

LESSON 9

- **ARROWS**
 - Construction of Braille Arrows
 - Vertical, Slanted, and Curved Arrow Shafts
 - Boldface and Compounded Arrows
- **INTRODUCTION TO SPATIAL ARRANGEMENTS**
 - Spatial Arrangements with Addition and Subtraction
 - Introduction to Cancellation
 - Arrangement on the Page
 - Placement of Code Switch Indicators

Answers to Practice Material

LESSON PREVIEW

The construction of braille arrows is demonstrated, showing several styles of arrowheads and arrow shafts. Braille format for spatially arranged addition and subtraction problems is studied.

Note: Due to the amount of vertical space used with spatial arrangements, this lesson consumes more pages than most.

ARROWS

[NC Rule 22]

9.1 Arrows Used in Mathematics

Here are some examples of arrows which bear mathematical meaning.

$$\begin{array}{lll} A \rightarrow B & \overrightarrow{PQ} & 2\text{CO} \rightleftharpoons \text{CO}_2 + \text{C} \\ f: a \mapsto b & P \uparrow Q & A \rightarrow B \leftrightarrow C \leftarrow D \end{array}$$

Note that some chemical arrows are constructed differently from math arrows. In a chemistry transcription, the arrows of *Chemical Notation Using the Nemeth Braille Code* should be used.

9.2 Construction of Braille Arrows

The components of an arrow are transcribed in the following order.

- (1) The shape indicator. (See below.)
- (2) The arrow direction, if it must be indicated (vertical or slanted). (Sections [9.9.1](#) and [9.9.2](#).)
- (3) The typeface of the arrow, if it must be indicated. (Section [9.10](#).)
- (4) The left arrowhead or dot, if any. (Sections [9.5](#), [9.7](#), and [9.8](#).)
- (5) The arrow shaft, if required. (Sections [9.4](#) and [9.9](#).)
- (6) The right arrowhead or dot, if any. (Sections [9.4](#), [9.7](#), and [9.8](#).)

An explicit terminator is not necessary.

| |
|--------------------------------------|
| $\ddot{}$ Shape Indicator |
|--------------------------------------|

9.3 Spacing and Punctuation with Arrows

When arrows function as a sign of comparison, the entire construction is spaced according to the rules governing comparison signs. When not functioning as a sign of comparison, an arrow is spaced according to its context. Spacing issues will be illustrated throughout this lesson.

Punctuation associated with an arrow is mathematical.

9.4 Horizontal Arrow Shafts

The length of a shaft is indicated by the number of times the arrow shaft symbol is used. Two braille symbols represent the ordinary shaft length. By comparison, one braille symbol represents a short shaft, and three or more symbols indicate a longer shaft.

| Horizontal Arrow Shafts | | |
|-------------------------|-------------------------|-------|
| ⋯⋯ | Ordinary length, single | — |
| ⋯ | Short, single | - |
| ⋯⋯⋯ | Long, single | —— |
| ⋯⋯ | Ordinary length, double | == |
| ⋯ | Short, double | = |
| ⋯⋯⋯ | Long, double | === |
| ⋯⋯⋯ | Dashed | - - - |
| ⋯⋯⋯ | Dotted | . . . |
| ⋯⋯⋯ | Wavy | ~ |

9.5 Barbed Arrowheads

An arrowhead may be barbed, blunted, straight, or curved, and may occur at the left, at the right, or at both ends of an arrow shaft. An arrowhead may also appear with only its upper or lower barb. First, we will look at barbed arrowheads appearing at the end of a horizontal arrow shaft.

The short line in each image represents the point where the arrow shaft meets the arrowhead.

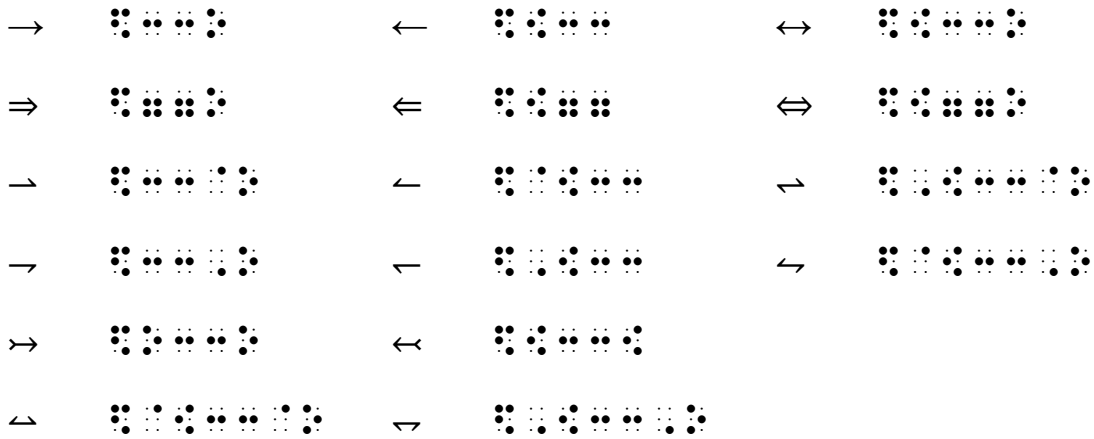
| Barbed Arrowheads | | |
|-------------------|----------------------------|---|
| ⋯ | Full, left pointing | ◀ |
| ⋯ | Full, right pointing | ▶ |
| ⋯ | Lower only, left pointing | ◁ |
| ⋯ | Lower only, right pointing | ▷ |
| ⋯ | Upper only, left pointing | ◁ |
| ⋯ | Upper only, right pointing | ▷ |

Arrowheads printed as a solid triangle are considered to be barbed arrowheads and are transcribed as such.

Many types of arrows can be constructed using the given shaft and arrowhead symbols. Some examples are shown below.

Note: Code switch indicators are omitted in the isolated examples in this section.

Consider the shaft in the barbed arrows shown below to be the standard length for the book. A two-cell "ordinary length" shaft is transcribed. Notice the similarity between the print and braille symbols.



An additional rule may apply to the first arrow shown above. See 9.6.

By comparison, the shafts in the arrows shown below are longer. A three-cell shaft is transcribed.



And, by comparison, the shafts in the arrows shown next are shorter. A one-cell shaft is transcribed.



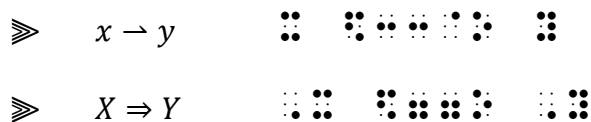
Other shaft styles are illustrated below.

Dashed and dotted

Wavy



a. **Spacing.** Note the spacing before and after these arrows which are functioning as comparison signs.



9.6.1 **Nonuse of the Contracted Form of the Right-Pointing Arrow.** All other right-pointing arrows require the use of the appropriate shaft symbol.

| | | | | | |
|---|------------------------|----|------|----|----|
| ➤ | $X \dashrightarrow Y$ | ⠠⠠ | ⠠⠠ | ⠠⠠ | ⠠⠠ |
| ➤ | $X \rightsquigarrow Y$ | ⠠⠠ | ⠠⠠⠠⠠ | ⠠⠠ | ⠠⠠ |
| ➤ | $X \longrightarrow Y$ | ⠠⠠ | ⠠⠠⠠⠠ | ⠠⠠ | ⠠⠠ |
| ➤ | $X \rightarrow Y$ | ⠠⠠ | ⠠⠠⠠ | ⠠⠠ | ⠠⠠ |

Instructions: Leave one space (one blank cell) between the arrows in A. and B. Assume shafts in items A, C, and D to be of regular length, and in item B to be long. In item D, divide the long expression before the arrow that comes between the double parentheses. Assume all to be in regular type even though they may appear darker.

PRACTICE 9A

Arrows with Barbed Ends

- A. \Leftrightarrow \rightarrow \leftrightarrow \longleftrightarrow \dashrightarrow \rightsquigarrow \rightsquigarrow \rightsquigarrow \rightsquigarrow
- B. \longleftarrow \longleftrightarrow \rightleftarrows \Leftrightarrow
- C. The principal operator of the left formula in Fig. 7.2 is \leftrightarrow , while the principal operator of the right formulas is \rightarrow .
- D. Construct a truth table for $(p \rightarrow (q \rightarrow r)) \rightarrow ((p \rightarrow q) \rightarrow (p \rightarrow r))$.

