
- There should always be a blank line above and below spatially aligned problems (Rule XXV, §185).
- If the sign of operation is included in print, then it is included in braille.
- The separation line extends one cell to the left and one cell to the right of the overall width of the arrangement (Rule XXIV, §179c).

The primary difference between multiplication problems and addition and subtraction problems is the placement of the multiplication sign. It is placed one cell to the left of the multiplier, regardless of the length of the multiplicand (top number) and multiplier (bottom number) (Rule XXIV, §179b).

When a product is included for a multiplication problem the length of the separation line is adjusted to accommodate the product. The separation line must still extend one cell to the left and one cell to the right of the widest part of the problem.

Example 4.11 contains five spatially arranged multiplication problems. Pay special attention to where the multiplication sign is placed in each problem. Also, notice that there are two blank cells between the separation lines. In the fourth problem, notice that the answer has been included in print. Thus, the answer is included in the braille.

Example 4.11

3	6824	87
×5	×12	× 9
⏟	⏟	⏟
⠠⠠⠠	⠠⠠⠠⠠	⠠⠠
⠠⠠⠠	⠠⠠⠠⠠	⠠⠠⠠
⠠⠠⠠⠠⠠	⠠⠠⠠⠠⠠⠠	⠠⠠⠠⠠⠠

$$\begin{array}{r} 4.9 \\ \times 8 \\ \hline 39.2 \end{array}$$

$$\begin{array}{r} \$25.00 \\ \times 18 \\ \hline \end{array}$$

Spatial Arrangements for Division Problems

In a division problem, the **dividend** is the number that is being divided, and the **divisor** is the number that the dividend is being divided by. The **quotient** is the answer to the division problem.

The following example is a division problem. It is not considered to be in spatial format as it only includes the divisor and dividend, comprised only of numerals. Therefore, a numeric indicator is placed before the divisor (Rule XXIV, §180c).

Example 4.12

$$6 \overline{)18}$$

A division problem is considered to be in spatial format when more than the divisor and dividend are shown (Rule XXIV, §180c). When braille problems as a spatial arrangement, a blank line is left above and below the problem unless the problem is the last item on the page.

No numeric indicators are used in a spatially arranged division problem.

The division sign is made with the dots 1-3-5. Place the divisor in the far left, followed by the division sign, and then the dividend.

$$\overline{) \quad \text{(curved division sign)}}$$

$$\overline{) \quad \text{(curved division sign on left, separation line above)}}$$

Practice 4.6

Interline the spatially aligned problems.

$$\begin{array}{r}
 12345 \\
 6789 \\
 101112 \\
 13141516 \\
 17181920 \\
 21222324
 \end{array}$$

$$\begin{array}{r}
 12345 \\
 6789 \\
 101112 \\
 13141516 \\
 17181920 \\
 21222324
 \end{array}$$

$$\begin{array}{r}
 12345 \\
 6789 \\
 101112 \\
 13141516 \\
 17181920 \\
 21222324
 \end{array}$$

$$\begin{array}{r}
 12345 \\
 6789 \\
 101112 \\
 13141516 \\
 17181920 \\
 21222324
 \end{array}$$

$$\begin{array}{r}
 12345 \\
 6789 \\
 101112 \\
 13141516 \\
 17181920 \\
 21222324
 \end{array}$$

$$\begin{array}{r}
 12345 \\
 6789 \\
 101112 \\
 13141516 \\
 17181920 \\
 21222324
 \end{array}$$

Use your braillewriter to write the problems in spatial format. Leave one blank line between the rows of problems. There should also be one blank cell between the problem number and the start of each separation line.

$$1. \begin{array}{r} 32 \\ 3 \overline{)96} \end{array}$$

$$2. \begin{array}{r} 126 \\ 9 \overline{)1,134} \end{array}$$

$$3. \begin{array}{r} 825 \\ \times 11 \\ \hline 9075 \end{array}$$

$$4. \begin{array}{r} 64 \\ \times 12 \\ \hline \end{array}$$

$$5. \begin{array}{r} 91 \\ 5 \overline{)455} \\ \underline{45} \\ 5 \\ \underline{5} \\ 0 \end{array}$$

Carried Number Indicator

Carried numbers, more commonly called **renamed numbers**, are sometimes used in spatially arranged addition problems. Renamed numbers are typically introduced in Grade 3.

