LESSON 4

Read about this PROVISIONAL EDITION in the front matter to this book.
Check the NFB website periodically for updates to this lesson.

- WORDS
    - Introduction to Abbreviations
    - Single-Word Switch Indicator
- Switch Indicators at Page Turns, cont.
- LETTERS
    - Introduction to the English Letter Indicator
    - Mathematical Letter Combinations

FORMAT
Keep Together
FORMAT SUMMARY #2

WORDS

4.1 Words in Mathematical Context: When words are part of an equation or math expression the words are included in the technical notation—that is, the whole expression is placed inside the Nemeth switches. No contractions are used within Nemeth switches. Spacing rules of the Nemeth Code are followed.

Example 4.1-1 In the next problem, length=5, width=12, height=7.

⠠⠔ ⠮ ⠝⠑⠭⠞ ⠏⠗⠕⠃⠇⠑⠍⠂ ⠸⠩ ⠇⠑⠝⠛⠞⠓ ⠨⠅ ⠼⠢⠠
⠺⠊⠙⠞⠓ ⠨⠅ ⠼⠂⠆⠠ ⠓⠑⠊⠛⠓⠞ ⠨⠅ ⠼⠶ ⠸⠱⠲

The words are brailled without contractions. Nemeth Code requires a space before and after the comparison signs (equals signs) regardless of print spacing.

In the next example, words are substituted for values in a formula. The words are part of the math expression and are brailled without contractions. The division symbol is unspaced from the words according to Nemeth Code rules for spacing of operation signs.

Example 4.1-2 Dividend ÷ Divisor = Quotient

⠸⠩ ⠠⠙⠊⠧⠊⠙⠑⠝⠙⠨⠌⠠⠙⠊⠧⠊⠎⠕⠗ ⠨⠅ ⠠⠟⠥⠕⠞⠊⠑⠝⠞ ⠸⠱

As part of a math problem expressed in symbols and words, the words are included in the switch.

Example 4.1-3 Adding decimals in a recipe: .5 of a cup + .75 of a cup = _?_ cup

⠠⠁⠙⠙⠬ ⠙⠑⠉⠊⠍⠁⠇⠎ ⠔ ⠁ ⠗⠑⠉⠊⠏⠑⠒
⠸⠩ ⠼⠨⠢ ⠕⠋ ⠁ ⠉⠥⠏⠬⠨⠶⠢ ⠕⠋ ⠁ ⠉⠥⠏ ⠨⠅ ⠿ ⠉⠥⠏
⠸⠱

The operation sign (+) is unspaced; the comparison sign (=) is spaced, according to the rules of the Nemeth Code.

4.2 Words in Narrative: It is not necessary to include a word inside the Nemeth switches when a word is adjacent to a mathematical item. For example,

Words Labeling a Math Item

Example 4.2-1 Figure 4.7 shows Shape 4 and its reflection, Shape 4′.

⠠⠋⠊⠛⠥⠗⠑ ⠼⠙⠲⠛ ⠩⠪⠎ ⠠⠩⠁⠏⠑ ⠼⠙ ⠯ ⠭⠎
⠗⠑⠋⠇⠑⠉⠰⠝⠂ ⠠⠩⠁⠏⠑ ⠸⠩ ⠼⠲⠄ ⠸⠱⠲

Example 4.2-2 Chris used 25.5 cans of paint.

⠠⠡⠗⠊⠎ ⠥⠎⠫ ⠸⠩ ⠼⠆⠢⠨⠢ ⠸⠱ ⠉⠁⠝⠎ ⠷ ⠏⠁⠔⠞⠲

Example 4.2-3 What is 5.5 percent of 72?

⠠⠱⠁⠞ ⠊⠎ ⠸⠩ ⠼⠢⠨⠢ ⠸⠱ ⠏⠻⠉⠢⠞ ⠷ ⠼⠛⠃⠦

Units of Measure

Example 4.2-4 Logan weighed exactly 7.00 pounds at birth.

⠠⠇⠕⠛⠁⠝ ⠺⠑⠊⠣⠫ ⠑⠭⠁⠉⠞⠇⠽ ⠸⠩ ⠼⠶⠨⠴⠴ ⠸⠱
⠏⠨⠙⠎ ⠁⠞ ⠃⠊⠗⠹⠲

Note that the number need not fall on the same line with the unit of measure when the unit of measure is a word.

Example 4.2-5 Marc's sister weighed 6 pounds 3.2 ounces.

⠠⠍⠜⠉⠄⠎ ⠎⠊⠌⠻ ⠺⠑⠊⠣⠫ ⠼⠋ ⠏⠨⠙⠎ ⠸⠩ ⠼⠒⠨⠆ ⠸⠱
⠳⠝⠉⠑⠎⠲

4.3 Punctuation With Words: Words are not punctuated mathematically, even when they are brailled in mathematical context. For a comma, the dot 2 comma is used; for other punctuation marks, no punctuation indicator is used. The next example shows a set of class members using mathematical braces to enclose the set.

Example 4.3-1 {Richard, Daniel, Steven}

⠸⠩ ⠨⠷⠠⠗⠊⠉⠓⠁⠗⠙⠂ ⠠⠙⠁⠝⠊⠑⠇⠂ ⠠⠎⠞⠑⠧⠑⠝⠨⠾ ⠸⠱

The literary comma is used when a comma follows a word, even in mathematical context.

In the next example the math form being described is illustrated with words. Because the model is a math expression, a switch to Nemeth Code is required.

Example 4.3-2 A semicolon is used to separate variables from parameters in the form (variable; parameter).

⠠⠁ ⠎⠑⠍⠊⠉⠕⠇⠕⠝ ⠊⠎ ⠥⠎⠫ ⠞⠕ ⠎⠑⠏⠜⠁⠞⠑
⠧⠜⠊⠁⠃⠇⠑⠎ ⠋ ⠏⠜⠁⠍⠑⠞⠻⠎ ⠔ ⠮ ⠿⠍
⠸⠩ ⠷⠧⠁⠗⠊⠁⠃⠇⠑⠆ ⠏⠁⠗⠁⠍⠑⠞⠑⠗⠾ ⠸⠱⠲

The semicolon does not require a punctuation indicator because words are punctuated in literary mode, even in mathematical context.

PRACTICE 4A

A. If 1 pound of Swiss cheese costs $2.50, how much does 4.7 pounds cost?

B. JMHS's set of high-jump champions: {Terry, Leslie, Traci}

C. The parts of a subtraction problem are named as follows: minuend – subtrahend = difference.

D. 98.6 degrees Fahrenheit is not necessarily "normal" body temperature for everyone.

E. Find the original and new prices when x=2 games and when x=7 games. Did you get the same prices as you found in problem 6?

Introduction to Abbreviations

This lesson examines abbreviations within narrative.

4.4 Abbreviations: An abbreviation by itself is not mathematical and does not require a switch to Nemeth Code.

Example 4.4-1 SAS means "side angle side".

⠠⠠⠎⠁⠎ ⠍⠂⠝⠎ ⠦⠎⠊⠙⠑ ⠁⠝⠛⠇⠑ ⠎⠊⠙⠑⠴⠲

Even though SAS is a special abbreviation in the field of mathematics, as used in this example it is simply an abbreviation in the narrative and is brailled in UEB.

Example 4.4-2 In hours, how long is the 8 a.m.-3 p.m. school day?

⠠⠔ ⠓⠳⠗⠎⠂ ⠓⠪ ⠇⠰⠛ ⠊⠎ ⠮ ⠼⠓ ⠁⠲⠍⠲⠤⠼⠉ ⠏⠲⠍⠲
⠎⠡⠕⠕⠇ ⠐⠙⠦

A freestanding unmodified numeral and any associated abbreviation does not require a code switch.

When an abbreviation is part of an equation or math expression, both the number and the abbreviation are placed inside the Nemeth switches.

Example 4.4-3 15 mm can be expressed as 1.5 cm.

⠼⠁⠑ ⠍⠍ ⠉ ⠆ ⠑⠭⠏⠗⠑⠎⠎⠫ ⠵ ⠸⠩ ⠼⠂⠨⠢ ⠉⠍ ⠸⠱⠲

The abbreviation "cm" applies to the number "1.5" and so the abbreviation is included in the switches.

No contractions are used in an abbreviation that is brailled in Nemeth Code.

⫸ 1.5 min ⠼⠂⠨⠢ ⠍⠊⠝

Example 4.4-4 There are 60 sec in 1 min. It follows that 1.5 min expressed in seconds is 90 sec.