9.7 Blunted, Straight, and Curved Arrowheads

Here are three other types of arrowheads identified in the Nemeth Code. Examples with a single shaft of ordinary length are shown. The longer horizontal line in each image represents the end of the arrow shaft.

Please disregard the differences in size and line weight in these images.

BLUNTED ARROWHEADS

Each blunted arrowhead can be left or right pointing.

| | | |
|----------------------|---------------------------------------|-----------------------------|
| <p>⠠ Full</p> | <p>⠠⠠⠠⠠</p> <p>⠠⠠⠠⠠</p> <p>⠠⠠⠠⠠⠠⠠</p> | <p>┌</p> <p>┐</p> <p>┌┐</p> |
| <p>⠠⠠ Lower only</p> | <p>⠠⠠⠠⠠</p> <p>⠠⠠⠠⠠⠠⠠</p> | <p>┌</p> <p>┐</p> |
| <p>⠠⠠ Upper only</p> | <p>⠠⠠⠠⠠</p> <p>⠠⠠⠠⠠⠠⠠</p> | <p>└</p> <p>┘</p> |

STRAIGHT ARROWHEADS

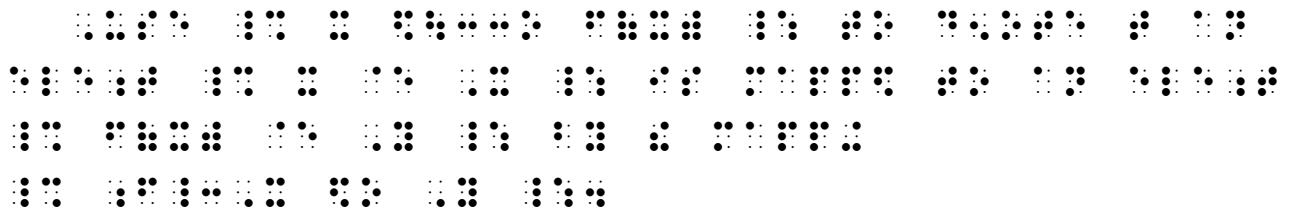
Each straight arrowhead can be left or right pointing.

| | | |
|----------------------|---------------------------------------|-----------------------------|
| <p>⠠ Full</p> | <p>⠠⠠⠠⠠</p> <p>⠠⠠⠠⠠</p> <p>⠠⠠⠠⠠⠠⠠</p> | <p>┆</p> <p>┆</p> <p>┆┆</p> |
| <p>⠠⠠ Lower only</p> | <p>⠠⠠⠠⠠</p> <p>⠠⠠⠠⠠⠠⠠</p> | <p>┆</p> <p>┆</p> |
| <p>⠠⠠ Upper only</p> | <p>⠠⠠⠠⠠</p> <p>⠠⠠⠠⠠⠠⠠</p> | <p>┆</p> <p>┆</p> |

| CURVED ARROWHEADS | | |
|-------------------|----------------------------|----------|
| ⠠⠠ | Full, left pointing | ⠠⠠⠠⠠ ← |
| ⠠⠠ | Full, right pointing | ⠠⠠⠠⠠ → |
| | | ⠠⠠⠠⠠⠠⠠ ↔ |
| ⠠⠠⠠ | Lower only, left pointing | ⠠⠠⠠⠠⠠ ↙ |
| ⠠⠠⠠ | Lower only, right pointing | ⠠⠠⠠⠠⠠ ↘ |
| ⠠⠠⠠ | Upper only, left pointing | ⠠⠠⠠⠠⠠ ↖ |
| ⠠⠠⠠ | Upper only, right pointing | ⠠⠠⠠⠠⠠ ↗ |

Example 9-3

Use $x \mapsto f(x)$ to denote that an element $x \in X$ is mapped to an element $f(x) \in Y$ by the mapping $f: X \rightarrow Y$.



Review 5.7 in Lesson 5 regarding transcription of the colon used in mapping notation.

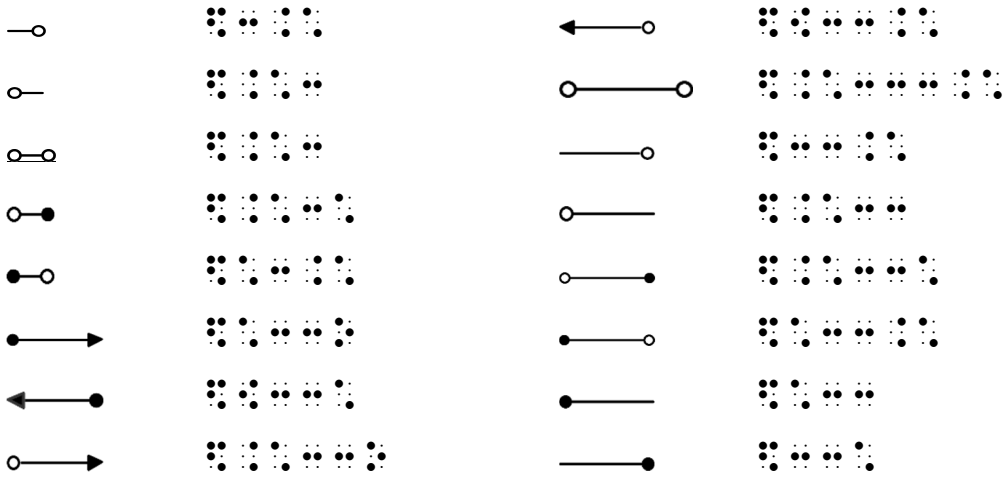
9.8 Arrows with Dotted Ends

Arrows may be represented by a shaft preceded or followed by a solid or hollow dot.

| | | |
|-----|------------|---|
| ⠠⠠ | Solid Dot | • |
| ⠠⠠⠠ | Hollow Dot | ◦ |

Dotted ends are most commonly encountered in geometry and will be illustrated in the lesson on modified expressions. *Note:* Arrow symbols used with graphic number lines are not represented by the braille symbols shown above. Refer to the most recent edition of *Guidelines and Standards for Tactile Graphics* for number line techniques.

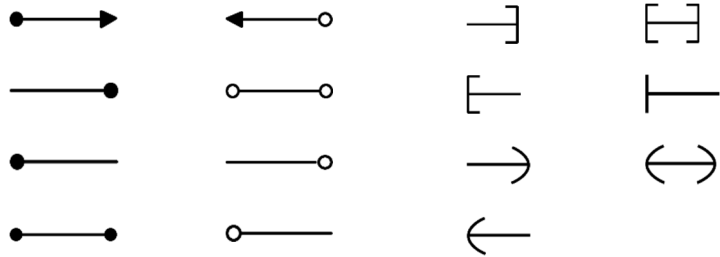
An sample list of arrows with dotted ends is shown on the next page.



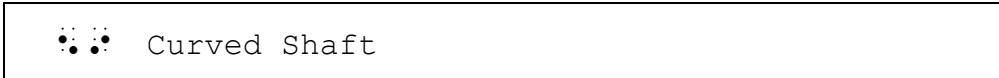
Instructions: Transcribe in four columns, as printed. Assume all shafts are of regular length. Arrowheads printed as a solid triangle are considered to be barbed arrowheads.

PRACTICE 9B

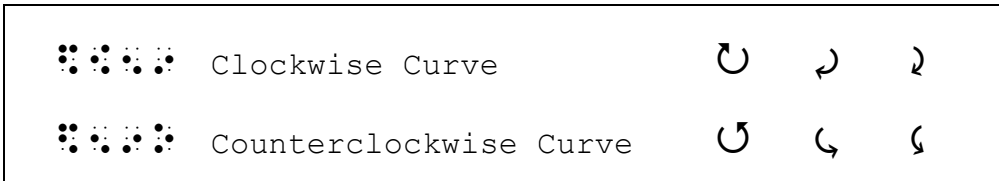
Other Types of Arrowheads



9.9.3 **Curved Arrow Shaft [NC 22.5.1]** Direction indicators are not used with curved arrows. Instead, the curved shaft symbol is used, and the type of arrowhead reveals the direction of curvature.



