LESSON 4

- MORE ABOUT LETTERS
    - Variables
    - Roman Numerals
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- ENCLOSED LISTS
- MORE ABOUT ENGLISH LETTERS
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- Keep Together—Abbreviation
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Answers to Practice Material

LESSON PREVIEW

A closer look at letters used as variables. How to tell if a letter is a variable or an abbreviation. Treatment of Roman numerals. Treatment of other mathematical letter combinations as well as sequences of unspaced letters. How to handle letters used as numerals in nondecimal bases. German, Greek, Hebrew, and Russian letters used in mathematical notation. A look at mathematical constants. Rules regarding the "enclosed list". More rules about English letters and about abbreviations. Code switching considerations with headings.

MORE ABOUT LETTERS

Variables

4.1 Mathematical Variables

An alphabetic character that represents an unspecified number is called a *variable*. Variables are usually printed in italics uniformly throughout a technical document or textbook. In both UEB and Nemeth, italics applied to a variable are disregarded unless other circumstances require the typeface to be retained, a topic which will be discussed in Lesson 7.

Example 4-1

The equation of a line is $y = mx + b$ where m represents the *slope*.

⠠⠮ ⠑⠟⠥⠁⠰⠝ ⠷ ⠁ ⠇⠔⠑ ⠊⠎ ⠸⠩ ⠽ ⠨⠅ ⠍⠭⠬⠃ ⠸⠱
⠐⠱ ⠰⠍ ⠗⠑⠏⠗⠑⠎⠢⠞⠎ ⠮ ⠨⠂⠎⠇⠕⠏⠑⠲

Reminder: Line 1 "y": The English-letter indicator is not used when a "single letter" immediately precedes a sign of comparison. Line 2 "m": A freestanding letter may be transcribed in UEB.

4.1.1 **A Variable with an Associated Abbreviation—Keep Together.** When a variable is associated with an abbreviation, the letter and the abbreviation must not be divided between lines. This format rule also applies in UEB text.

Example 4-2

Write the expression for the number of miles Ann can cover in 11 days if she can walk x mi. in 3 days.

⠠⠺⠗⠊⠞⠑ ⠮ ⠑⠭⠏⠗⠑⠎⠨⠝ ⠿ ⠮ ⠝⠥⠍⠃⠻ ⠷ ⠍⠊⠇⠑⠎
⠠⠁⠝⠝ ⠉ ⠉⠕⠧⠻ ⠔ ⠼⠁⠁ ⠐⠙⠎ ⠊⠋ ⠩⠑ ⠉ ⠺⠁⠇⠅
⠰⠭ ⠍⠊⠲ ⠔ ⠼⠉ ⠐⠙⠎⠲

"x" and "mi." must be transcribed on the same line.

4.1.2 **Abbreviation or Variable?** The letter chosen to represent a variable is often based on the subject matter. In the next example, $2l + 2w$, the variables l and w represent unknown measurements for length and width. The letters l and w are chosen to aid in recognition of the parts of the formula, they are not abbreviations for the words length and width. Keep in mind that a variable represents a numerical value. A value will be "plugged into" the formula in place of the variable to produce a solution. In contrast, an abbreviation represents a word—it has no numerical value. You can often answer the question "abbreviation or variable?" by noticing the typeform. In a formal publication, a variable will be printed in italics; an abbreviation will be in normal typeface.

Example 4-3

The perimeter formula for a rectangle is $2l + 2w$. How many meters of fencing is needed if $l = 14$ m and $w = 2$ m?

⠀⠀⠠⠮ ⠏⠻⠊⠍⠑⠞⠻ ⠿⠍⠥⠇⠁ ⠿ ⠁ ⠗⠑⠉⠞⠁⠝⠛⠇⠑ ⠊⠎
⠸⠩ ⠼⠆⠇⠬⠆⠺ ⠸⠱⠲ ⠠⠓⠪ ⠸⠍ ⠍⠑⠞⠻⠎ ⠷ ⠋⠢⠉⠬ ⠊⠎
⠝⠑⠫⠫ ⠊⠋ ⠸⠩ ⠇ ⠨⠅ ⠼⠂⠲ ⠰⠍ ⠠⠄⠯
⠺ ⠨⠅ ⠼⠆ ⠰⠍ ⠸⠱⠦

l and w are variables; m is the abbreviation for "meters".