⠠⠐⠮ ⠜⠑ ⠼⠋⠚ ⠎⠑⠉ ⠔ ⠼⠁ ⠍⠔⠲ ⠠⠭ ⠋⠕⠇⠇⠪⠎ ⠞
⠸⠩ ⠼⠂⠨⠢ ⠍⠊⠝ ⠸⠱ ⠑⠭⠏⠗⠑⠎⠎⠫ ⠔ ⠎⠑⠉⠕⠝⠙⠎ ⠊⠎
⠼⠊⠚ ⠎⠑⠉⠲

4.4.1 FORMAT—Keep Together: An abbreviation and a preceding or following numeral to which it applies must not be divided between braille lines. Because Nemeth Code format rules are applied throughout a technical transcription, this rule also applies in UEB text. Note that the print copy may not follow this format, but it must be applied in the braille transcription.

Example 4.4-5 One millisec is a thousandth of a second. That is, there are 1000 ms in 1 sec, or 1 sec equals 1000 ms. How many ms in 1 min?

⠠⠐⠕ ⠍⠊⠇⠇⠊⠎⠑⠉ ⠊⠎ ⠁ ⠹⠳⠎⠯⠹ ⠷ ⠁ ⠎⠑⠉⠕⠝⠙⠲
⠠⠞ ⠊⠎⠂ ⠐⠮ ⠜⠑ ⠼⠁⠚⠚⠚ ⠍⠎ ⠔ ⠼⠁ ⠎⠑⠉⠂ ⠕⠗
⠼⠁ ⠎⠑⠉ ⠑⠟⠥⠁⠇⠎ ⠼⠁⠚⠚⠚ ⠍⠎⠲ ⠠⠓⠪ ⠸⠍ ⠍⠎ ⠔
⠼⠁ ⠍⠔⠦

4.4.2 Punctuation with Abbreviations: Abbreviations are not punctuated mathematically, even when they are brailled in mathematical context. For a comma, the dot 2 comma is used; for other punctuation marks, no punctuation indicator is used. Note in the example below that the periods following "min." and "sec." do not require a punctuation indicator.

≫ 4.72 min. = 283.2 sec. ⠼⠲⠨⠶⠆ ⠍⠊⠝⠲ ⠨⠅ ⠼⠆⠦⠒⠨⠆ ⠎⠑⠉⠲

Example 4.4-6 Converting minutes to seconds, 4.72 min. = 283.2 sec.

⠠⠒⠧⠻⠞⠬ ⠍⠔⠥⠞⠑⠎ ⠞⠕ ⠎⠑⠉⠕⠝⠙⠎⠂
⠸⠩ ⠼⠲⠨⠶⠆ ⠍⠊⠝⠲ ⠨⠅ ⠼⠆⠦⠒⠨⠆ ⠎⠑⠉⠲ ⠸⠱

4.4.2.a Abbreviations with a Related Period: Examine the print copy to determine if the abbreviations include a period. If they do, the abbreviation must not be separated from its related period. If a Nemeth Code terminator follows the abbreviation, the related period is brailled before the terminator, unspaced from its abbreviation. If a period functions both with an abbreviation and as punctuation at the end of a sentence, keep the period with its abbreviation.

Example 4.4-7 1 metric kilogram is equivalent to 2.20 lb., which can also be written as 2 lb. 3.274 oz.

⠼⠁ ⠍⠑⠞⠗⠊⠉ ⠅⠊⠇⠕⠛⠗⠁⠍ ⠊⠎ ⠑⠟⠥⠊⠧⠁⠇⠢⠞ ⠞⠕
⠸⠩ ⠼⠆⠨⠆⠴ ⠇⠃⠲ ⠸⠱⠂ ⠱ ⠉ ⠁⠇ ⠆ ⠺⠗⠊⠞⠞⠢ ⠵
⠸⠩ ⠼⠆ ⠇⠃⠲ ⠼⠒⠨⠆⠶⠲ ⠕⠵⠲ ⠸⠱

The comma is part of the sentence structure and so is placed after the Nemeth Code terminator. Although "2 lb." by itself does not require a switch, because it is part of a measurement that contains a decimal, the entire weight is brailled in Nemeth Code to maintain continuity.

In an isolated problem where there are no context clues to determine whether a period applies to the abbreviation or merely ends the sentence, assume that it relates to the abbreviation.

Example 4.4-8 The baby elephant weighed in at 89.47 kg. Convert to pounds.

⠠⠮ ⠃⠁⠃⠽ ⠑⠇⠑⠏⠓⠁⠝⠞ ⠺⠑⠊⠣⠫ ⠔ ⠁⠞

⠸⠩ ⠼⠦⠔⠨⠲⠶ ⠅⠛⠲ ⠸⠱ ⠠⠒⠧⠻⠞ ⠞⠕ ⠏⠨⠙⠎⠲

The end-of-sentence period after "kg" is treated as if it belongs to the abbreviation because there are no context clues to the function of the period.

Compare this to the next example where it is clear that the abbreviation has no related period.

Example 4.4-9 The baby elephant weighed in at 89.47 kg! Convert to pounds.

⠠⠮ ⠃⠁⠃⠽ ⠑⠇⠑⠏⠓⠁⠝⠞ ⠺⠑⠊⠣⠫ ⠔ ⠁⠞

⠸⠩ ⠼⠦⠔⠨⠲⠶ ⠅⠛ ⠸⠱⠖ ⠠⠒⠧⠻⠞ ⠞⠕ ⠏⠨⠙⠎⠲

There is no period after the abbreviation "kg". The punctuation applies to the sentence.

4.4.3 Spacing with Abbreviations: An abbreviation consisting of two or more components is transcribed as spaced or unspaced to conform with the print text. "Keep together" format applies to the entire abbreviation and its related numeral, even in UEB text.

Example 4.4-10 Demonstrate to your classmates that 1 sq. in. is equivalent to 645.16 sq. mm.

⠠⠙⠑⠍⠕⠝⠌⠗⠁⠞⠑ ⠞⠕ ⠽⠗ ⠉⠇⠁⠎⠎⠍⠁⠞⠑⠎ ⠞ ⠀⠀⠀⠀

⠼⠁ ⠎⠟⠲ ⠊⠝⠲ ⠊⠎ ⠑⠟⠥⠊⠧⠁⠇⠢⠞ ⠞⠕

⠸⠩ ⠼⠖⠲⠢⠨⠂⠖ ⠎⠟⠲ ⠍⠍⠲ ⠸⠱

In print, there is a space before and after "sq."

Example 4.4-11 15.34 fl.oz. of water weighs 1 lb.

⠸⠩ ⠼⠂⠢⠨⠒⠲ ⠋⠇⠲⠕⠵⠲ ⠸⠱ ⠷ ⠺⠁⠞⠻ ⠺⠑⠊⠣⠎

⠼⠁ ⠇⠃⠲

In print, there is no space between "fl." and "oz."

Unless a Nemeth Code rule states otherwise, a space must be left between an abbreviation and the numeral to which it applies, even if the print copy shows no space.

Example 4.4-12 The differential pressure is 5.7kPa.

⠠⠮ ⠙⠊⠖⠻⠢⠞⠊⠁⠇ ⠏⠗⠑⠎⠎⠥⠗⠑ ⠊⠎
⠸⠩ ⠼⠢⠨⠶ ⠅⠠⠏⠁⠲ ⠸⠱

In print, there is no space between "5.7" and the abbreviation "kPa."

This Nemeth Code spacing rule applies even in UEB text.

Example 4.4-13 Measure the width of your desk using a 30mm ruler.

⠠⠍⠂⠎⠥⠗⠑ ⠮ ⠺⠊⠙⠹ ⠷ ⠽⠗ ⠙⠑⠎⠅ ⠥⠎⠬ ⠁ ⠀⠀⠀⠀⠀
⠼⠉⠚ ⠍⠍ ⠗⠥⠇⠻⠲

In print, there is no space between "30" and "mm".

> The BANA Nemeth Code Technical Committee is discussing details regarding punctuation of the omission dash and ellipsis when these symbols indicate a missing word or abbreviation. This section will be completed after decisions are made.

4.5 Numbers with Ordinal Endings: Ordinal endings are not abbreviations. Recall from **Lesson 1** that a numeral with an ordinal ending is brailled in UEB if it occurs in literary context.

Example 4.5-1 Rearrange: 2nd, 4th, 1st, 3rd.

⠠⠗⠑⠜⠗⠁⠝⠛⠑⠒ ⠼⠃⠝⠙⠂ ⠼⠙⠹⠂ ⠼⠁⠎⠞⠂ ⠼⠉⠗⠙⠲

If the ordinal appears in mathematical context, the ordinal ending becomes part of the expression and is punctuated mathematically.

⋙ 1st, ⠼⠂⠎⠞⠠

Example 4.5-2 first = 1st, second = 2nd, third = 3rd, fourth = 4th, ...