Rotation direction is indicated as follows. A curved shaft preceded by a *left*-pointing arrowhead represents a clockwise arrow. A curved shaft followed by a *right*-pointing arrowhead represents a counterclockwise arrow.



PRACTICE 9C

Other Types of Arrow Shafts

Vertical



Slanted



Curved



Can you figure out how to construct this spear with a northwest, blunted arrowhead?



Boldface and Compounded Arrows

9.10 Boldface Arrow [NC 22.6]

When an arrow is printed in boldface type and the typeform is determined to be significant and therefore retained, the boldface typeform indicator (dots 456) is incorporated into the structure of the arrow. The typeform indicator is placed at the beginning of the arrow symbol, before the arrowhead or arrow shaft. When a direction indicator is required, the direction indicator is transcribed first, followed by the boldface typeform indicator.

| | | |
|---------|----------------------------------|---|
| ⠠⠠⠠⠠⠠ | Boldface Pointing Right | → |
| ⠠⠠⠠⠠⠠ | Boldface Pointing Left | ← |
| ⠠⠠⠠⠠⠠⠠⠠ | Boldface Pointing Left and Right | ↔ |
| ⠠⠠⠠⠠⠠⠠⠠ | Boldface Pointing Up | ↑ |
| ⠠⠠⠠⠠⠠⠠⠠ | Boldface Pointing Down | ↓ |
| ⠠⠠⠠⠠⠠⠠⠠ | Boldface Pointing Up and Down | ↕ |

Reminder: A right-pointing arrow in nonregular type requires a shaft. The contracted form is not used.

9.11 Arrows Used as Signs of Comparison Compounded Vertically [NC 21.9]

Lesson 5 introduced signs of comparison compounded vertically—two or more simple signs of comparison arranged one under the other in print. When arrows are so arranged, the same principle applies. The combination of symbols becomes a single comparison sign "compounded vertically". The uppermost arrow symbol is transcribed first, immediately followed by and unspaced from the symbol for the lower arrow. Each arrow requires a shape indicator.

When the arrow is part of a sign of comparison compounded vertically, the uncontracted form of the right-pointing arrow is used. The contracted form of the right-pointing arrow is never used in the construction of arrows compounded vertically.

| | | |
|-------|-----------------------------------|---|
| ⠠⠠⠠⠠⠠ | Uncontracted Right-Pointing Arrow | → |
|-------|-----------------------------------|---|

Arrows compounded vertically are most often encountered in the subject of chemistry. When the rules of *Chemical Notation Using the Nemeth Braille Code* are being followed, use the arrow constructions from that code, which differ from the Nemeth symbols.

When arrows compounded vertically are encountered in mathematics, use the constructions shown below. Mathematical arrows which are not shown in this list should be transcribed in accordance with the principle outlined in this section.

| | | |
|-------------|--|---|
| ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ | Pointing Right Over Pointing Left | ↔ |
| ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ | Pointing Left Over Pointing Right | ↔ |
| ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ | Long Pointing Right Over Short Pointing Left | ↔ |
| ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ | Short Pointing Right Over Long Pointing Left | ↔ |
| ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ | Pointing Right, Upper Barb Only Over Pointing Left, Lower Barb Only | ↔ |
| ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ | Pointing Right Over Boldface Pointing Left | ↔ |
| ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ | Boldface Pointing Left Over Pointing Right | ↔ |
| ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ | Boldface Pointing Right Over Boldface Pointing Left | ↔ |

9.12 Arrows Used as Signs of Comparison Compounded Horizontally [NC 21.11]

Lesson 5 also introduced the topic of signs of comparison compounded horizontally. When arrows are arranged side by side, the same principle applies. The combination of symbols becomes a single comparison sign "compounded horizontally". A multipurpose indicator (dot 5) is inserted between the unspaced symbols to indicate that the symbols are printed side by side. Arrows not shown in this list should be transcribed in accordance with this principle.

| | | |
|------------|--|---|
| ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ | Pointing Up Followed by Pointing Down | ↕ |
| ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ | Pointing Down Followed by Pointing Up | ↕ |
| ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ | Pointing Up Followed by Boldface Pointing Down | ↕ |
| ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ | Boldface Pointing Down Followed by Boldface Pointing Up | ↕ |

Arrows compounded horizontally are most often encountered in the subject of chemistry. When the rules of *Chemical Notation Using the Nemeth Braille Code* are being followed, use the arrow constructions from that code, which differ from the Nemeth symbols.

9.13 Nonmathematical Arrows

Nonmathematical arrows should not be used for nonmathematical purposes. Rules and guidelines in BANA publications examine flowchart arrows, arrows in graphic organizer diagrams, lead lines in tactile graphics, etc. Refer to *Guidelines and Standards for Tactile Graphics* for techniques regarding arrows in specific applications such as box-and-whisker plots, clock faces, graphs, line plots, measurement tools, number lines, and spinners.

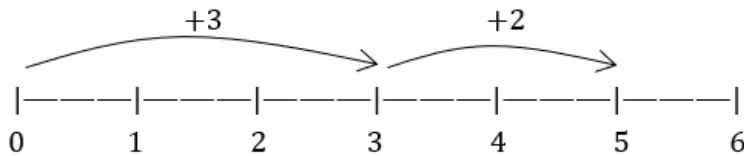
Here are some samples. (Transcriptions are not shown.)

Example 9-6

$$(2x + 3)(x - 5) = 2x^2 - 10x + 3x - 15$$

These "pointing" arrows should be drawn as a raised-line tactile graphic.

Example 9-7



Methods for depicting arrows above number lines are given in *Guidelines and Standards for Tactile Graphics*.

Example 9-8

$$\frac{3}{4} \leftarrow \text{fraction line}$$

The lead line in this diagram could be omitted without a loss of information.

INTRODUCTION TO SPATIAL ARRANGEMENTS

9.14 Background

Up to this point we have looked at mathematical material that is read linearly, from left to right, whether it appears embedded within the narrative or set apart from the text as displayed material. When material is arranged on more than one line in print and there is essential vertical alignment of place values or characters, a spatial arrangement is required in braille. ("Alignment" refers to vertical location in the same column or cell.)

- 9.14.1 **Numeric Indicator.** The numeric indicator is generally not used in arrangements which are aligned for computation. Use of the numeric indicator in certain situations abides by rules particular to that specific focus. This distinction will be clarified as each topic is presented.
- 9.14.2 **Format.** A blank line is required above and below a spatial arrangement. However, transition to a new braille page before beginning or after ending a spatial arrangement takes the place of the required blank line. When no running head is used, a spatial arrangement can begin on line 1 unless a code switch indicator is required at the page turn, or unless the print page number interferes with the alignment. Similarly, a spatial arrangement can end on line 25 unless a Nemeth Code terminator is required or unless the braille page number interferes with the alignment. These exceptions are illustrated later in this lesson.

This lesson teaches rules for the transcription of spatially arranged addition and subtraction problems.

Spatial Arrangements with Addition and Subtraction

The Preliminary Lesson introduced linear problems using the symbol + for plus, – for minus, and = for equals.

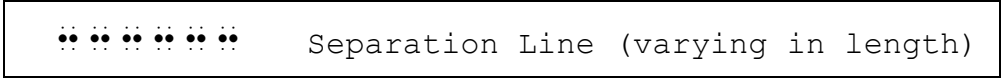
$$\begin{array}{l} \gg 2 + 3 = 5 \quad \dots \dots \dots \dots \dots \\ \gg 7 - 6 = 1 \quad \dots \dots \dots \dots \dots \end{array}$$

When addition and subtraction problems are printed in a vertical arrangement, Nemeth rules for spatial arrangements apply. We will use standard terminology to refer to the parts.

| | | | |
|-----|------------------------|-----|------------------------|
| 2 | <i>addend</i> | 7 | <i>minuend</i> |
| + 3 | <i>addend</i> | - 6 | <i>subtrahend</i> |
| — | <i>separation line</i> | — | <i>separation line</i> |
| 5 | <i>sum</i> | 1 | <i>difference</i> |

9.15 Separation Line

The line printed between the addends and the sum or between the subtrahend and the difference (signifying "equals") is called the "separation line" and is transcribed as a line of dots 25. In braille, the separation line must be made one cell longer at either end than the overall width of the arrangement.