PRACTICE 4A

1. Express y in terms of x if $2x - 3y = 12$.
2. If $A = l \times l$, what is the length (l) of a side in inches if the area (A) of a square is 7.3 sq.ft.?
3. It is much easier to remember $A = lw$ (Area = length × width) than it is to remember $B = jt$ when trying to figure out how much carpet to buy for the living room.
4. What is the area A of trapezoid T with upper base $a = 3$ m, lower base $b = 6$ m, and height $h = 13$ m?

Roman Numerals

4.2 Code Switching with Roman Numerals

The rules you have learned about freestanding, unmodified mathematical numbers also apply to Roman numerals. Specifically, freestanding, unmodified Roman numerals within the narrative may be transcribed in UEB, but inside the switches they follow Nemeth rules. A Roman numeral used as an identifier may be transcribed in either code. Use context clues to decide whether or not to switch, just as you do with Arabic numerals.

Example 4-4

In Roman numerals, I means 1 and X means 10. IX means 9; XI means 11. See page vii for more examples.

⠀⠀⠠⠔ ⠠⠗⠕⠍⠁⠝ ⠝⠥⠍⠻⠁⠇⠎⠂ ⠠⠊ ⠍⠂⠝⠎ ⠼⠁ ⠯ ⠰⠠⠭
⠍⠂⠝⠎ ⠼⠁⠚⠲ ⠠⠠⠊⠭ ⠍⠂⠝⠎ ⠼⠊⠆ ⠠⠠⠭⠊ ⠍⠂⠝⠎ ⠼⠁⠁⠲
⠠⠎⠑⠑ ⠏⠁⠛⠑ ⠧⠊⠊ ⠿ ⠍ ⠑⠭⠁⠍⠏⠇⠑⠎⠲

Code switching is not required for these unmodified Roman numerals within the narrative.

4.3 Capital Roman Numerals

4.3.1 **Roman Numerals Consisting of One Capital Letter.** In Nemeth context, an English-letter indicator and a single capitalization indicator are used before a Roman numeral when it follows the Nemeth definition of a "single letter" – that is, if the Roman numeral is preceded by a space or by one or more punctuation marks and followed by a space or by one or more punctuation marks. (See 3.10.1.)

`⠰   English-letter Indicator`

`⠠   Single Capitalization Indicator`

There are seven Roman numerals consisting of a single letter.

⋙ I V X L C D M

⠰⠠⠊ ⠰⠠⠧ ⠰⠠⠭ ⠰⠠⠇ ⠰⠠⠉ ⠰⠠⠙ ⠰⠠⠍

Within a mathematical expression, the rules regarding the use or the nonuse of the English-letter indicator with a single-letter capital Roman numeral are the same as for any single English letter. (Lesson 3)

Example 4-5

Since I = 1 and X = 10, it follows that IX + I = X.

⠠⠎⠔⠉⠑ ⠸⠩ ⠠⠊ ⠨⠅ ⠼⠂ ⠠⠄⠯ ⠠⠭ ⠨⠅ ⠼⠂⠴ ⠸⠱⠂ ⠭
⠋⠕⠇⠇⠪⠎ ⠞ ⠸⠩ ⠠⠠⠊⠭⠬⠠⠊ ⠨⠅ ⠠⠭ ⠸⠱⠲

English-letter indicators are not needed, according to Nemeth rules for letters touching a sign of operation and for letters immediately preceding or following a comparison sign. Each Roman numeral is preceded by a single or a double capitalization indicator.

4.3.2 **Roman Numerals Consisting of Two or More Capital Letters.** The double capitalization indicator of the Nemeth Code is used before a Roman numeral consisting of two or more unspaced capitalized letters.

`⠠⠠   Double Capitalization Indicator`

Recall that, in Nemeth, a mathematical letter sequence that corresponds to a shortform of UEB does not require an English-letter indicator because no contractions are used inside the switches. This rule also applies to Roman numerals.

⋙ IV DC MMXVII ⠠⠠⠊⠧ ⠠⠠⠙⠉ ⠠⠠⠍⠍⠭⠧⠊⠊

⫸ CD DCV ⠠⠠⠉⠙ ⠠⠠⠙⠉⠧

Within a mathematical expression, Nemeth spacing rules are followed.