⠸⠩ ⠋⠊⠗⠎⠞ ⠨⠅ ⠼⠂⠎⠞⠠ ⠎⠑⠉⠕⠝⠙ ⠨⠅ ⠼⠆⠝⠙⠠
⠞⠓⠊⠗⠙ ⠨⠅ ⠼⠒⠗⠙⠠ ⠋⠕⠥⠗⠞⠓ ⠨⠅ ⠼⠲⠞⠓⠠ ⠄⠄⠄ ⠸⠱

PRACTICE 4B

1. If 1 lb. of Gouda cheese costs \$2.96, what will you pay for 2.5 lbs.?
2. If 2kg Gruyère costs £2,65, what is the cost of a wheel weighing 3kg?
3. Continuing the set of ordinals, fifth = 5th, sixth = 6th, seventh = 7th, eighth = 8th.
4. 1 kcal is equivalent to 3088.03 ft.lb.

More To Come This does not complete the discussion of abbreviations in mathematical context. Single-letter abbreviations, abbreviations that use the same letters as a shortform, and further spacing rules within mathematical expressions are discussed in **Lesson 5**.

Single-Word Switch Indicator

4.6 The Single-Word Switch Indicator: Words that do not provide mathematical meaning are transcribed in UEB. To avoid use of switch indicators when a single word (or hyphenated compound word) occurs between two math expressions, the single-word switch indicator is used to indicate that the following word (or hyphenated compound word) is in UEB. The indicator is unspaced from the word. Contractions are used according to the rules of UEB. The switch is required on a single word even if the word contains no contractions. The effect of the indicator is terminated by a space, and Nemeth Code resumes.

Single-Word Switch Indicator	⠠⠄

Example 4.6-1 Since $40 \cdot 7 = 280$ and $5 \cdot 7 = 35,$ does $45 \cdot 7 = 280 + 35$ or 315?

⠠⠄⠎⠔⠉⠑ ⠸⠩ ⠼⠲⠴⠡⠶ ⠨⠅ ⠼⠆⠦⠴ ⠠⠄⠯
⠼⠢⠡⠶ ⠨⠅ ⠼⠒⠢⠠ ⠠⠄⠙⠕⠑⠎
⠼⠲⠢⠡⠶ ⠨⠅ ⠼⠆⠦⠴⠬⠒⠢ ⠸⠱ ⠕⠗ ⠼⠉⠁⠑⠦

The words "Since," "and," "does," and "or" are part of the sentence structure—they are not being used mathematically—and so UEB applies. The linked expression $45 \cdot 7 = 280 + 35$ *is kept together on one braille line.*

Example 4.6-2 Compare: $2 + 2 = 4$ vis-à-vis $2 \times 2 = 4$.

⠠⠄⠉⠕⠍⠏⠜⠑⠒ ⠸⠩ ⠼⠆⠬⠆ ⠨⠅ ⠼⠲ ⠠⠄⠧⠊⠎⠤⠘⠡⠁⠤⠧⠊⠎
⠼⠆⠈⠡⠆ ⠨⠅ ⠼⠲⠸⠱⠲

Until this symbol becomes widely recognized, we suggest that the single-word switch indicator be listed on the Special Symbols page in the transcriber-generated portion of each volume. See **Lesson 18** for details.

4.6.1 Consider the Context: Compare the treatment of the word "of" in these two examples.

Example 4.6-3 Estimate tax: 6% of $5.25

⠠⠑⠌⠊⠍⠁⠞⠑ ⠞⠁⠭⠒ ⠸⠩ ⠼⠖⠈⠴ ⠠⠄⠷ ⠈⠎⠢⠨⠆⠢ ⠸⠱

"of" is narrative and so is brailled in UEB using a single-word switch.

Example 4.6-4 6% of $5.25 = $.32

⠸⠩ ⠼⠖⠈⠴ ⠕⠋ ⠈⠎⠢⠨⠆⠢ ⠨⠅ ⠈⠎⠨⠒⠆ ⠸⠱

"of" is part of the math expression ($5.25 alone does not equal $.32) and so "of" is brailled as a word in Nemeth Code, without contractions.

Example 4.6-5 What is 5.5 percent of 72? 5.5% of 72 = 3.96.

⠠⠱⠁⠞ ⠊⠎ ⠸⠩ ⠼⠢⠨⠢ ⠸⠱ ⠏⠻⠉⠢⠞ ⠷ ⠼⠛⠃⠦
⠸⠩ ⠼⠢⠨⠢⠈⠴ ⠕⠋ ⠼⠶⠆ ⠨⠅ ⠼⠒⠨⠔⠖ ⠸⠱⠲

4.6.2 Lower Wordsigns: A lower wordsign may be used with a single-word switch indicator without violating the lower sign rule.

Example 4.6-6 Let 2 + 3 × 4 be (2 + 3) × 4, and 2 + (3 × 4). What do you notice?

⠠⠇⠑⠞ ⠸⠩ ⠼⠆⠬⠒⠈⠡⠲ ⠠⠄⠆ ⠷⠆⠬⠒⠾⠈⠡⠲⠠ ⠠⠄⠯
⠼⠆⠬⠷⠒⠈⠡⠲⠾ ⠸⠱⠲ ⠠⠱⠁⠞ ⠙ ⠽ ⠝⠕⠞⠊⠉⠑⠦

4.6.3 Two or More Words: When more than one narrative word in succession appears within mathematical context, Nemeth Code must be terminated in order to transcribe the words in UEB.

Example 4.6-7 "Work the problem 2 + 3 × 4 as 2 + (3 × 4), not as (2 + 3) × 4," said Mary.

⠦⠠⠐⠺ ⠮ ⠏⠗⠕⠃⠇⠑⠍ ⠸⠩ ⠼⠆⠬⠒⠈⠡⠲ ⠠⠄⠵
⠼⠆⠬⠷⠒⠈⠡⠲⠾ ⠸⠱⠂ ⠝ ⠵ ⠸⠩ ⠷⠆⠬⠒⠾⠈⠡⠲ ⠸⠱⠂⠴ ⠎⠙
⠠⠍⠜⠽⠲

4.6.4 Switch Considerations: Just because a numeral can be brailled in UEB does not mean it *must* be brailled in UEB. Consider how cumbersome it would be to read the next example if you used Nemeth Code only for the negative numbers. (The correct transcription is shown.)

Example 4.6-8 The daily high temperatures last week (in degrees Fahrenheit) were 7, 1, –3, 0, –1, 3, and –5.

⠠⠮ ⠙⠁⠊⠇⠽ ⠓⠊⠣ ⠞⠑⠍⠏⠻⠁⠞⠥⠗⠑⠎ ⠇⠁⠌ ⠺⠑⠑⠅
⠐⠣⠔ ⠙⠑⠛⠗⠑⠑⠎ ⠠⠋⠁⠓⠗⠢⠓⠑⠊⠞⠐⠜ ⠶ ⠸⠩ ⠼⠶⠠ ⠼⠂⠠
⠤⠼⠒⠠ ⠼⠴⠠ ⠤⠼⠂⠠ ⠼⠒⠠ ⠠⠄⠯ ⠤⠼⠢ ⠸⠱⠲

Switch Indicators at Page Turns, cont.

4.7 Review of "Keep Together" Considerations: Now that you have had more experience with switch indicators, we will consider more layout issues that occur at braille page turns. Keep the following points in mind as they relate to mathematical expressions within the narrative text.

- A mathematical expression that will fit entirely on the braille line must not be divided between lines.
- If the math expression is preceded by the opening Nemeth Code indicator and followed by the Nemeth Code terminator, and if there is room on the line for both switch indicators and the expression, keep them all on the same line.
- If there is not room on the line for both switch indicators and the math expression, one of the switches will fall on a different line.
- If neither switch indicator will fit on the same line as the math expression, priority is given to keeping the math expression intact, placing each switch indicator on another line. The opening Nemeth Code indicator will be the last item on the preceding line; the Nemeth Code terminator will be the first item on the following line.
- If a page number on line 25 or line 1 does not allow the entire expression to fit on the line, the expression is brought down to the next line that has enough usable cells.
- If a math expression is preceded by the opening Nemeth Code indicator and followed by the Nemeth Code terminator and it falls at a page turn, place each switch indicator on the same page as the mathematical material to which it applies. An opening Nemeth Code indicator should not be the last item at the bottom of a braille page; a Nemeth Code Terminator should not be the first item at the top of a braille page.

The expression in the first example will fit on one braille line along with the switches and the ending punctuation ...

Example 4.7-1 Expressed in words, dividend ÷ divisor = quotient.