9.16 Alignment with Addition and Subtraction

In spatial arrangements for addition and subtraction, the corresponding digits, commas, and decimal points are vertically aligned one below the other. In other words, digits under digits, commas under commas, decimal points under decimal points.

The Examples Placement of code switch indicators with spatial arrangements is discussed later in this lesson. Assume Nemeth context in these examples. Switch indicators and the blank line before and after each example are not shown.

Example 9-9

| | | | |
|--|---|--|---|
| $\begin{array}{r} 2 \\ +3 \\ \hline 5 \end{array}$ | $\begin{array}{c} \cdot\cdot \\ \cdot\cdot \cdot\cdot \\ \cdot\cdot \cdot\cdot \cdot\cdot \\ \cdot\cdot \cdot\cdot \cdot\cdot \cdot\cdot \\ \cdot\cdot \end{array}$ | $\begin{array}{r} 7 \\ -6 \\ \hline 1 \end{array}$ | $\begin{array}{c} \cdot\cdot \\ \cdot\cdot \cdot\cdot \\ \cdot\cdot \cdot\cdot \cdot\cdot \\ \cdot\cdot \cdot\cdot \cdot\cdot \cdot\cdot \\ \cdot\cdot \end{array}$ |
|--|---|--|---|

Numeric indicators are not used. Digits are aligned by place value, as printed. The separation line extends one cell to the left and one cell to the right of the overall arrangement.

Example 9-10

| | | | |
|--|--|--|--|
| $\begin{array}{r} 2,017 \\ +1,963 \\ \hline 3,980 \end{array}$ | $\begin{array}{c} \cdot\cdot \cdot\cdot \cdot\cdot \cdot\cdot \\ \cdot\cdot \cdot\cdot \cdot\cdot \cdot\cdot \cdot\cdot \\ \cdot\cdot \cdot\cdot \cdot\cdot \cdot\cdot \cdot\cdot \cdot\cdot \\ \cdot\cdot \cdot\cdot \cdot\cdot \cdot\cdot \cdot\cdot \cdot\cdot \end{array}$ | $\begin{array}{r} 7.5 \\ -6.7 \\ \hline 0.8 \end{array}$ | $\begin{array}{c} \cdot\cdot \cdot\cdot \cdot\cdot \\ \cdot\cdot \cdot\cdot \cdot\cdot \cdot\cdot \\ \cdot\cdot \cdot\cdot \cdot\cdot \cdot\cdot \cdot\cdot \\ \cdot\cdot \cdot\cdot \cdot\cdot \cdot\cdot \cdot\cdot \end{array}$ |
|--|--|--|--|

Commas and decimal points are aligned as printed. The separation line extends one cell to the left and one cell to the right of the overall arrangement.

9.16.1 **Intentional Misalignment.** If items have been intentionally misaligned as an exercise for the student, the misalignment is preserved in the transcription. In the next example, the student has been instructed to arrange the digits for proper place value.

Example 9-11

| | |
|--------|---------|
| 25.92 | ⠠⠠⠠⠠ |
| 10.4 | ⠠⠠⠠⠠ |
| +3.796 | ⠠⠠⠠⠠⠠ |
| | ⠠⠠⠠⠠⠠⠠⠠ |

The decimal points are intentionally misaligned. The braille transcription matches the print arrangement.

9.16.2 **Operation Sign is Absent.** The plus sign is not always present in addition problems. If there is no operation sign, examine the surrounding text to determine that this is indeed an addition problem. Then apply alignment rules for addition.

Example 9-12

| | |
|------|--------|
| .36 | ⠠⠠⠠ |
| 7.02 | ⠠⠠⠠⠠ |
| 3.04 | ⠠⠠⠠⠠ |
| | ⠠⠠⠠⠠⠠⠠ |

9.17 Placement of Symbols

9.17.1 **Operation Symbols.** The plus or minus symbol indicating addition or subtraction is placed one column of cells to the left of the leftmost numeric symbol in the part of the arrangement which lies *above* the separation line, regardless of print layout.

Example 9-13

| | | | | | | | | | | | | | | | |
|--|------|----|----|----|--|------|---|----|----|----|----|--|------|--|----|
| <table style="border-collapse: collapse;"> <tr> <td style="padding-right: 20px;">97</td> <td style="text-align: center;">⠠⠠</td> </tr> <tr> <td style="padding-right: 20px;">+1</td> <td style="text-align: center;">⠠⠠</td> </tr> <tr> <td style="border-top: 1px solid black; padding-top: 2px; padding-right: 20px;"></td> <td style="text-align: center;">⠠⠠⠠⠠</td> </tr> </table> | 97 | ⠠⠠ | +1 | ⠠⠠ | | ⠠⠠⠠⠠ | <table style="border-collapse: collapse;"> <tr> <td style="padding-right: 20px;">97</td> <td style="text-align: center;">⠠⠠</td> </tr> <tr> <td style="padding-right: 20px;">+1</td> <td style="text-align: center;">⠠⠠</td> </tr> <tr> <td style="border-top: 1px solid black; padding-top: 2px; padding-right: 20px;"></td> <td style="text-align: center;">⠠⠠⠠⠠</td> </tr> <tr> <td></td> <td style="text-align: center;">⠠⠠</td> </tr> </table> | 97 | ⠠⠠ | +1 | ⠠⠠ | | ⠠⠠⠠⠠ | | ⠠⠠ |
| 97 | ⠠⠠ | | | | | | | | | | | | | | |
| +1 | ⠠⠠ | | | | | | | | | | | | | | |
| | ⠠⠠⠠⠠ | | | | | | | | | | | | | | |
| 97 | ⠠⠠ | | | | | | | | | | | | | | |
| +1 | ⠠⠠ | | | | | | | | | | | | | | |
| | ⠠⠠⠠⠠ | | | | | | | | | | | | | | |
| | ⠠⠠ | | | | | | | | | | | | | | |

The plus sign is printed within the column reserved for the tens place. In braille, the plus sign is placed one column to the left of the leftmost numeric symbol that appears above the separation line.

Example 9-14

$$\begin{array}{r}
 877 \\
 -16 \\
 \hline
 861
 \end{array}$$

The minus sign is printed under the "8" in the minuend. In braille, the minus sign is placed one column to the left of the leftmost numeric symbol that appears above the separation line.

- a. **Considerations Below the Separation Line.** Placement of the operation symbol is in relation to the numeric characters above the separation line. If an answer is printed below the separation line, part of it may fall beneath symbols which appear above the separation line.

Example 9-15

$$\begin{array}{r}
 65 \\
 +56 \\
 \hline
 121
 \end{array}$$

The "ones" and "tens" place values in the sum are aligned with those place values in the addends. Because the plus sign is placed one cell to the left of the "tens" column, the "hundreds" place value in the sum (below the separation line) falls in the same column as the plus sign.

- 9.17.2 **Currency Symbols.** Currency symbols which appear above the separation line must also be similarly placed—that is, one column of cells to the left of the leftmost numeric symbol in the part of the arrangement which lies *above* the separation line. A plus or minus symbol (one cell) aligned below a currency symbol (two cells) is right adjusted in the column.

Example 9-16

$$\begin{array}{r}
 \$.36 \\
 7.02 \\
 +3.04 \\
 \hline
 \end{array}$$

- a. **Considerations Below the Separation Line.** Placement of the currency symbol applies to the numeric characters above the separation line. If an answer is printed below the separation line, part of it may be shown beneath the symbols which appear above it.

Example 9-17

| | |
|---------|------------|
| \$.36 | ⠠⠠⠠⠠⠠⠠ |
| 7.02 | ⠠⠠⠠⠠⠠⠠ |
| + 3.04 | ⠠⠠⠠⠠⠠⠠ |
| ----- | ⠠⠠⠠⠠⠠⠠ |
| \$10.42 | ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ |
| | ⠠⠠⠠⠠⠠⠠ |

The decimal point and place values in the sum align with the decimal points and place values in the addends. The dollar signs above and below the separation line are not aligned in print and so need not be aligned in braille.

- b. **Further Considerations.** A symbol of operation or a currency symbol may be placed in the same position shown in print as long as the symbols above the separation line are placed at least one column of cells to the left of the leftmost column of numeric characters appearing there.