Example 4-6

Add. CCCXX + CCLXXXV = DCV

⠠⠁⠙⠙⠲ ⠸⠩ ⠠⠠⠉⠉⠉⠭⠭⠬⠠⠠⠉⠉⠇⠭⠭⠭⠧ ⠨⠅ ⠠⠠⠙⠉⠧ ⠸⠱

> *Within the equation, the Roman numerals are unspaced from the plus sign. A space precedes and follows the equals sign. Each of these Roman numerals is preceded by a double capitalization indicator.*

4.4 Lowercase Roman Numerals

In Nemeth context, an English-letter indicator is used before any lowercase Roman numeral when it follows the Nemeth definition of a "single letter" – that is, if the Roman numeral is preceded by a space or by one or more punctuation marks <u>and</u> followed by a space or by one or more punctuation marks.

⠰	`English-letter Indicator`

A lowercase Roman numeral is treated as a "single letter" even when it consists of more than one character.

⫸ i ii iii iv v ⠰⠊ ⠰⠊⠊ ⠰⠊⠊⠊ ⠰⠊⠧ ⠰⠧

4.5 Punctuation with Roman Numerals

A Roman numeral is punctuated mathematically if the punctuation falls inside the switches. The presence of punctuation does not change the rules regarding use of the English-letter indicator if the numeral is standing alone as a "single letter".

⫸ "I, IV, V, MMXVI"

⠦⠰⠠⠊⠠ ⠠⠠⠊⠧⠠ ⠰⠠⠧⠠ ⠠⠠⠍⠍⠭⠧⠊⠸⠴

⫸ "i", "ii", "iii".

⠦⠰⠊⠸⠴⠠ ⠦⠰⠊⠊⠸⠴⠠ ⠦⠰⠊⠊⠊⠸⠴⠲

Example 4-7

In Roman numerals, "IX" = 9, "L" = 50, and "C" = 100.

⠠⠔ ⠠⠗⠕⠍⠁⠝ ⠝⠥⠍⠻⠁⠇⠎⠂ ⠸⠩ ⠦⠠⠠⠊⠭⠸⠴ ⠨⠅ ⠼⠔⠠
⠦⠰⠠⠇⠸⠴ ⠨⠅ ⠼⠢⠴⠠ ⠠⠄⠯ ⠦⠰⠠⠉⠸⠴ ⠨⠅ ⠼⠂⠴⠴ ⠸⠱⠲

An English-letter indicator is required for a single-letter Roman numeral when preceded and followed by a punctuation mark.

Example 4-8

In Roman numerals "CD" = 400 and "DCV" = 605.

⠠⠔ ⠠⠗⠕⠍⠁⠝ ⠝⠥⠍⠻⠁⠇⠎ ⠸⠩ ⠦⠠⠠⠉⠙⠸⠴ ⠨⠅ ⠼⠲⠴⠴
⠠⠄⠯ ⠦⠠⠠⠙⠉⠧⠸⠴ ⠨⠅ ⠼⠖⠴⠢ ⠸⠱⠲

4.6 Roman Numerals Used as Identifiers

Identifiers are transcribed according to the rules for the code in use at that location. Compare these isolated examples of Roman numeral identifiers, noting the use of indicators and the construction of the punctuation or grouping symbols.

	UEB	Nemeth
i.	⠊⠲	⠰⠊⠸⠲
ii.	⠊⠊⠲	⠰⠊⠊⠸⠲
(i)	⠐⠣⠊⠐⠜	⠷⠊⠾
(ii)	⠐⠣⠊⠊⠐⠜	⠷⠊⠊⠾

Example 4-9

i) *Convert:* 4’7” = 55” and 5' = 60"

ii) *Add:* 55" + 6" = 61"

iii) *Compare:* 61" > 60"

⠊⠐⠜ ⠨⠂⠠⠒⠧⠻⠞⠒ ⠸⠩ ⠼⠲⠄⠶⠄⠄ ⠨⠅ ⠼⠢⠢⠄⠄ ⠠⠄⠯
  ⠼⠢⠄ ⠨⠅ ⠼⠖⠴⠄⠄
⠰⠊⠊⠾ ⠠⠄⠨⠂⠠⠁⠙⠙⠒ ⠼⠢⠢⠄⠄⠬⠖⠄⠄ ⠨⠅ ⠼⠖⠂⠄⠄
⠰⠊⠊⠊⠾ ⠠⠄⠨⠂⠠⠉⠕⠍⠏⠜⠑⠒ ⠼⠖⠂⠄⠄ ⠨⠂ ⠼⠖⠴⠄⠄ ⠸⠱