The **carried number indicator** is created in Nemeth Code with a line of dots 2-3-5-6. It has the same length as the separation line (Rule XXIV, §178d). There is no print equivalent for a carried number indicator.

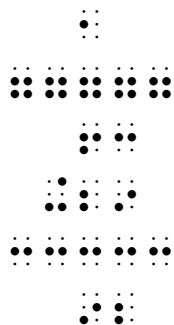
⠠⠠⠠⠠

Carried number indicator

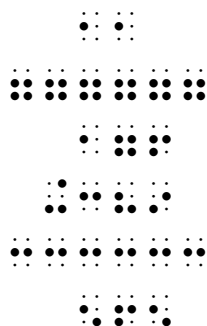
In Example 4.16, a carried number indicator is used above the first addend in both problems.

Example 4.16

$$\begin{array}{r} 1 \\ 63 \\ +29 \\ \hline 92 \end{array}$$



11
176
+389
565



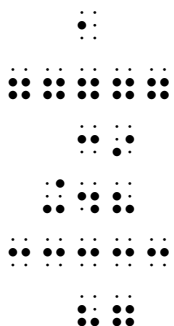
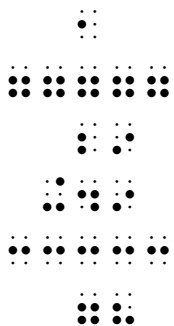
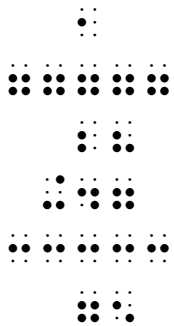
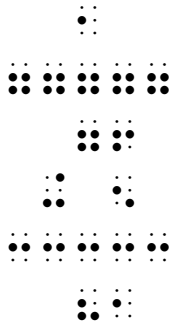
Teaching Tip: Students are usually introduced to the carried number indicator as they may see this symbol in their textbooks, especially in examples. They are taught how to read this symbol as well as the purpose of the indicator, but not necessarily how to write it on a braillewriter.

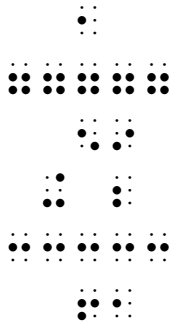
Teaching Tip: Although students will use a variety of tools when completing math problems, it is essential that the braillewriter be introduced as a calculation tool when they are introduced to spatially arranged problems (Research and Development Institute, 2006).

Teaching Tip: Students are usually allowed to do the computation on their braillewriter without strictly adhering to all of the Nemeth Code rules and formatting (Research and Development Institute, 2006). This allows them to focus on the math and speed up the process of using the braillewriter as a calculation tool.

Practice 4.7

Interline the problems.





Number Lines

Students are usually introduced to number lines created on a braillewriter with Nemeth Code symbols in fourth grade (BANA, 2010). The following Nemeth Code symbols are used to create number lines:

⠠⠠⠠ (dots 2-4-6) left-pointing arrowhead

⠠⠠ (dots 2-5) line (axis line)

⠠⠠⠠⠠ (dots 1-2-3-5) coordinate scale mark

⠠⠠⠠ (dots 1-3-5) right-pointing arrowhead

⠠⠠⠠⠠⠠⠠ (dots 1-2-3-4-5-6) solid, filled-in, or closed circle (point included)