Example 9-18

| | |
|--------|------------|
| \$1.45 | ⠠⠠⠠⠠⠠⠠ |
| - 1.05 | ⠠⠠⠠⠠⠠⠠ |
| ----- | ⠠⠠⠠⠠⠠⠠ |
| \$.40 | ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ |
| | ⠠⠠⠠⠠⠠⠠ |

In print, the minus sign appears to the left of the dollar sign. This alignment is duplicated in braille.

Example 9-19

| | |
|--------|------------|
| \$1.45 | ⠠⠠⠠⠠⠠⠠ |
| - 1.05 | ⠠⠠⠠⠠⠠⠠ |
| ----- | ⠠⠠⠠⠠⠠⠠ |
| \$.40 | ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ |
| | ⠠⠠⠠⠠⠠⠠ |

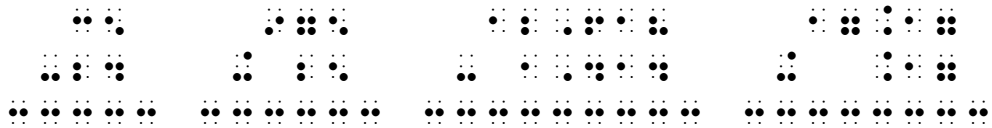
In print, the minus sign appears directly beneath the dollar sign and the two dollar signs are vertically aligned. This alignment is duplicated in braille.

9.18 Side-by-Side Layout

Spatial arrangements may be placed side by side across a page. Care must be taken to leave at least three blank cells between any symbol on any line of one spatial arrangement and any symbol on any line of a neighboring arrangement. "Any symbol" does not refer to a separation line. This means that one blank space is left between the end of one separation line and the beginning of the next when neighboring arrangements contain separation lines.

Example 9-20

| | | | |
|------------|------------|---------------|--------------|
| 35 | 975 | 12,618 | 17.17 |
| <u>-24</u> | <u>+25</u> | <u>-1,414</u> | <u>+ .17</u> |

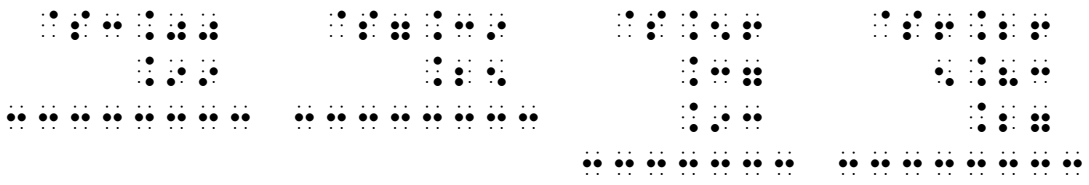


Each separation line extends one cell to the left and one cell to the right of its overall arrangement. One clear column of blank space is between the ends of the separation lines.

9.18.1 **Top Alignment.** The first addend in each problem is transcribed on the same line, regardless of the print arrangement. When the separation lines are not on the same braille line, at least one clear column of blank space (one cell's width) must be maintained between the ends of the separation lines. This assures that at least three blank cells come between any symbol on any line of one spatial arrangement and any symbol on any line of a neighboring spatial arrangement (separation lines excluded).

Example 9-21

| | | | |
|------------|------------|------------|------------|
| \$3.00 | \$7.39 | \$.56 | \$6.26 |
| <u>.99</u> | <u>.25</u> | .37 | 5.83 |
| | | <u>.93</u> | <u>.27</u> |



One clear column of blank space is between the ends of the separation lines, even those that do not fall on the same braille line.

Example 9-22

| | | | |
|-------|--------|--------|--------|
| \$.56 | | \$6.26 | |
| .37 | \$3.00 | 5.83 | \$7.39 |
| .93 | .99 | .27 | .25 |

| | | | |
|---------|-----------|---------|---------|
| ⠠⠠⠠⠠⠠⠠ | | ⠠⠠⠠⠠⠠⠠⠠ | |
| ⠠⠠⠠ | | ⠠⠠⠠ | |
| ⠠⠠⠠ | ⠠⠠⠠⠠⠠⠠⠠⠠⠠ | ⠠⠠⠠ | ⠠⠠⠠⠠⠠⠠⠠ |
| ⠠⠠⠠⠠⠠⠠⠠ | | ⠠⠠⠠⠠⠠⠠⠠ | |

In print, the problems are arranged so that all separation lines are across the same row. In braille, the addends are top adjusted.

Instructions: Placement of code switches and blank lines has not been discussed yet. Please follow these directives in your transcription of this PRACTICE. Transcribe the opening Nemeth Code indicator on a line by itself, in cell 1. The next line should be blank. Begin the problems on the line following the blank line. Use side-by-side layout, with the first cell of the leftmost separation line in cell 1. Leave only one blank line between the two sets of problems. After completion of the last problem, leave one line blank and transcribe a Nemeth Code terminator in cell 1.

PRACTICE 9D

| | | | | |
|-------|---------|---------|-----|---------|
| 900 | | 25.763 | | 5,025 |
| + 100 | 4391 | - 4.239 | 718 | + 3,999 |
| 1000 | + 81 | 21.524 | 281 | 9,024 |
| 2.15 | \$3,854 | \$ 8.62 | | |
| 6.13 | 602 | - 6.37 | | |
| 2.15 | + 918 | \$ 8.62 | | |

9.19 Omissions in Work Arranged Spatially for Computation

Recall that, in a linear problem, the transcriber indicates the omission of an answer by transcribing a general omission symbol. (See **Lesson 1**.)

$$\gg 123 + 456 = \begin{array}{ccccccc} \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \end{array}$$

On the other hand, when nothing is printed below the separation line in a spatially arranged problem, the transcriber follows print. Do not insert a general omission symbol to represent blank space below a spatially arranged problem.

$$\gg \begin{array}{r} 123 \\ + 456 \\ \hline \end{array} \begin{array}{cccc} \cdot & \cdot & \cdot & \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \end{array}$$

An omission may be printed any number of ways – as a question mark, an ellipsis, an underscore, a box, etc. In braille, only the general omission symbol is used to show an omission within a spatial arrangement. The one-cell symbol allows the transcription to maintain alignment of the place values.

$\cdot \cdot$ General Omission Symbol

Example 9-23

$$\begin{array}{r} 94 \\ + ? \\ \hline 100 \end{array} \begin{array}{cccc} \cdot & \cdot & & \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \end{array}$$

The omission is printed as a questions mark.

9.19.1 The number of general omission symbols transcribed reflects the number of omission signs used in print.

Example 9-24

$$\begin{array}{r} 946 \\ + ?? \\ \hline 1002 \end{array} \begin{array}{cccc} \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \end{array}$$

In print, each omission is denoted as a questions mark.

Example 9-28

$$\begin{array}{r}
 3x^2 \quad + 2 \\
 x^2 + 4xy - 5 \\
 \hline
 4x^2 + 4xy - 3
 \end{array}$$

9.20.3 **Misalignment in Print.** The braille transcription must show proper alignment, even if items are not aligned in print. *Exception:* If the terms are intentionally misaligned in an exercise or illustration, follow print alignment in the braille transcription.

Example 9-29

$$\begin{array}{r}
 4x + 20y + 6z \\
 18x - 9z \\
 \hline
 5y + 4z
 \end{array}$$

Terms are not aligned in this print example. The braille transcription aligns terms and symbols.

Example 9-30

Rearrange the second polynomial in order to add like terms in columns.

$$\begin{array}{r}
 3y^5 + y^4 + 2y^3 - 27 + 5 \\
 2y^5 + 3y^3 + 7y + 2
 \end{array}$$

⠆⠆

Both polynomials are right justified in print. The student is instructed to align the terms. (This example illustrates the proper placement of switch indicators and margins for displayed spatial material. Both topics are discussed later in this lesson.)

9.21 Abbreviations

When abbreviations occur in a spatially arranged addition or subtraction problem, they are vertically aligned and transcribed according to the rules for abbreviations outlined in Lessons 3 and 4.

Example 9-31

$$\begin{array}{r} 4 \text{ ft. } 7 \text{ in.} \\ + 3 \text{ ft. } 5 \text{ in.} \\ \hline 7 \text{ ft. } 12 \text{ in.} \end{array}$$

9.22 Fractions

In a spatial addition or subtraction arrangement containing fractions, the fraction lines are vertically aligned. Each numerator and denominator must be in contact with its fraction line. Fraction indicators must be vertically aligned.