⠠⠑⠭⠏⠗⠑⠎⠎⠫ ⠔ ⠘⠺⠎⠂
⠸⠩ ⠙⠊⠧⠊⠙⠑⠝⠙⠨⠌⠙⠊⠧⠊⠎⠕⠗ ⠨⠅ ⠟⠥⠕⠞⠊⠑⠝⠞ ⠸⠱⠲

... unless a page number shares the line.

```
  ⠠⠑⠭⠏⠗⠑⠎⠎⠫ ⠔ ⠘⠺⠎⠂                   ⠼⠓⠙
— — — — — — — — — — — — — — — — — — — — — — —
⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠁⠼⠋
⠸⠩ ⠙⠊⠧⠊⠙⠑⠝⠙⠨⠌⠙⠊⠧⠊⠎⠕⠗ ⠨⠅ ⠟⠥⠕⠞⠊⠑⠝⠞ ⠸⠱⠲
```

..OR..

```
  ⠠⠑⠭⠏⠗⠑⠎⠎⠫ ⠔ ⠘⠺⠎⠂
⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠼⠓⠙
— — — — — — — — — — — — — — — — — — — — — — —
⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠁⠼⠋
⠸⠩ ⠙⠊⠧⠊⠙⠑⠝⠙⠨⠌⠙⠊⠧⠊⠎⠕⠗ ⠨⠅ ⠟⠥⠕⠞⠊⠑⠝⠞ ⠸⠱⠲
```

The expression in the next example will fit on one line but the code switch indicators will not. One of the indicators must be placed on a different line.

Example 4.7-2 Expressed in words, minuend – subtrahend = difference.

```
  ⠠⠑⠭⠏⠗⠑⠎⠎⠫ ⠔ ⠘⠺⠎⠂ ⠸⠩
⠍⠊⠝⠥⠑⠝⠙⠤⠎⠥⠃⠞⠗⠁⠓⠑⠝⠙ ⠨⠅ ⠙⠊⠋⠋⠑⠗⠑⠝⠉⠑ ⠸⠱⠲
```

At a page turn, do not leave the switch indicator alone at the bottom of a braille page.

```
  ⠠⠑⠭⠏⠗⠑⠎⠎⠫ ⠔ ⠘⠺⠎⠂                   ⠼⠓⠙
— — — — — — — — — — — — — — — — — — — — — — —
⠸⠩⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠁⠼⠋
⠍⠊⠝⠥⠑⠝⠙⠤⠎⠥⠃⠞⠗⠁⠓⠑⠝⠙ ⠨⠅ ⠙⠊⠋⠋⠑⠗⠑⠝⠉⠑ ⠸⠱⠲
```

..OR..

```
  ⠠⠑⠭⠏⠗⠑⠎⠎⠫ ⠔ ⠘⠺⠎⠂
⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠼⠓⠙
— — — — — — — — — — — — — — — — — — — — — — —
⠸⠩⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠁⠼⠋
⠍⠊⠝⠥⠑⠝⠙⠤⠎⠥⠃⠞⠗⠁⠓⠑⠝⠙ ⠨⠅ ⠙⠊⠋⠋⠑⠗⠑⠝⠉⠑ ⠸⠱⠲
```

The next example is similar to the example presented in **Lesson 2**—the expression itself requires a full braille line. The switch indicators are on the preceding and following lines.

Example 4.7-3 Expressed in words, dividend – partial product = remainder.

```
⠀⠀⠠⠑⠭⠏⠗⠑⠎⠎⠫⠀⠔⠀⠘⠺⠎⠂⠀⠸⠩
⠙⠊⠧⠊⠙⠑⠝⠙⠤⠏⠁⠗⠞⠊⠁⠇⠀⠏⠗⠕⠙⠥⠉⠞⠀⠨⠅⠀⠗⠑⠍⠁⠊⠝⠙⠑⠗
⠸⠱⠲
```

The switch indicators must fall on the same page as the expression to which they apply.

```
⠀⠀⠠⠑⠭⠏⠗⠑⠎⠎⠫⠀⠔⠀⠘⠺⠎⠂⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠼⠓⠙
— — — — — — — — — — — — — — — — — — — — — — —
⠸⠩⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠁⠼⠋
⠙⠊⠧⠊⠙⠑⠝⠙⠤⠏⠁⠗⠞⠊⠁⠇⠀⠏⠗⠕⠙⠥⠉⠞⠀⠨⠅⠀⠗⠑⠍⠁⠊⠝⠙⠑⠗
⠸⠱⠲
```

..OR..

```
⠀⠀⠠⠑⠭⠏⠗⠑⠎⠎⠫⠀⠔⠀⠘⠺⠎⠂
⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠼⠓⠙
— — — — — — — — — — — — — — — — — — — — — — —
⠸⠩⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠁⠼⠋
⠙⠊⠧⠊⠙⠑⠝⠙⠤⠏⠁⠗⠞⠊⠁⠇⠀⠏⠗⠕⠙⠥⠉⠞⠀⠨⠅⠀⠗⠑⠍⠁⠊⠝⠙⠑⠗
⠸⠱⠲
```

In this final example, there is more than one expression between the code switches. Each expression is kept together on one braille line but there is no need to force the switches to be on the same page. There is no need to restate "Nemeth Code" at the page turn.

Example 4.7-4 Find the volume of a rectangular prism with length = 2 ft, width = 4 ft, and height = 3 ft.

```
⠀⠀⠠⠋⠔⠙⠀⠮⠀⠧⠕⠇⠥⠍⠑⠀⠷⠀⠁⠀⠗⠑⠉⠞⠁⠝⠛⠥⠇⠜⠀⠏⠗⠊⠎⠍⠀⠾
⠸⠩⠀⠇⠑⠝⠛⠞⠓⠀⠨⠅⠀⠼⠆⠀⠋⠞⠂⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠼⠉⠉
— — — — — — — — — — — — — — — — — — — — — — —
⠺⠊⠙⠞⠓⠀⠨⠅⠀⠼⠲⠀⠋⠞⠂⠀⠠⠄⠯⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠁⠼⠃⠃
⠓⠑⠊⠛⠓⠞⠀⠨⠅⠀⠼⠒⠀⠋⠞⠀⠸⠱⠲
```

Each of the three expressions must not be allowed to wrap before or after the equals sign or between the numeral and the abbreviation "ft". The first two occurrences of the abbreviation "ft" do not have a related period so you must assume that the period following the third occurrence does not relate to the abbreviation; it only ends the sentence and so is brailled after the Nemeth Code terminator.

Instructions: In the first paragraph, assume there is a braille page turn after the word "to". Use braille page number "55" and print page number "a44" on line 1 of the new braille page.

PRACTICE 4C

A unit of work is the foot-pound (ft-lb). One foot-pound converts to 12.000000427771 inch-pounds. How many in-lb is 4.6 ft-lb? How many ft-lb is 247.9927443 in-lb?

If 1 joule = 10 million ergs, and 1 megajoule = 1,000,000 joules, how many ergs is 1 megajoule? 1megajoule = ? ergs

---

4.8 New Print Page: The page change indicator and page number are constructed in the same way in either code. The code in place before the page change indicator remains in effect following the page change indicator.

Example 4.8-1 Are 5 ∶ 2, 10 ∶ 4, and

— — — — — [print page turn] — — — — — — — — —

15 ∶ 16 equivalent ratios?

⠀⠀⠠⠜⠑ ⠸⠩ ⠼⠢ ⠐⠂ ⠼⠆⠠ ⠼⠂⠴ ⠐⠂ ⠼⠲⠠ ⠠⠄⠯
⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠤⠼⠃⠙
⠼⠂⠢ ⠐⠂ ⠼⠂⠖ ⠸⠱ ⠑⠟⠥⠊⠧⠁⠇⠢⠞ ⠗⠁⠞⠊⠕⠎⠦

LETTERS

4.9 Single English Letters in Narrative: The language of mathematics uses single letters as mathematical characters. Special provision is made for a single English letter that has mathematical meaning when it appears within narrative. As long as the English letter is freestanding and is unmodified, it may be transcribed in UEB. The letter may touch punctuation.

Example 4.9-1 In this equation, b must be greater than a.

⠀⠀⠠⠔ ⠹ ⠑⠟⠥⠁⠰⠝⠂ ⠰⠃ ⠍⠌ ⠆ ⠛⠗⠞⠻ ⠹⠁⠝ ⠁⠲

Example 4.9-2 Graph the models of temperatures in summer (s) and in winter (w).

⠀⠀⠠⠛⠗⠁⠏⠓ ⠮ ⠍⠕⠙⠑⠇⠎ ⠷ ⠞⠑⠍⠏⠻⠁⠞⠥⠗⠑⠎ ⠔
⠎⠥⠍⠍⠻ ⠐⠣⠰⠎⠐⠜ ⠯ ⠔ ⠺⠔⠞⠻ ⠐⠣⠰⠺⠐⠜⠲

A freestanding letter with an ordinal ending may also be brailled in UEB.

Example 4.9-3 Find the nth term of the arithmetic sequence.