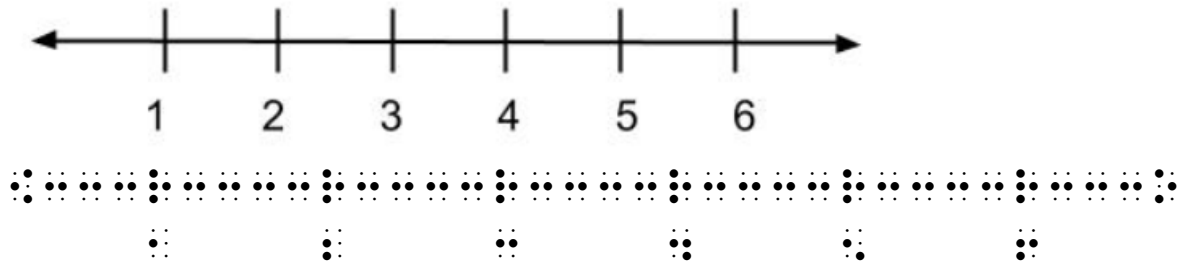
Number lines are considered a spatial arrangement (BANA, 2010). Similar to spatially aligned problems, number lines are preceded and followed by a blank line.

Scale marks, sometimes called hash marks or tick marks, are labeled below the number line using Nemeth Code numbers without numeric indicators. If arrowheads are included in the print number line, then include them on braille number lines.

The axis line between the scale marks can vary in length, but once the length between the first two scale marks is decided on, the same length of axis line should be used between the other scale marks on the same number line.

Example 4.17 includes a number line with scale marks labeled from 1 to 6. Notice that numeric indicators are not used, and the units on the number line are equally spaced.

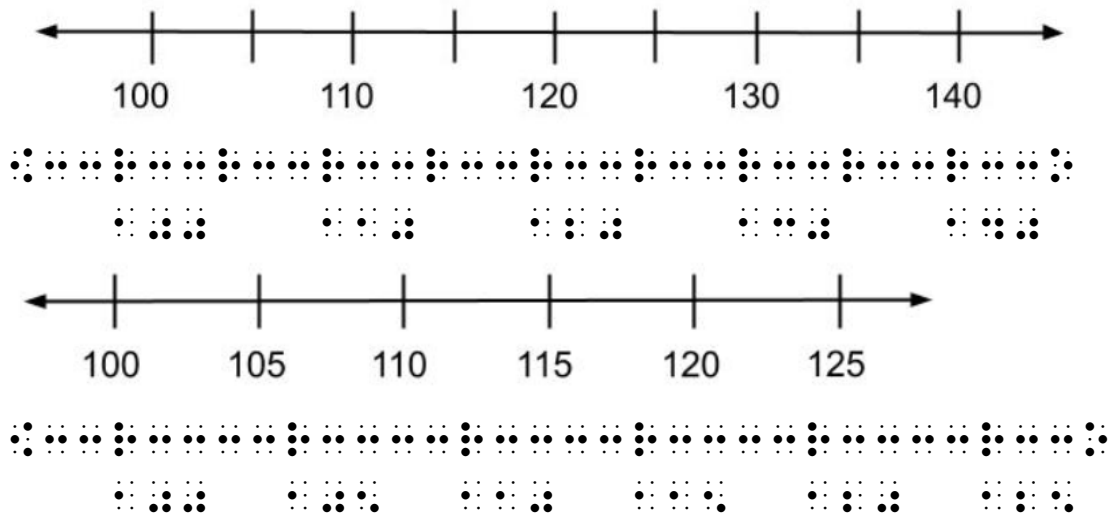
Example 4.17



Sometimes number lines include larger numbers that will not fit on the number line. You can either omit alternate labels while keeping the coordinate markers or increase the length of space between units.

Example 4.18 includes two number lines with labeled scale marks. The first number line includes alternate labels from 100 to 140, and the second number line from 100 to 125 includes an increased length of space between the units. Both versions are correct.

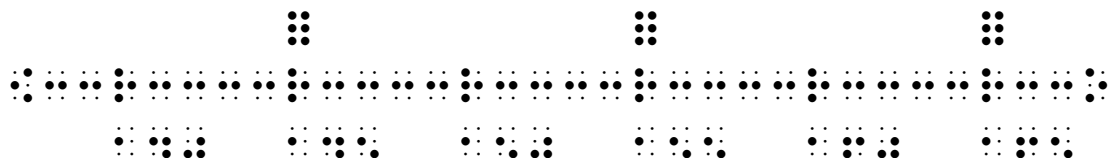
Example 4.18



The closed circle is placed directly above a specific location on the number line in order to plot a point. This could be directly above a scale mark or somewhere in between two scale marks. Example 4.19 includes a number line with points plotted at 145, 155, and 165.