Example 9-32

$$\begin{array}{r} 3/ \\ + 1/ \\ \hline \end{array}$$

Example 9-33

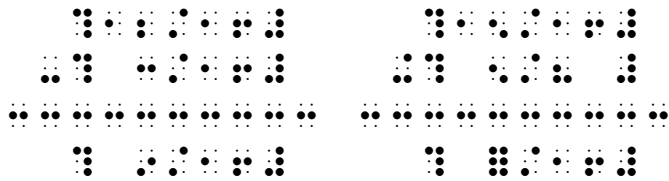
$$\begin{array}{r} 1/2 \\ + 3/4 \\ \hline \end{array}$$

9.22.1 Alignment of Fraction Indicators

- Blank cells are inserted in order to achieve alignment of fraction indicators when numerators and/or denominators contain a different number of digits.

Example 9-34

$$\begin{array}{r} 12 \\ \hline 16 \\ - 3 \\ \hline 16 \\ \hline 9 \\ \hline 16 \end{array} \qquad \begin{array}{r} 15 \\ \hline 16 \\ + 5 \\ \hline 8 \\ \hline ? \\ \hline 16 \end{array}$$



Fraction indicators and fraction lines are aligned.

- b. When different kinds of fraction indicators occur in the same problem, align the (1456) and (3456) symbols. Indicators and numbers must not appear in the same column. Blank cells are inserted in order to achieve this alignment.

Example 9-35

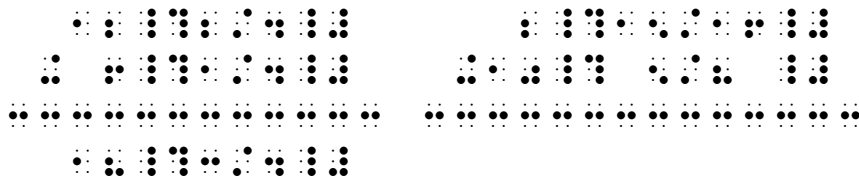
$$\begin{array}{r} \frac{3}{8} \\ + 9 \frac{1}{8} \\ \hline \end{array} \qquad \begin{array}{r} 5 \frac{1}{2} \\ + \frac{11}{12} \\ \hline \end{array}$$



- c. The whole number part of a mixed number is vertically aligned by place value.

Example 9-36

$$\begin{array}{r} 12 \frac{2}{4} \\ + 6 \frac{1}{4} \\ \hline 18 \frac{3}{4} \end{array} \qquad \begin{array}{r} 2 \frac{15}{16} \\ + 10 \frac{5}{8} \\ \hline \end{array}$$



9.22.2 **Linear Portion of a Spatial Arrangement.** An equals sign printed within a spatial arrangement follows linear spacing rules for signs of comparison.

Example 9-37

$$\begin{array}{r}
 1 \frac{5}{12} \\
 + 6 \frac{5}{12} \\
 \hline
 7 \frac{10}{12} = 7 \frac{5}{6}
 \end{array}$$

A numeric indicator is required for the final answer because it is not part of the vertical computation.

Example 9-38

$$\begin{array}{r}
 4 \frac{4}{8} = 3 \frac{12}{8} \\
 - 2 \frac{5}{8} = - 2 \frac{5}{8} \\
 \hline
 1 \frac{7}{8}
 \end{array}$$

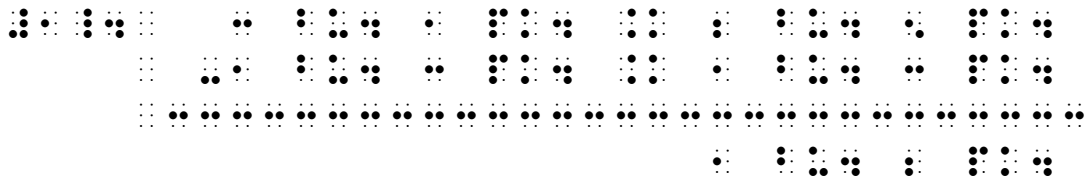
These equals signs show a relationship between the two side-by-side spatial arrangements.

9.23 Placement of Identifiers

The numeric or alphabetic identifier associated with a spatially arranged addition or subtraction problem is positioned at the top line of the problem—that is, with the first addend or with the subtrahend. One clear column of blank space (one cell's width) must be left between the last symbol in the identifier and the symbol furthest left in the overall arrangement including separation lines.

Example 9-39

$$\begin{array}{r}
 1. \quad 3 \text{ bu. } 1 \text{ pk.} = 2 \text{ bu. } 5 \text{ pk.} \\
 \quad - 1 \text{ bu. } 3 \text{ pk.} = 1 \text{ bu. } 3 \text{ pk.} \\
 \hline
 \quad \quad \quad 1 \text{ bu. } 2 \text{ pk.}
 \end{array}$$



- 9.23.1 **Side-by-Side Layout.** Spatially arranged itemized material may be arranged side by side. The identifiers are located on the same braille line across the width of the page, in sequential order. Problems are spaced so that no less than three blank cells come between any symbol on any line of one spatial arrangement and any symbol on any line of a neighboring arrangement (separation lines excluded) including the neighboring identifier.

Note that this is a special rule pertaining to spatially arranged itemized material. As taught in Lesson 1, each main item in *nonspatial* itemized material must start in cell 1, even if the print copy arranges the items side by side across the page.

Example 9-40

$$\begin{array}{r}
 1) \quad 15 \\
 \quad +3 \\
 \hline
 \end{array}
 \quad
 \begin{array}{r}
 2) \quad 15 \\
 \quad -3 \\
 \hline
 \end{array}
 \quad
 \begin{array}{r}
 3) \quad 15 \\
 \quad +13 \\
 \hline
 \end{array}
 \quad
 \begin{array}{r}
 4) \quad 15 \\
 \quad -13 \\
 \hline
 \end{array}
 \quad
 \begin{array}{r}
 5) \quad 150 \\
 \quad +130 \\
 \hline
 \end{array}
 \quad
 \begin{array}{r}
 6) \quad 150 \\
 \quad -130 \\
 \hline
 \end{array}$$

10

11

12

13

14

15

16

17

18

Lines 11 and 15: Three blank cells come between the rightmost symbol in each problem (the "ones" column) and the numeric indicator of the next identifier.

Lines 11-13 and 15-17: One blank cell comes between the right parenthesis of each identifier and the leftmost cell of the separation line on line 3.

Line 14: A blank line precedes the second group of spatially arranged problems.

Line 15: No attempt is made to align identifiers with those on line 11.

Instructions: Transcribe the opening Nemeth Code indicator on a line by itself, in cell 1. The next line should be blank. Begin the problems on the line following the blank line. Use side-by-side layout. After completion of the last problem, leave one line blank and transcribe a Nemeth Code terminator in cell 1.

PRACTICE 9E

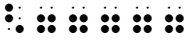
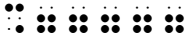
$$\begin{array}{r}
 1) \quad 621 \\
 \quad + ??? \\
 \hline
 1096
 \end{array}
 \quad
 \begin{array}{r}
 2) \quad 17x - 8y - z \\
 \quad - 2x + 17y + 6z \\
 \hline
 15x + 9y + _
 \end{array}
 \quad
 \begin{array}{r}
 3) \quad 3x^2 - 5x + 4 \\
 \quad - 5x^2 + 12x - 12 \\
 \hline
 -2x^2 + 7x - 8
 \end{array}$$

$$\begin{array}{r}
 4) \quad 1 \frac{2}{3} \text{ yr} \\
 \quad + 5 \frac{5}{12} \text{ yr} \\
 \hline
 6 \frac{13}{12} \text{ yr} = 7 \frac{1}{12} \text{ yr}
 \end{array}$$

9.24 Regrouping Numbers in Addition Problems

Small numbers printed above or below digits in a problem are referred to as "regrouping numbers". (Older texts may call them "carried numbers".) The transcription places the regrouping numbers in the same location as printed, inserting the appropriate regrouping indicator between the regrouping numbers and their associated digits. A regrouping line usually does not appear in print, since the smaller font is enough to distinguish them.