⠠⠋⠔⠙ ⠮ ⠝⠹ ⠞⠻⠍ ⠷ ⠮ ⠜⠊⠹⠍⠑⠞⠊⠉ ⠎⠑⠟⠥⠰⠑⠲

Exception: Certain mathematical letters are characterized by a special typeface and must be brailled in Nemeth Code. Such letters will be studied in **Lesson 7**.

4.10 Single English Letters in Nemeth Code: An English letter that has mathematical meaning and which appears in technical context—that is, between Nemeth Code switches—is transcribed according to the rules of the Nemeth Code. Before illustrating the rules with examples, the definition of "single letter" as used in the Nemeth Code is presented.

4.10.1 Nemeth Code Definition of "Single Letter": To be defined as a "single letter" in the Nemeth Code several criteria must be met.

i. A "single letter" must be from the English alphabet, in regular type, and unmodified.

These are "single letters"	p D z R	
These are not "single letters"	π $\mathbf{D}$ $\bar{z}$ $\mathbb{R}$	*The first letter is not from the English alphabet, the second and fourth letters are not in regular type, the third letter is modified.*

- o SPECIAL CASE: A letter representing a mathematical variable is often printed in italics but the italics are disregarded in braille. **Lesson 7** discusses typeform.

ii. Furthermore, in the print copy the letter must be both preceded by a space or by one or more punctuation marks *AND* followed by a space or by one or more punctuation marks.

These are "single letters"	"y" x, "w S"	*Each letter is preceded and followed by punctuation or by a space.*
These are not "single letters"	−x "wS" y+z	*The x, z, and S are not preceded by a space or by punctuation (−x is "negative x"); the y and the w are not followed by a space or by punctuation.*

- o *Note:* Nemeth Code grouping symbols are not considered to be punctuation marks. Rules for letters touching grouping symbols are discussed later.

iii. Whether the leading punctuation mark is preceded by a space or not is irrelevant; whether the following punctuation mark is followed by a space or not is irrelevant.

These are "single letters"	"x"+"y"	*Each letter is both preceded and followed by punctuation.*

iv. If the space shown in print is not shown in braille, the letter is no longer a "single letter."

These are not "single letters" $r + s$ *Although each letter is preceded and followed by a space in print, in braille the plus sign is unspaced from the letters.*

v. And finally, to be defined as a "single letter" the letter must not be an abbreviation nor can it be a word ("a", "A", "I", or "O").

These are not "single letters" I need 4.5 m of fabric. *"I" is a word; "m" is an abbreviation for "meters".*

Single-letter abbreviations are discussed in a later lesson.

Throughout this course, when referring to the Nemeth Code definition of a single letter, the term "single letter" is in quotation marks.

Introduction to the English Letter Indicator

When a single letter from the English alphabet is used in mathematical context it may require the use of the English letter indicator. And—even though no contractions are used in Nemeth Code—a letter combination that is the same as a shortform may require the use of a letter indicator for clarity.

English Letter Indicator ("ELI") ⠰

Several rules are in place regarding situations where the ELI is or is not used. It is important to note that the English letter indicator does not function in the same way as the UEB Grade 1 symbol indicator. The term "English letter indicator" clearly describes the function of the indicator.

4.11 Use of the English Letter Indicator with a "Single Letter": Except as noted in the next section, an ELI is required when a letter is a "single letter" as defined in **4.10.1**, above.

4.11.1 Capitalization of "Single Letters": To indicate a single capitalized letter, the capitalization indicator is placed between the ELI and the letter. The effect of the capitalization indicator extends only to the letter which follows it.

Capitalization Indicator ⠠

4.11.2 Punctuation of "Single Letters": A "single letter" is punctuated mathematically if the letter and the punctuation fall within the Nemeth switch indicators.

The examples from **4.10.1** are illustrated below, assuming mathematical context. Note the placement of the capitalization indicator as well as the use of mathematical punctuation.

Example 4.11-1 p D z R x, "y" "w S" "x"+"y"

⠸⠩ ⠰⠏ ⠰⠠⠙ ⠰⠵ ⠰⠠⠗ ⠰⠭⠠ ⠦⠰⠽⠸⠴ ⠦⠰⠺ ⠰⠠⠎⠸⠴
⠦⠰⠭⠸⠴⠬⠸⠦⠰⠽⠸⠴ ⠸⠱

4.11.3 Mapping Notation: In mapping notation, the symbol **:** is brailled as an unspaced colon. In the next example, because the letters n and v are each preceded AND followed by a space and/or a punctuation mark, they each require an ELI. A punctuation indicator is required before the colon.

⫸ m:W ⠰⠍⠸⠒⠰⠺

Example 4.11-2 m:W means "the mapping m of W."

⠸⠩ ⠰⠍⠸⠒⠰⠠⠺ ⠸⠱ ⠍⠂⠝⠎ ⠦⠮ ⠍⠁⠏⠏⠬ ⠰⠍ ⠷ ⠰⠠⠺⠲⠴

Instructions: Demonstrate use of the English letter indicator and proper punctuation mode in the following series of single letters. Braille this practice entirely in Nemeth Code, using Example 4.11-1 as a model.

PRACTICE 4D

c, C; r, R; "l", "L"; "i, j, k"; "l"×"w"×"h"; f:R.

4.12 Nonuse of the English Letter Indicator with a "Single Letter":

Even though a letter meets the criteria of "single letter" above , the ELI is not used when the following conditions are present.

4.12.1 Comparison Sign: If the letter is immediately preceded by a sign of comparison an ELI is not used.

⫸ 4 > x ⠼⠲ ⠨⠂ ⠭

If the letter is immediately followed by a sign of comparison an ELI is not used.

⫸ x > 2 ⠭ ⠨⠂ ⠼⠆

⫸ a : b :: c : d ⠁ ⠐⠂ ⠃ ⠰⠆ ⠉ ⠐⠂ ⠙

⫸ "x = 3" ⠦⠭ ⠨⠅ ⠼⠒⠸⠴

Example 4.12-1 Prove: If x, y, and u are real numbers such that $x < y$ and $x = u$, then $u < y$.

⠠⠏⠗⠕⠧⠑⠒ ⠠⠊⠋ ⠰⠭⠂ ⠰⠽⠂ ⠯ ⠰⠥ ⠜⠑ ⠗⠂⠇
⠝⠥⠍⠃⠻⠎ ⠎⠡ ⠞ ⠸⠩ ⠭ ⠐⠅ ⠽ ⠠⠄⠯ ⠭ ⠨⠅ ⠥⠠ ⠠⠄⠮⠝
⠥ ⠐⠅ ⠽ ⠸⠱⠲

Note: If punctuation comes between the letter and a sign of comparison, the letter is now a "single letter" by definition and an ELI is required.

⋙ "x" = 3 ⠦⠰⠭⠸⠴ ⠨⠅ ⠼⠒

In this mapping example, the letters "p" and "s" require an ELI because they are "single letters". Letters "r" and "q" do not need an ELI because they immediately precede/follow a sign of comparison.

⋙ p:r = q:s ⠰⠏⠸⠒⠗ ⠨⠅ ⠟⠸⠒⠰⠎

4.12.2 Enclosed Within Grouping Symbols: If a "single letter" is entirely enclosed within signs of grouping, the ELI is omitted.

⋙ (a) ⠷⠁⠾

⋙ {P} ⠨⠷⠠⠏⠨⠾

⋙ |y| ⠳⠽⠳

Example 4.12-2 "The absolute value of y" is notated |y|.

⠦⠠⠮ ⠁⠃⠎⠕⠇⠥⠞⠑ ⠧⠁⠇⠥⠑ ⠷ ⠰⠽⠴ ⠊⠎ ⠝⠕⠞⠁⠞⠫
⠸⠩ ⠳⠽⠳ ⠸⠱⠲

4.12.3 Unspaced Sequence of Terms: The ELI is not used with one or more English letters (in regular type) which occur in an unspaced sequence of mathematical symbols.

⋙ d' ⠙⠄

⋙ N% ⠠⠝⠈⠴

⋙ 2z ⠼⠆⠵

⋙ 2 × z ⠼⠆⠈⠡⠵

⋙ 2nth ⠼⠆⠝⠞⠓

Example 4.12-3 Sides d' and d are similar.

⠠⠎⠊⠙⠑⠎ ⠸⠩ ⠙⠄ ⠸⠱ ⠯ ⠰⠙ ⠜⠑ ⠎⠊⠍⠊⠇⠜⠲

Example 4.12-4 35 equals N% of 120.

⠼⠉⠑ ⠑⠟⠥⠁⠇⠎ ⠸⠩ ⠠⠝⠈⠴ ⠸⠱ ⠷ ⠼⠁⠃⠚⠲

Example 4.12-5 2 · z can also be written as 2z.