4.7 Mathematical Letter Combinations Similar to Roman Numerals

When it is unclear whether a mathematical letter combination is a Roman numeral, the combination is treated as if it were *not* a Roman numeral. In such cases, the letter combination is transcribed in Nemeth. The letters are treated individually and the English-letter indicator is used or is not used in accordance with the rules for English letters. (Review *Mathematical Letter Combinations* in Lesson 3.)

Example 4-10

What does DC denote in the following statement?

⠠⠱⠁⠞ ⠙⠕⠑⠎ ⠸⠩ ⠠⠙⠠⠉ ⠸⠱ ⠙⠢⠕⠞⠑ ⠔ ⠮ ⠋⠕⠇⠇⠪⠬
⠌⠁⠞⠑⠰⠞⠦

> *Out of context, it is not clear whether "DC" means the Roman numeral "600" or if it is referring to a line segment. Therefore, the letters are transcribed as a mathematical letter sequence. A switch to Nemeth Code is required.*

Example 4-11

div has special meaning.

⠸⠩ ⠙⠊⠧ ⠸⠱ ⠓⠁⠎ ⠎⠏⠑⠉⠊⠁⠇ ⠍⠂⠝⠬⠲

> *Out of context, it is not clear whether "div" means the Roman numeral "504" or if it is a special mathematical term. Therefore, the letters are transcribed as a mathematical letter sequence. A switch to Nemeth Code is required.*

Review: Nonuse of the English-letter Indicator

In Nemeth, the English-letter indicator is not used with a Roman numeral in the following circumstances.

i. When a Roman numeral consists of two or more unspaced capitalized letters in regular type, no English-letter indicator is used.

⫸ II III VIII XV ⠠⠠⠊⠊ ⠠⠠⠊⠊⠊ ⠠⠠⠧⠊⠊⠊ ⠠⠠⠭⠧

ii. When a Roman numeral immediately precedes or follows a sign of comparison, no English-letter indicator is used.

⫸ X = 10 ⠠⠭ ⠨⠅ ⠼⠂⠴

⫸ 1000 = M ⠼⠂⠴⠴⠴ ⠨⠅ ⠠⠍

iii. When a Roman numeral is in an expression consisting of a sequence of unspaced mathematical symbols, no English-letter indicator is used.

⫸ ix − v = iv ⠊⠭⠤⠧ ⠨⠅ ⠊⠧

iv. When a Roman numeral is entirely enclosed between grouping signs, no English-letter indicator is used.

⫸ (ii) ⠷⠊⠊⠾

v. When a Roman numeral is modified, no English-letter indicator is used.

⋙ I' ⠠⠊⠄

Roman numerals starting with 5,000 include a line over the numeral in print. This notation will be discussed in Lesson 12.

PRACTICE 4B

i. Triangle ABC in Quadrant IV is reflected in Quadrant III as Triangle $A'B'C'$.

ii. $iv + vi = x$

iii. $X = 10$, $L = 50$, $C = 100$, and $D = 500$.

iv. Review items v and vi.

v. Explain why $MC = 1100$, but $CM = 900$.

vi. Use Formulas I' and III' to prove the statement.

Nondecimal Bases

4.8 Letters Used to Represent Numerals in Nondecimal Bases

When a system of numeration is to a base larger than 10, additional digits are devised to represent digits beyond the ten Arabic numerals. One method for providing additional digits is to use letters. For example, in base 12, t or T may represent ten and e or E may represent eleven. These letters do not function as letters – they are digits and are indicated as such by use of the numeric indicator. Only uncapitalized letters are used to represent nondecimal numerals in braille, even when the letters are capitalized in print.

⫸ t or T ⠼⠞

⫸ e or E ⠼⠑

The rules regarding the use (or nonuse) of the numeric indicator for nondecimal digits are the same as the rules for the ten Arabic numerals 0 through 9. Numerals in nondecimal bases are mathematical symbols and are punctuated accordingly.

Transcriber's Note Required. If the print copy uses capital letters, a transcriber's note is required to inform the reader of a change in capitalization in the braille transcription.