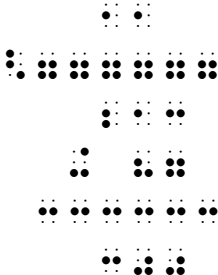
The first cell of the regrouping indicator tells the reader to read the numbers above the line or below the line.

| | |
|---|---|
|  | Regrouping Indicator for Numbers Above the Arrangement (varying in length) |
|  | Regrouping Indicator for Numbers Below the Arrangement (varying in length) |

The regrouping indicator will be one cell longer on the left than the separation line. It is important to place the regrouping numbers in the same columnar positions as in print.

In the first example, the regrouping numbers are printed above the first addend. In the second example, the regrouping numbers are printed above the separation line.

Example 9-41

| | |
|--|---|
| $ \begin{array}{r} \overset{1}{2}13 \\ + 87 \\ \hline 300 \end{array} $ |  |
|--|---|

In the print copy, the regrouping numbers are in a smaller typeface and a regrouping line is not present.

Example 9-42

| | | |
|---|------------|--------|
| | 7 9 | ⠠⠨⠠⠑ |
| | 2 1 4 | ⠠⠨⠠⠑⠠⠒ |
| + | 1 8 | ⠠⠨⠠⠕ |
| | <u>1 2</u> | ⠠⠨⠠⠕ |
| | 3 1 1 | ⠠⠨⠠⠑⠠⠒ |

In the print copy, the regrouping numbers are in a smaller typeface and a regrouping line is not present.

- 9.24.1 **With Identifiers.** If an identifier is present, it is placed on the first line of the addition problem (the first addend) regardless of the presence of regrouping numbers. One blank space must be left between the last symbol in the identifier and the symbol furthest left in the overall arrangement, including separation lines and regrouping indicators.

Example 9-43

| | | |
|----|--------------|--------|
| | 2 1 | ⠠⠨⠠⠑ |
| 1. | 25.9 | ⠠⠨⠠⠑⠠⠕ |
| | 49.4 | ⠠⠨⠠⠑⠠⠕ |
| | 87.2 | ⠠⠨⠠⠑⠠⠕ |
| | <u>162.5</u> | ⠠⠨⠠⠑⠠⠕ |

Example 9-45

$$\begin{array}{r}
 \overset{11}{7} \cancel{2} \overset{13}{3} \\
 - 254 \\
 \hline
 569
 \end{array}$$

Cancellation indicators align with cancellation indicators. The minus sign on line 4 is placed one column to the left of the opening cancellation indicator on line 3 to assure a clear column below that indicator.

9.25.1 **With Identifiers.** If an identifier is present, it is placed on the first line of the subtraction problem (the minuend) regardless of the presence of canceled items. One blank space must be left between the last symbol in the identifier and the symbol furthest left in the overall arrangement, including separation lines.

Example 9-46

A.

$$\begin{array}{r}
 \overset{7}{\cancel{1}} \overset{12}{\cancel{2}} \overset{4}{\cancel{3}} \overset{16}{\cancel{4}} \\
 - 2347 \\
 \hline
 5909
 \end{array}$$

PRACTICE 9F

Regrouping Numbers and Cancellation

1.

$$\begin{array}{r}
 \overset{1}{9} \overset{1}{4} \overset{1}{8} \\
 + 75 \\
 \hline
 1023
 \end{array}$$

2.

$$\begin{array}{r}
 \$ \overset{12}{2} \overset{2}{.} 52 \\
 65.89 \\
 91.99 \\
 \hline
 32.03 \\
 \hline
 \$192.43
 \end{array}$$

3.

$$\begin{array}{r}
 \overset{4}{\cancel{8}} \overset{16}{\cancel{0}} \overset{1}{\cancel{2}} \overset{13}{\cancel{4}} \\
 - 804 \\
 \hline
 4819
 \end{array}$$

Arrangement on the Page

A spatial arrangement should be confined to one braille page. Strategies for larger arrangements are beyond the scope of this course.

9.26 Blank Lines

A blank line is required above and below a spatial arrangement in most situations.

9.26.1 **Blank Lines and the Page Change Indicator.** The presence of a page change indicator does not affect the blank line requirement. There may be times when a blank line is needed both before and after the page change indicator, for example, when spatial arrangements occur both before and after the page change.

Example 9-47

| | |
|------------|------------|
| 15 | 15 |
| <u>+13</u> | <u>-13</u> |

===== new print page 123

| | |
|-------------|-------------|
| 150 | 150 |
| <u>+130</u> | <u>-130</u> |

Braille representation of the example above, showing two sets of arithmetic problems. Each set is preceded and followed by a blank line. The page change indicator 'new print page 123' is shown between the two sets.

Each set of spatial problems requires a blank line before and after it.

9.26.2 **Blank Lines and Box Lines.** A blank line is left both above and below a spatial arrangement even if the arrangement directly precedes or follows a box line. (No examples are given.)

Example 9-50

$$\begin{array}{r}
 1) \quad 15 \\
 \quad + 3 \\
 \hline
 \end{array}
 \qquad
 \begin{array}{r}
 2) \quad 451 \\
 \quad - 301 \\
 \hline
 \end{array}
 \qquad
 \begin{array}{r}
 3) \quad 959 \\
 \quad + 13 \\
 \hline
 \end{array}$$

22

23

24

25

9.27 Wide Arrangements [NC 26.6.1]

As noted above, if any portion of a spatial arrangement falls on lines 1, 2, 24, or 25 of the braille page, at least three blank spaces must be left between the symbol furthest to the right of the overall arrangement and the first symbol of the page number. This restriction includes the rightmost symbol of a separation line. If this spacing cannot be achieved, the arrangement must begin on line 3 or end on line 23, respectively.

The following example illustrates a wide arrangement that begins in cell 3, assuming it is displayed to narrative.

Example 9-51

$$\begin{array}{r}
 S = 1 + 3 + 5 + \dots + 45 + 47 + 49 \\
 S = 49 + 47 + 45 + \dots + 5 + 3 + 1 \\
 \hline
 2S = 50 + 50 + 50 + \dots + 50 + 50 + 50
 \end{array}$$

Example 9-51-a (Arranged near the top of a braille page, with no running head.)

1

2

3

4

5

6

The separation line invades the three-cell area before the print page number on line 1, so this problem is not allowed to fall on lines 1 or 2.

Example 9-53

1. a.
$$\begin{array}{r} 15 \\ +3 \\ \hline \end{array}$$
 b.
$$\begin{array}{r} 15 \\ -3 \\ \hline \end{array}$$
 c.
$$\begin{array}{r} 15 \\ +13 \\ \hline \end{array}$$
 d.
$$\begin{array}{r} 15 \\ -13 \\ \hline \end{array}$$

9.28.2 **With Narrative.** If there is narrative associated with the main division number, the subdivisions begin on the next available line (following the required blank line that precedes spatial material) starting in cell 3.

Example 9-54

1. Solve: a.
$$\begin{array}{r} 15 \\ +3 \\ \hline \end{array}$$
 b.
$$\begin{array}{r} 15 \\ -3 \\ \hline \end{array}$$
 c.
$$\begin{array}{r} 15 \\ +13 \\ \hline \end{array}$$
 d.
$$\begin{array}{r} 15 \\ -13 \\ \hline \end{array}$$

Placement of Code Switch Indicators

Each code switch indicator should fall on the same braille page as the mathematical material to which it applies. (There are times when this is not possible.)

A code switch indicator does not take the place of a blank line. To keep the code switch indicators from interfering with the layout of the problem, they are placed outside of the arrangement. Position the required blank lines *between* the Nemeth switches as described below.

9.29 Code Switching with Unitemized Spatial Arrangements

- i. If the problems are not displayed to text, the opening Nemeth Code indicator is placed in cell 1 on a line by itself. If there is text, the opening Nemeth Code indicator is placed on the same line with the end of the text above the problem unless there is no room, in which case the opening Nemeth Code indicator is placed in cell 1 on a line by itself. This applies to spatial material following instructions and for spatial material following a transcriber's note as well.
- ii. The required blank line comes next.
- iii. The leftmost symbol of the arrangement is placed in cell 1, or in the appropriate cell for displayed material.
- iv. When Nemeth Code is closed after a spatial problem, the required blank line comes first, followed by the Nemeth Code terminator in cell 1 on a line by itself.
- v. Resume UEB text on the line following the terminator, unless a format change that requires a leading blank line, such as a heading, follows. See Section 9.31, below.