⠸⠩ ⠼⠆⠡⠵ ⠸⠱ ⠉ ⠁⠇ ⠆ ⠺⠗⠊⠞⠞⠢ ⠵ ⠸⠩ ⠼⠆⠵ ⠸⠱⠲

Example 4.12-6 Let 5y = the smaller number.

⠠⠇⠑⠞ ⠸⠩ ⠼⠢⠽ ⠨⠅ ⠞⠓⠑ ⠎⠍⠁⠇⠇⠑⠗ ⠝⠥⠍⠃⠑⠗ ⠸⠱⠲

The words "the smaller number" are part of the math expression (they show what 5y equals) and so are included within the switches.

Example 4.12-7 A field containing the nth roots of unity for odd n also contains the 2nth roots.

⠠⠁ ⠋⠊⠑⠇⠙ ⠒⠞⠁⠔⠬ ⠮ ⠝⠹ ⠗⠕⠕⠞⠎ ⠷ ⠥⠝⠰⠽ ⠿
⠕⠙⠙ ⠰⠝ ⠁⠇ ⠒⠞⠁⠔⠎ ⠮ ⠸⠩ ⠼⠆⠝⠞⠓ ⠸⠱ ⠗⠕⠕⠞⠎⠲

4.12.3.a Probability Notation: In probability notation, a letter (often "P" which represents "the probability of") is followed, unspaced, by the "event" which is written between mathematical grouping symbols (often parentheses). In the next example, the event is "heads". Because the letter "P" is unspaced from the mathematical symbol "(" the letter is not a "single letter" and so an ELI is not used.

⋙ P(heads) ⠠⠏⠷⠓⠑⠁⠙⠎⠾

Example 4.12-8 The probability of a flipped coin landing on "heads" is written P(heads).

⠠⠮ ⠏⠗⠕⠃⠁⠃⠊⠇⠰⠽ ⠷ ⠁ ⠋⠇⠊⠏⠏⠫ ⠉⠕⠔ ⠇⠯⠬ ⠕⠝
⠦⠓⠂⠙⠎⠴ ⠊⠎ ⠺⠗⠊⠞⠞⠢ ⠸⠩ ⠠⠏⠷⠓⠑⠁⠙⠎⠾ ⠸⠱⠲

4.13 Letters as Identifiers: Letters used as identifiers are constructed according to the rules of the code which is in effect at the time—UEB or Nemeth Code. Compare:

Print	UEB	Nemeth Code
a.	⠁⠲	⠰⠁⠸⠲
B.	⠰⠠⠃⠲	⠰⠠⠃⠸⠲
(a)	⠐⠣⠁⠐⠜	⠷⠁⠾
(B)	⠐⠣⠰⠠⠃⠐⠜	⠷⠠⠃⠾
c)	⠰⠉⠐⠜	⠰⠉⠾

Instructions: Demonstrate the use and the nonuse of the English letter indicator for "single letters" by brailling this practice entirely in Nemeth Code. To keep the identifiers beginning in the proper cell, braille an opening Nemeth Code indicator in cell 1 on the first line and begin the first item on the next line.

PRACTICE 4E

(a) $\mathrm{r} = \mathrm{rate}$

(b) $\text{"r"} = \mathrm{rate}$

(c) $\mathrm{x},\ \mathrm{y},\ \mathrm{z} < 100$

(d) $\mathrm{n}¢ = \$4.95$

(e) $\mathrm{x} > \text{"3"}$

(f) $\mathrm{a} + \mathrm{b}$

(g) $|\mathrm{y}| = |-\mathrm{y}|$

(h) $|\mathrm{x} + \mathrm{y}| = |\mathrm{x}| + |\mathrm{y}|$

(i) $\mathrm{P}(\text{red and blue})$

Mathematical Letter Combinations

4.14 Mathematical Letter Sequence: The option to remain in UEB to braille a mathematical letter applies only to a single freestanding English letter. A mathematical sequence of letters is a mathematical expression and must be transcribed in Nemeth Code. A mathematical letter sequence is punctuated mathematically if the punctuation falls within the Nemeth switch indicators.

Example 4.14-1 Rays on, om, and op are the same length.

⠠⠗⠁⠽⠎ ⠸⠩ ⠕⠝⠠ ⠕⠍⠠ ⠠⠄⠯ ⠕⠏ ⠸⠱ ⠜⠑ ⠮ ⠎⠁⠍⠑
⠇⠢⠛⠹⠲

Example 4.14-2 If th equals ef, then lm equals ch.

⠠⠊⠋ ⠸⠩ ⠞⠓ ⠠⠄⠑⠟⠥⠁⠇⠎ ⠑⠋⠠ ⠠⠄⠮⠝ ⠇⠍
⠠⠄⠑⠟⠥⠁⠇⠎ ⠉⠓ ⠸⠱⠲

The BANA Nemeth Code Technical Committee is discussing details regarding the treatment of letter sequences in terms such as xy-coordinate and yz-plane. Correct transcriptions of the next two examples will be confirmed after decisions are made. For now we recommend treating the entire hyphenated expression mathematically.

Example 4.14-3 Draw an xy-coordinate graph.

PROVISIONAL SOLUTION:

⠠⠙⠗⠁⠺ ⠁⠝ ⠸⠩ ⠭⠽⠤⠉⠕⠕⠗⠙⠊⠝⠁⠞⠑ ⠸⠱ ⠛⠗⠁⠏⠓⠲

Example 4.14-4 Note where the cylinder intersects the yz-plane.

PROVISIONAL SOLUTION:

⠠⠝⠕⠞⠑ ⠐⠱ ⠮ ⠉⠽⠇⠔⠙⠻ ⠔⠞⠻⠎⠑⠉⠞⠎ ⠮
⠸⠩ ⠽⠵⠤⠏⠇⠁⠝⠑ ⠸⠱⠲

4.15 Capitalized Letter Sequence: Each capitalized letter in a mathematical sequence of letters must be capitalized individually.

⪢ PQRS ⠠⠏⠠⠟⠠⠗⠠⠎

Example 4.15-1 Prove PQRS is a rhombus.

⠠⠏⠗⠕⠧⠑ ⠸⠩ ⠠⠏⠠⠟⠠⠗⠠⠎ ⠸⠱ ⠊⠎ ⠁ ⠗⠓⠕⠍⠃⠥⠎⠲

4.16 Shortform Letter Combinations: If the mathematical letter sequence corresponds to a shortform of UEB, further rules apply. To be a "shortform letter combination" in mathematical context the letters must correspond to a shortform of UEB, must not represent a word or an abbreviation, and all of its letters must be lowercase.

These are "shortform letter combinations"	ab ac dcl
These are not "shortform letter combinations"	Ab ad DCL

Abbreviations that use the same letters as a shortform are discussed in a later lesson.

Rules regarding the use or nonuse of the ELI with a "shortform letter combination" are similar to the rules which apply to "single letters".

4.16.1 Use of the English Letter Indicator with a "Shortform Letter Combination": The ELI is used when a shortform letter combination ...

i. is in regular type;
ii. is unmodified;
iii. is preceded by a space or by one or more punctuation marks AND followed by a space or by one or more punctuation marks. Nemeth grouping symbols are not punctuation marks.

The effect of the indicator extends to the entire shortform following it.

Example 4.16-1 Use mathematical notation to express "ac times cd" and "cd plus de".

⠠⠥⠎⠑ ⠍⠁⠮⠍⠁⠞⠊⠉⠁⠇ ⠝⠕⠞⠁⠰⠝ ⠞⠕ ⠑⠭⠏⠗⠑⠎⠎
⠸⠩ ⠦⠰⠁⠉ ⠠⠄⠐⠞⠎ ⠰⠉⠙⠸⠴ ⠠⠄⠯ ⠦⠰⠉⠙ ⠠⠄⠏⠇⠥⠎
⠙⠑⠸⠴ ⠸⠱⠲

Two-letter combinations must be brailled in Nemeth Code, but only those letter combinations that are the same as a shortform require an ELI. Mathematical punctuation is used.

4.16.1.a Ordinals: The Nemeth Code rules regarding the use of the ELI are followed when an ordinal ending is present. If an ELI is required without the ordinal ending, it is still necessary. A switch to Nemeth Code is required because of the two-letter mathematical items.

Example 4.16-2 Mark the abth and jkth columns.

⠠⠍⠜⠅ ⠮ ⠸⠩ ⠰⠁⠃⠞⠓ ⠠⠄⠯ ⠚⠅⠞⠓ ⠸⠱ ⠉⠕⠇⠥⠍⠝⠎⠲

Only the letter combination that is the same as a shortform requires an ELI.