Sample note on the Transcriber's Notes page: "Letters representing nondecimal digits are capitalized in print."

Sample transcriber's note within the text:

t and e are capitalized in print.

Example 4-12

Counting in base twelve: 0 1 2 3 4 5 6 7 8 9 T E. 13T8 and T1E5 are base 12 numerals.

⠈⠨⠣⠰⠞ ⠯ ⠰⠑ ⠜⠑ ⠉⠁⠏⠊⠞⠁⠇⠊⠵⠫ ⠔
⠏⠗⠔⠞⠲⠈⠨⠜
⠠⠉⠨⠞⠬ ⠔ ⠃⠁⠎⠑ ⠞⠺⠑⠇⠧⠑⠒ ⠸⠩ ⠼⠴ ⠼⠂ ⠼⠆ ⠼⠒ ⠼⠲
⠼⠢ ⠼⠖ ⠼⠶ ⠼⠦ ⠼⠔ ⠼⠞ ⠼⠑⠸⠲ ⠼⠂⠒⠞⠦ ⠠⠄⠯
⠼⠞⠂⠑⠢ ⠜⠑ ⠃⠁⠎⠑ ⠼⠁⠃ ⠝⠥⠍⠻⠁⠇⠎⠲

4.9 Nonalphabetic Symbols Used to Represent Numerals

If symbols other than letters represent digits, the transcriber should choose one-cell symbols to represent the special signs. The preferred method is to select letters of the English alphabet in a similar manner as described above. A transcriber's note must specify the meanings assigned to these letters. If the print sign lacks a symbol in the Code, the transcriber’s note should include a drawing or a description in order to identify it.

Sample transcriber's note:

#d, #c, #p, and #l represent the dollar, cent, percent, and British pound symbols shown in print.

Example 4-13

If $ ¢ % and £ represent the digits 0, 1, 2, and 3, solve this addition problem: ¢£+%$ = ?

⠈⠨⠣⠸⠩ ⠼⠙⠠ ⠼⠉⠠ ⠼⠏⠠ ⠠⠄⠯ ⠼⠇ ⠸⠱
⠗⠑⠏⠗⠑⠎⠢⠞ ⠮ ⠙⠕⠇⠇⠜⠂ ⠉⠢⠞⠂ ⠏⠻⠉⠢⠞⠂ ⠯
⠠⠃⠗⠊⠞⠊⠩ ⠏⠸⠙ ⠎⠽⠍⠃⠕⠇⠎ ⠩⠪⠝ ⠔ ⠏⠗⠔⠞⠲⠈⠨⠜
⠠⠊⠋ ⠸⠩ ⠼⠙ ⠼⠉ ⠼⠏ ⠠⠄⠯ ⠼⠇ ⠸⠱ ⠗⠑⠏⠗⠑⠎⠢⠞ ⠮
⠙⠊⠛⠊⠞⠎ ⠼⠚⠂ ⠼⠁⠂ ⠼⠃⠂ ⠯ ⠼⠉⠂ ⠎⠕⠇⠧⠑ ⠹ ⠁⠙⠙⠊⠰⠝
⠏⠗⠕⠃⠇⠑⠍⠒ ⠸⠩ ⠼⠉⠇⠬⠏⠙ ⠨⠅ ⠿ ⠸⠱

The opening Nemeth Code indicator immediately follows the UEB opening transcriber's note indicator.

Example 4-14

In the duodecimal system, ↊ represents the number ten and ↋ represents the number eleven.

⠠⠔ ⠮ ⠙⠥⠕⠙⠑⠉⠊⠍⠁⠇ ⠎⠽⠌⠑⠍⠂ ⠸⠩ ⠼⠞ ⠸⠱
⠈⠨⠣⠏⠗⠔⠞⠫ ⠵ ⠁⠝ ⠔⠧⠻⠞⠫ ⠝⠥⠍⠃⠻ ⠼⠃⠈⠨⠜
⠗⠑⠏⠗⠑⠎⠢⠞⠎ ⠮ ⠝⠥⠍⠃⠻ ⠞⠢ ⠯ ⠸⠩ ⠼⠑ ⠸⠱ ⠈⠨⠣⠏⠗⠔⠞⠫
⠵ ⠁⠝ ⠔⠧⠻⠞⠫ ⠝⠥⠍⠃⠻ ⠼⠉⠈⠨⠜ ⠗⠑⠏⠗⠑⠎⠢⠞⠎ ⠮ ⠝⠥⠍⠃⠻
⠑⠇⠑⠧⠢⠲

The two print symbols are described in embedded transcriber's notes: "printed as an inverted number 2" and "printed as an inverted number 3".