Example 4.19





Practice 4.8

Recreate the four number lines in Examples 4.16, 4.17, and 4.18.

Chapter Summary

Spatial Arrangements

- When problems are written vertically in print, they are written vertically in Nemeth Code.
- There should always be a blank line above and below spatially aligned problems (Rule XXV, §185).
- Numeric indicators are not used in spatial arrangements, and single line spacing is used throughout the problem, even for young students (Rule II, §11b).
- The separation line extends one cell to the left and one cell to the right of the widest arrangement in the problem (Rule XXIV, §178c).
- When transcribing vertically aligned numbered problems, leave a blank cell between the problem number and the beginning of the separation line (Rule XXV, §185b).
- When vertically aligned problems are placed side-by-side in print, there must be at least one blank cell between the separation lines in braille (Rule XXV, §185c).
- Leave two blank cells between the end of a separation line and the following problem number (Rule XXV, §185c).
- The plus or minus sign is placed one cell to the left of the widest number above the separation line in the arrangement (Rule XXIV, §178c).
- The multiplication sign is placed one cell to the left of the multiplier, regardless of the length of the multiplicand and multiplier (Rule XXIV, §179b).
- A division problem is considered to be in spatial format when more than the divisor and dividend are shown (Rule XXIV, §180c).
- Place the division sign immediately before the dividend (Rule XXIV, §180b).
- The carried number indicator has the same length as the separation line (Rule XXIV, §178d).

Number Lines

- Students are usually introduced to number lines created on a braillewriter with Nemeth Code symbols in fourth grade (*Tactile Graphics*, 6.5.1.12; *Tactile Graphics*, 6.5.1.13).
- Number lines are preceded and followed by a blank line (*Tactile Graphics*, 6.5.1.2).
- If arrowheads are included in the print number line, then include them on braille number lines (*Tactile Graphics*, 6.5.1.3).
- Do not use numeric indicators on number lines (*Tactile Graphics*, 6.5.1.1).

Chapter 4: Answer Key

Answer 4.1

8

-4

9

+1

6

-5

7

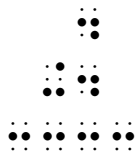
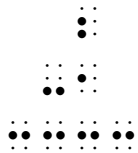
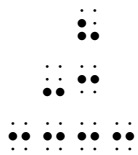
-6

8

+2

1

+3



Answer 4.2 (continued)

$$\begin{array}{r} 12 \\ + 12 \\ \hline 24 \end{array}$$

$$\begin{array}{r} 1234 \\ + 1234 \\ \hline 2468 \end{array}$$

$$\begin{array}{r} 123456 \\ + 123456 \\ \hline 246912 \end{array}$$

Answer 4.3

$$\begin{array}{r} 18 \\ - 3 \\ \hline \end{array} \quad \begin{array}{r} 6 \\ - 4 \\ \hline \end{array} \quad \begin{array}{r} 5 \\ + 9 \\ \hline \end{array}$$

$$\begin{array}{r} 788 \\ + 14 \\ \hline \end{array} \quad \begin{array}{r} 68 \\ - 3 \\ \hline \end{array} \quad \begin{array}{r} 12 \\ + 15 \\ \hline \end{array}$$

$$\begin{array}{r} 12 \\ + 12 \\ \hline 24 \end{array} \quad \begin{array}{r} 6 \\ - 4 \\ \hline 2 \end{array} \quad \begin{array}{r} 5 \\ + 9 \\ \hline 14 \end{array}$$

$$\begin{array}{r} 1234 \\ + 1234 \\ \hline 2468 \end{array} \quad \begin{array}{r} 68 \\ - 3 \\ \hline 65 \end{array} \quad \begin{array}{r} 12 \\ + 15 \\ \hline 27 \end{array}$$