Example 9-55

| | | |
|-----------|------------|------------|
| 15 | 115 | 155 |
| <u>+3</u> | <u>+30</u> | <u>+13</u> |

Braille representation of the example above, showing the placement of Nemeth code indicators and blank lines. The opening Nemeth code indicator is placed in cell 1 on a line by itself. The required blank line comes next. The leftmost symbol of the arrangement is placed in cell 1, or in the appropriate cell for displayed material. When Nemeth Code is closed after a spatial problem, the required blank line comes first, followed by the Nemeth Code terminator in cell 1 on a line by itself. Resume UEB text on the line following the terminator, unless a format change that requires a leading blank line, such as a heading, follows.

Example 9-56

Add or subtract, as indicated by the signs.

$$\begin{array}{r} 15 \\ +3 \\ \hline \end{array} \quad \begin{array}{r} 115 \\ -30 \\ \hline \end{array} \quad \begin{array}{r} 155 \\ +13 \\ \hline \end{array}$$

Braille representation of the arithmetic problems above, including a Nemeth Code terminator (⠠⠨⠠) at the end of the line.

The opening switch fits at the end of the line of text. The arrangements are displayed to narrative and so the leftmost cell (the first separation line) is placed in cell 3. The Nemeth Code terminator is placed outside of the arrangement, after the required blank line, in cell 1.

Example 9-57

1. Add or subtract. Circle your answer.

$$\begin{array}{r} 15 \\ +3 \\ \hline \end{array} \quad \begin{array}{r} 115 \\ -30 \\ \hline \end{array} \quad \begin{array}{r} 155 \\ +13 \\ \hline \end{array}$$

Braille representation of the arithmetic problems above, including a Nemeth Code terminator (⠠⠨⠠) at the beginning of the line.

The opening switch does not fit at the end of the line of text, so it is placed in cell 1 on the next line. The switch indicator does not take the place of the

required blank line. The arrangements are displayed to itemized text and so the leftmost cell is placed in cell 5. The Nemeth Code terminator is placed outside of the arrangement, after the required blank line, in cell 1.

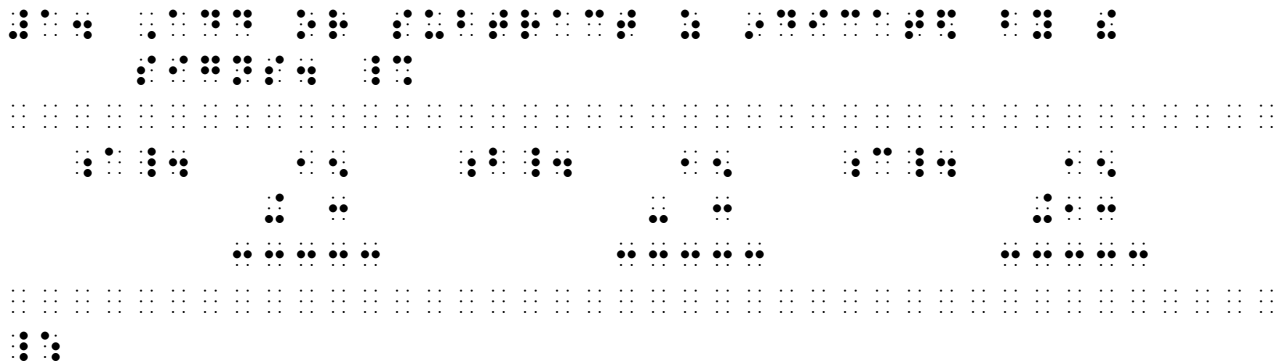
9.30 Code Switching with Itemized Spatial Arrangements

- i. An opening Nemeth Code indicator which precedes itemized spatial material follows the same directives as with any itemized material. (See Lesson 2.) That is, if there is text, the opening Nemeth Code indicator is placed on the same line with the end of the text above the itemized problem unless there is no room, in which case the opening Nemeth Code indicator is placed in the runover cell.
- ii. The required blank line comes next.
- iii. The layout of the arrangements follow the directives given in Sections 9.23 and 9.28.
- iv. When Nemeth Code is closed after a spatial problem, the required blank line comes first, followed by the Nemeth Code terminator in cell 1 on a line by itself.
- v. Resume UEB text on the line following the terminator, unless a format change that requires a leading blank line, such as a heading, follows. See Section 9.31, below.

Example 9-58

1. Add or subtract as indicated by the signs.

$$\begin{array}{r}
 \text{a. } 15 \\
 +3 \\
 \hline
 \end{array}
 \quad
 \begin{array}{r}
 \text{b. } 15 \\
 -3 \\
 \hline
 \end{array}
 \quad
 \begin{array}{r}
 \text{c. } 15 \\
 +13 \\
 \hline
 \end{array}$$



The opening switch fits at the end of the line of text. The Nemeth Code terminator is placed outside of the arrangement, after the required blank line, in cell 1.

Example 9-59

1. Solve these problems using counting cubes.

a.
$$\begin{array}{r} 15 \\ +3 \\ \hline \end{array}$$
 b.
$$\begin{array}{r} 15 \\ -3 \\ \hline \end{array}$$
 c.
$$\begin{array}{r} 15 \\ +13 \\ \hline \end{array}$$

2. Solve these problems with your pencil.

The opening switch does not fit at the end of the line of text, so it is placed in the runover cell (cell 5). The Nemeth Code terminator is placed outside of the arrangement, after the required blank line, in cell 1. Item 2 begins on the next line.

Example 9-60

Solve these problems using counting cubes.

1.
$$\begin{array}{r} 15 \\ +3 \\ \hline \end{array}$$
 2.
$$\begin{array}{r} 15 \\ -3 \\ \hline \end{array}$$
 3.
$$\begin{array}{r} 15 \\ +13 \\ \hline \end{array}$$

The opening switch does not fit at the end of the line of the instructions, so it is placed in cell 1 because spatially arranged material follows. The switch indicator does not take the place of the required blank line before the spatial

arrangements. The Nemeth Code terminator is placed outside of the arrangement, after the required blank line, in cell 1.

9.31 Code Switching with Headings and with the Page Change Indicator

Recall from [9.26.1](#) that a blank line is required before a page change indicator when the print page ends with a spatial arrangement. The next example illustrates blank lines necessary when a heading begins on the new print page and code switching is necessary. Blank lines are required before and after each centered heading, and before and after each problem set. Each code switch indicator is placed in cell 1 on a line by itself.

ADDITION PROBLEMS

| | | | | |
|--|--|--|--|--|
| $\begin{array}{r} 10 \\ +10 \\ \hline \end{array}$ | $\begin{array}{r} 10 \\ +20 \\ \hline \end{array}$ | $\begin{array}{r} 10 \\ +30 \\ \hline \end{array}$ | $\begin{array}{r} 10 \\ +40 \\ \hline \end{array}$ | $\begin{array}{r} 10 \\ +50 \\ \hline \end{array}$ |
|--|--|--|--|--|

===== new print page 45

SUBTRACTION PROBLEMS

| | | | | |
|--|--|--|--|--|
| $\begin{array}{r} 10 \\ -10 \\ \hline \end{array}$ | $\begin{array}{r} 20 \\ -10 \\ \hline \end{array}$ | $\begin{array}{r} 30 \\ -10 \\ \hline \end{array}$ | $\begin{array}{r} 40 \\ -10 \\ \hline \end{array}$ | $\begin{array}{r} 50 \\ -10 \\ \hline \end{array}$ |
|--|--|--|--|--|

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For further practice, see Appendix A—Reading Practice.

EXERCISE 9

Prepare Exercise 9 for your grader.

ANSWERS TO PRACTICE MATERIAL

PRACTICE 9A

- 1 $\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$
- 2 $\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$
- 3 $\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$
- 4 $\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$
- 5 $\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$
- 6 $\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$
- 7 $\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$
- 8 $\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$
- 9 $\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$
- 10 $\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$
- 11 $\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$
- 12 $\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$
- 13 $\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$

NOTES

- A. The dashed shaft must not be divided between lines.
- D. This long expression will not fit on one line. The arrows are comparison signs, making this is a "linked expression". In order to organize this expression into mathematical units, divide before the main sign of comparison – the third arrow in this case.