4.16.2 Nonuse of the English Letter Indicator with a "Shortform Letter Combination": When the following conditions are present, the ELI is not used even though a letter combination meets the criteria above. For English letters in regular type, an ELI is not used ...

... if the shortform contains any capitalized letters;

Example 4.16-3 Find chords AB, AC, and EF.

⠠⠋⠔⠙ ⠡⠕⠗⠙⠎ ⠸⠩ ⠠⠁⠠⠃⠠ ⠠⠁⠠⠉⠠ ⠠⠄⠯
⠠⠑⠠⠋ ⠸⠱⠲

Example 4.16-4 Wd means "W times d".

⠸⠩ ⠠⠺⠙ ⠸⠱ ⠍⠂⠝⠎ ⠦⠰⠠⠺ ⠐⠞⠎ ⠰⠙⠴⠲

... if the shortform letter combination immediately precedes or follows a sign of comparison.

Example 4.16-5 If a = c = d, then ac = cd.

⠠⠊⠋ ⠸⠩ ⠁ ⠨⠅ ⠉ ⠨⠅ ⠙⠠ ⠠⠄⠮⠝
⠁⠉ ⠨⠅ ⠉⠙ ⠸⠱⠲

It also follows that ...

... if the shortform letter combination is not both preceded and followed by a space or by punctuation, an ELI is not needed.

Example 4.16-6 What is angle acr + angle rcb?

⠠⠱⠁⠞ ⠊⠎ ⠸⠩ ⠁⠝⠛⠇⠑ ⠁⠉⠗⠬⠁⠝⠛⠇⠑ ⠗⠉⠃ ⠸⠱⠦

Example 4.16-7 3g × 3r × 3t = 27grt.

⠸⠩ ⠼⠒⠛⠈⠡⠒⠗⠈⠡⠒⠞ ⠨⠅ ⠼⠆⠶⠛⠗⠞ ⠸⠱⠲

... if the shortform is in direct contact with both an opening and a closing grouping sign, no ELI is used.

Example 4.16-8 (ab) and (cd) are not equal.

⠸⠩ ⠷⠁⠃⠾ ⠠⠄⠯ ⠷⠉⠙⠾ ⠸⠱ ⠜⠑ ⠝ ⠑⠟⠥⠁⠇⠲

Instructions: These examples illustrate both use and nonuse of the English letter indicator with a "single letter" or a "shortform letter combination". Explain your decisions.

PRACTICE 4F

(A) Prove: If $\mathrm{a} < \mathrm{b}$ and $\mathrm{c} < 0$, then $\mathrm{ac} > \mathrm{bc}$. Verify your proof by determining ac and bc when $\mathrm{a} = 5$, $\mathrm{b} = 7$, and $\mathrm{c} = -4$.

(B) $\mathrm{j} = 1, 2, \ldots, \mathrm{n}$

(C) 40% of $\mathrm{N} = 120$

(D) 40% of "N" $= 120$

(E) If "rcv = rjc" does "v" = "j"?

FORMAT SUMMARY #2

Here is a summary of the Nemeth Code formats encountered in Lessons 3 and 4.

Side-by-Side Items in Itemized Material with No Subdivisions: When unsubdivided itemized material is arranged side by side across the page in print, the braille format must be changed so that all identifiers start in cell 1.

Keep Together—Hyphenated Expressions: A hyphenated expression containing one or more mathematical components must not be divided between braille lines.

Keep Together—Mathematical Expression: If a page number on line 25 or line 1 does not allow the entire mathematical expression to fit on the line, the expression must be brought down to the next line that has enough usable cells. If the expression will fit on one line but the code switch indicators will not, one or both of the indicators can be placed on a different line.

Keep Together—Abbreviation: An abbreviation and a preceding or following numeral to which it applies must not be divided between braille lines.

For further practice, see Appendix A—Reading Practice.

ANSWERS TO PRACTICE MATERIAL

⠠⠠⠏⠗⠁⠉⠞⠊⠉⠑ ⠼⠙⠠⠁

⠠⠁⠲ ⠠⠊⠋ ⠼⠁ ⠏⠨⠙ ⠷ ⠠⠎⠺⠊⠎⠎ ⠡⠑⠑⠎⠑ ⠉⠕⠌⠎
⠸⠩ ⠈⠎⠆⠨⠢⠴ ⠸⠱⠂ ⠓⠪ ⠍⠡ ⠙⠕⠑⠎ ⠸⠩ ⠼⠲⠨⠶
⠏⠨⠙⠎ ⠉⠕⠌⠎⠦

⠰⠠⠃⠲ ⠠⠠⠚⠍⠓⠎⠄⠎ ⠎⠑⠞ ⠷ ⠓⠊⠣⠤⠚⠥⠍⠏ ⠡⠁⠍⠏⠊⠕⠝⠎⠒
⠸⠩ ⠨⠷⠠⠞⠑⠗⠗⠽⠂ ⠠⠇⠑⠎⠇⠊⠑⠂ ⠠⠞⠗⠁⠉⠊⠨⠾ ⠸⠱

⠰⠠⠉⠲ ⠠⠮ ⠐⠏⠎ ⠷ ⠁ ⠎⠥⠃⠞⠗⠁⠉⠰⠝ ⠏⠗⠕⠃⠇⠑⠍ ⠜⠑ ⠐⠝⠙
⠵ ⠋⠕⠇⠇⠪⠎⠒
⠸⠩ ⠍⠊⠝⠥⠑⠝⠙⠤⠎⠥⠃⠞⠗⠁⠓⠑⠝⠙ ⠨⠅ ⠙⠊⠋⠋⠑⠗⠑⠝⠉⠑⠲

⠰⠠⠙⠸⠲ ⠼⠔⠦⠨⠖ ⠸⠱ ⠙⠑⠛⠗⠑⠑⠎ ⠠⠋⠁⠓⠗⠢⠓⠑⠊⠞ ⠊⠎ ⠝
⠝⠑⠉⠑⠎⠎⠜⠊⠇⠽ ⠦⠝⠕⠗⠍⠁⠇⠴ ⠃⠕⠙⠽ ⠞⠑⠍⠏⠻⠁⠞⠥⠗⠑ ⠿
⠐⠑⠽⠐⠕⠲

⠰⠠⠑⠲ ⠠⠋⠔⠙ ⠮ ⠕⠗⠊⠛⠔⠁⠇ ⠯ ⠝⠑⠺ ⠏⠗⠊⠉⠑⠎ ⠱⠢
⠸⠩ ⠭ ⠨⠅ ⠼⠆ ⠸⠱ ⠛⠁⠍⠑⠎ ⠯ ⠱⠢ ⠸⠩ ⠭ ⠨⠅ ⠼⠶ ⠸⠱
⠛⠁⠍⠑⠎⠲ ⠠⠙⠊⠙ ⠽ ⠛⠑⠞ ⠮ ⠎⠁⠍⠑ ⠁⠝⠎⠺⠻⠎ ⠵ ⠽
⠋⠨⠙ ⠔ ⠏⠗⠕⠃⠇⠑⠍ ⠼⠋⠦

A. *A number and a related word ("4.7 pounds") do not have to fall together on the same line.*

B. *Words are punctuated with the dot 2 comma, even in mathematical context.*

C. *Following Nemeth Code spacing rules, the operation sign is unspaced from the words "minuend" and "subtrahend". Words are brailled without contractions in Nemeth Code. The period following the word "difference" does not need a punctuation indicator even though Nemeth Code has not yet terminated.*

D. *The identifier is in Nemeth Code—a punctuation indicator is needed before the period following the single letter "D". Nemeth Code terminates after "98.6".*

⠠⠠⠏⠗⠁⠉⠞⠊⠉⠑ ⠼⠙⠠⠃

⠼⠁⠲ ⠠⠊⠋ ⠼⠁ ⠇⠃⠲ ⠷ ⠠⠛⠳⠙⠁ ⠡⠑⠑⠎⠑ ⠉⠕⠌⠎
⠸⠩ ⠈⠎⠆⠨⠔⠖ ⠸⠱⠂ ⠱⠁⠞ ⠺ ⠽ ⠏⠁⠽ ⠿
⠸⠩ ⠼⠆⠨⠢ ⠇⠃⠎⠲ ⠸⠱⠦
⠼⠃⠲ ⠠⠊⠋ ⠼⠃ ⠅⠛ ⠠⠛⠗⠥⠽⠘⠡⠑⠗⠑ ⠉⠕⠌⠎
⠸⠩ ⠈⠇⠆⠨⠖⠢ ⠸⠱⠂ ⠱⠁⠞ ⠊⠎ ⠮ ⠉⠕⠌ ⠷ ⠁ ⠱⠑⠑⠇
⠺⠑⠊⠣⠬ ⠼⠉ ⠅⠛⠦
⠼⠉⠲ ⠠⠒⠞⠔⠥⠬ ⠮ ⠎⠑⠞ ⠷ ⠕⠗⠙⠔⠁⠇⠎⠂
⠸⠩ ⠋⠊⠋⠞⠓ ⠨⠅ ⠼⠢⠞⠓⠠ ⠎⠊⠭⠞⠓ ⠨⠅ ⠼⠖⠞⠓⠠
⠎⠑⠧⠑⠝⠞⠓ ⠨⠅ ⠼⠶⠞⠓⠠ ⠑⠊⠛⠓⠞⠓ ⠨⠅ ⠼⠦⠞⠓ ⠸⠱⠲
⠼⠙⠲ ⠼⠁ ⠅⠉⠁⠇ ⠊⠎ ⠑⠟⠥⠊⠧⠁⠇⠢⠞ ⠞⠕
⠸⠩ ⠼⠒⠴⠦⠶⠨⠲⠒ ⠋⠞⠲⠇⠃⠲ ⠸⠱