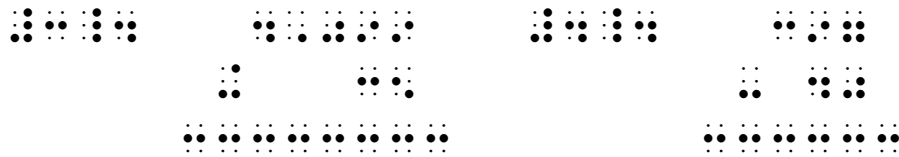
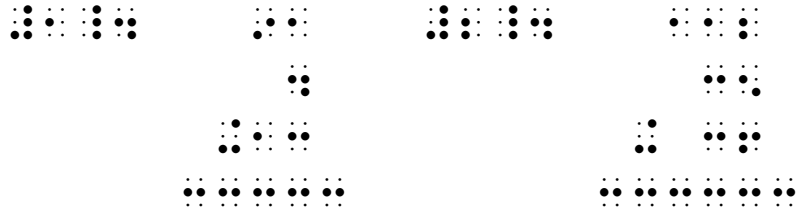
Answer 4.4

$$1. \begin{array}{r} 36 \\ - 29 \\ \hline \end{array} \quad 2. \begin{array}{r} 21 \\ + 88 \\ \hline \end{array}$$

Answer 4.4 (continued)

3.
$$\begin{array}{r} 807 \\ + 64 \\ \hline \end{array}$$

4.
$$\begin{array}{r} 4,847 \\ - 795 \\ \hline \end{array}$$



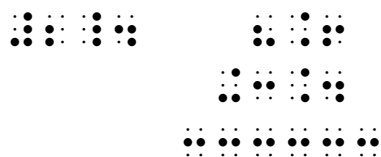
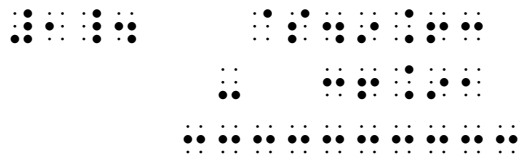
Answer 4.5

1.
$$\begin{array}{r} \$50 \\ + 20 \\ \hline \end{array}$$

2.
$$\begin{array}{r} \$2.12 \\ - .23 \\ \hline \end{array}$$

3.
$$\begin{array}{r} \$7.98 \\ - 5.73 \\ \hline \end{array}$$

4.
$$\begin{array}{r} \$.46 \\ 17.03 \\ + 2.99 \\ \hline \end{array}$$



Answer 4.5 (continued)

$$\begin{array}{r} 1234 \\ \times 56 \\ \hline 7404 \\ 74040 \\ \hline 69984 \end{array}$$

$$\begin{array}{r} 1234 \\ \times 5678 \\ \hline 9876 \\ 76543 \\ 543210 \\ 432100 \\ \hline 7006632 \end{array}$$

Answer 4.6

$$1. \begin{array}{r} 27 \\ \times 3 \\ \hline 81 \end{array}$$

$$2. \begin{array}{r} 35.8 \\ \times 6 \\ \hline 214.8 \end{array}$$

$$3. \begin{array}{r} \$60.25 \\ \times 13 \\ \hline \end{array}$$

$$4. \begin{array}{r} 30 \\ 5 \overline{)150} \end{array}$$

$$5. \begin{array}{r} 124 \\ 2 \overline{)248} \\ \underline{2} \\ 4 \\ \underline{4} \\ 8 \\ \underline{8} \\ 0 \end{array}$$

$$\begin{array}{r} 1234 \\ \times 5678 \\ \hline 9876 \\ 76543 \\ 543210 \\ 432100 \\ \hline 7006632 \end{array}$$

$$\begin{array}{r} 1234 \\ \times 5678 \\ \hline 9876 \\ 76543 \\ 543210 \\ 432100 \\ \hline 7006632 \end{array}$$