1. *A number and a related abbreviation ("2.5 lbs.") must not be separated between lines.*

2. *There must be a space between the number and the abbreviation "kg". The continental decimal point is brailled as (46).*

3. *Care is taken to ensure that each linked expression is not divided between braille lines. The ordinals are punctuated mathematically within the code switches.*

4. *The spacing of "ft.lb." matches print spacing (unspaced).*

⠠⠠⠏⠗⠁⠉⠞⠊⠉⠑ ⠼⠙⠠⠉

⠠⠁ ⠥⠝⠊⠞ ⠷ ⠐⠺ ⠊⠎ ⠮ ⠋⠕⠕⠞⠤⠏⠨⠙ ⠐⠣⠋⠞⠤⠇⠃⠐⠜⠲
⠠⠐⠕ ⠋⠕⠕⠞⠤⠏⠨⠙ ⠒⠧⠻⠞⠎ ⠞⠕   ⠼⠑⠑

⠸⠩ ⠼⠂⠆⠨⠴⠴⠴⠴⠴⠴⠲⠆⠶⠶⠶⠂ ⠸⠱ ⠔⠡⠤⠏⠨⠙⠎⠲   ⠁⠼⠙⠙
⠠⠓⠪ ⠸⠍ ⠔⠤⠇⠃ ⠊⠎ ⠸⠩ ⠼⠲⠨⠖ ⠋⠞⠤⠇⠃ ⠸⠱⠦ ⠠⠓⠪ ⠸⠍
⠋⠞⠤⠇⠃ ⠊⠎ ⠸⠩ ⠼⠆⠲⠶⠨⠔⠔⠆⠶⠲⠲⠒ ⠊⠝⠤⠇⠃⠦
⠠⠄⠠⠊⠋ ⠼⠂ ⠚⠕⠥⠇⠑ ⠨⠅ ⠼⠂⠴ ⠍⠊⠇⠇⠊⠕⠝ ⠑⠗⠛⠎⠂
⠠⠄⠯ ⠼⠂ ⠍⠑⠛⠁⠚⠕⠥⠇⠑ ⠨⠅ ⠼⠂⠠⠴⠴⠴⠠⠴⠴⠴ ⠚⠕⠥⠇⠑⠎
⠸⠱⠂ ⠓⠪ ⠸⠍ ⠻⠛⠎ ⠊⠎ ⠼⠁ ⠍⠑⠛⠁⠚⠳⠇⠑⠦
⠸⠩ ⠼⠂ ⠍⠑⠛⠁⠚⠕⠥⠇⠑ ⠨⠅ ⠿ ⠑⠗⠛⠎ ⠸⠱

⠠⠠⠏⠗⠁⠉⠞⠊⠉⠑ ⠼⠙⠠⠉

⠸⠩ ⠰⠉⠠ ⠰⠠⠉⠸⠆ ⠰⠗⠠ ⠰⠠⠗⠸⠆ ⠦⠰⠇⠸⠴⠠ ⠦⠰⠠⠇⠸⠴⠆
⠦⠰⠊⠠ ⠰⠚⠠ ⠰⠅⠸⠴⠆ ⠦⠰⠇⠸⠴⠈⠡⠸⠦⠰⠺⠸⠴⠈⠡⠸⠦⠰⠓⠸⠴⠆
⠰⠋⠸⠒⠰⠠⠗⠸⠲ ⠸⠱

Although the final period may be brailled outside of the terminator, because each of the other letters is followed by punctuation, it is logical to complete the sentence in Nemeth Code.

⠠⠠⠏⠗⠁⠉⠞⠊⠉⠑ ⠼⠙⠠⠑

⠸⠩

⠷⠁⠾ ⠗ ⠨⠅ ⠗⠁⠞⠑

⠷⠃⠾ ⠦⠰⠗⠸⠴ ⠨⠅ ⠗⠁⠞⠑

⠷⠉⠾ ⠰⠭⠠ ⠰⠽⠠ ⠵ ⠐⠅ ⠼⠂⠴⠴

⠷⠙⠾ ⠝⠈⠉ ⠨⠅ ⠈⠎⠲⠨⠔⠢

⠷⠑⠾ ⠭ ⠨⠂ ⠦⠼⠒⠸⠴

⠷⠋⠾ ⠁⠬⠃

⠷⠛⠾ ⠳⠽⠳ ⠨⠅ ⠳⠤⠽⠳

⠷⠓⠾ ⠳⠭⠬⠽⠳ ⠨⠅ ⠳⠭⠳⠬⠳⠽⠳

⠷⠊⠾ ⠠⠏⠷⠗⠑⠙ ⠁⠝⠙ ⠃⠇⠥⠑⠾ ⠸⠱

⠠⠠⠏⠗⠁⠉⠞⠊⠉⠑ ⠼⠙⠠⠋

⠐⠣⠠⠁⠐⠜ ⠠⠏⠗⠕⠧⠑⠒ ⠠⠊⠋ ⠸⠩ ⠁ ⠐⠅ ⠃ ⠠⠄⠯
⠉ ⠐⠅ ⠼⠴⠠ ⠠⠄⠮⠝ ⠁⠉ ⠨⠂ ⠃⠉ ⠸⠱⠲ ⠠⠧⠻⠊⠋⠽ ⠽⠗
⠏⠗⠕⠷ ⠃⠽ ⠙⠑⠞⠻⠍⠔⠬ ⠸⠩ ⠰⠁⠉ ⠠⠄⠯ ⠃⠉ ⠠⠄⠱⠢
⠁ ⠨⠅ ⠼⠢⠠ ⠃ ⠨⠅ ⠼⠶⠠ ⠠⠄⠯ ⠉ ⠨⠅ ⠤⠼⠲⠸⠲
⠷⠠⠃⠾ ⠚ ⠨⠅ ⠼⠂⠠ ⠼⠆⠠ ⠄⠄⠄⠠ ⠰⠝
⠷⠠⠉⠾ ⠼⠲⠴⠈⠴ ⠕⠋ ⠠⠝ ⠨⠅ ⠼⠂⠆⠴
⠷⠠⠙⠾ ⠼⠲⠴⠈⠴ ⠕⠋ ⠦⠰⠠⠝⠸⠴ ⠨⠅ ⠼⠂⠆⠴
⠷⠠⠑⠾ ⠠⠄⠠⠊⠋ ⠦⠗⠉⠧ ⠨⠅ ⠗⠚⠉⠸⠴ ⠠⠄⠙⠕⠑⠎
⠦⠰⠧⠸⠴ ⠨⠅ ⠦⠰⠚⠸⠴ ⠸⠱⠦

(A) Single letters and shortform letter combinations that fall before and after signs of comparison need no ELI. Two-letter mathematical expressions "ab" and "bc" must be brailled in Nemeth Code. "ac" needs an ELI when preceded and followed by a space because it is the same letter configuration as a shortform of UEB; "bc" is not a shortform letter combination and so does not need an ELI.

(B) Nemeth Code continues and so the identifier is brailled in Nemeth Code. No ELI is needed when a single letter is enclosed between grouping signs. Letter "j" is followed by a comparison sign—no ELI. Letter "n" is preceded and followed by a space—ELI required.

(C) Letter "N" is followed by a sign of comparison—no ELI.

(D) Letter "N" is preceded and followed by punctuation—ELI required even though equals sign follows.

(E) Nemeth Code continues. Identifier (E) is in Nemeth Code. The word "If" uses single-word switch indicator. Even though "rcv" and "rjc" are shortform letter combinations, an ELI is not needed because they are next to a comparison sign. On the other hand, letters "v" and "j" are each preceded and followed by punctuation—ELI is required despite the proximity of the equals sign.

EXERCISE 4

Exercise 4 will be available when this course is finished being written and is no longer "Provisional".

Proceed to Lesson 5.