PRACTICE 4C

I. In the hexadecimal system (base 16), the number "one thousand" is written as 3e8.

II. Convert hex 7A1 to decimal numeration.

OTHER ALPHABETS

4.10 Alphabetic Indicators

The language of mathematics uses letters from more than just the English alphabet. Specific provision is made in the Nemeth Code for the transcription of the letters of the German, Greek, Hebrew, and Russian (Cyrillic) alphabets. Each alphabet has a unique alphabetic indicator.

4.10.1 **Code Switching and Use of Letter Indicators.** Recall that switching to Nemeth to transcribe an English letter is not always required, and that the Nemeth English-letter indicator may be omitted in certain circumstances. In contrast, an alphabetic indicator is always required to identify a letter from the German, Greek, Hebrew, or Russian alphabets and a switch to Nemeth is always required for such letters even if UEB has a symbol for the letter.

4.10.2 **Capitalization and Punctuation.** When a letter from any alphabet is capitalized in Nemeth Code, the capitalization indicator (dot 6) is placed between the alphabetic indicator and the letter. Letters are individually capitalized—the effect of the capitalization indicator extends only to the letter which follows it. In a Nemeth transcription, letters from the German, Greek, Hebrew, and Russian alphabets are mathematical symbols and so are punctuated mathematically when the punctuation falls within the Nemeth switches.

Certain letters have unique mathematical applications. If you are unsure of a letter, find an expert who can identify it. Do not guess.

4.11 The Greek Alphabet

Many letters from the Greek alphabet are used in mathematics and science. The following indicator identifies a letter as being from the Greek alphabet.

⠨ Greek-letter Indicator (standard form)

This symbol is read as the Greek-letter indicator only when immediately followed by a letter or by the capitalization indicator and a letter. The Nemeth Code table of Greek letters is reproduced below.

Greek Alphabet Table

Name of letter	Regular uncapitalized		Regular capitalized		Alternative form	
alpha	α	⠨⠁	Α	⠨⠠⠁	∝	⠨⠈⠁
beta	β	⠨⠃	Β	⠨⠠⠃	ϐ	⠨⠈⠃
gamma	γ	⠨⠛	Γ	⠨⠠⠛		
delta	δ	⠨⠙	Δ	⠨⠠⠙		
epsilon	ϵ	⠨⠑	Ε	⠨⠠⠑		
zeta	ζ	⠨⠵	Ζ	⠨⠠⠵		
eta	η	⠨⠱	Η	⠨⠠⠱		
theta	θ	⠨⠹	Θ	⠨⠠⠹	ϑ	⠨⠈⠹
iota	ι	⠨⠊	Ι	⠨⠠⠊		
kappa	κ	⠨⠅	Κ	⠨⠠⠅		
lambda	λ	⠨⠇	Λ	⠨⠠⠇		
mu	μ	⠨⠍	Μ	⠨⠠⠍		
nu	ν	⠨⠝	Ν	⠨⠠⠝		
xi	ξ	⠨⠭	Ξ	⠨⠠⠭		
omicron	o	⠨⠕	Ο	⠨⠠⠕		
pi	π	⠨⠏	Π	⠨⠠⠏		
rho	ρ	⠨⠗	Ρ	⠨⠠⠗		
sigma	σ	⠨⠎	Σ	⠨⠠⠎	ς	⠨⠈⠎
tau	τ	⠨⠞	Τ	⠨⠠⠞		
upsilon	υ	⠨⠥	Υ	⠨⠠⠥		
phi	ϕ	⠨⠋	Φ	⠨⠠⠋	φ	⠨⠈⠋
chi	χ	⠨⠯	Χ	⠨⠠⠯		
psi	ψ	⠨⠽	Ψ	⠨⠠⠽		
omega	ω	⠨⠺	Ω	⠨⠠⠺		
sampi	ϡ	⠨⠉				
stigma	Ϛ	⠨⠮				
vau	F	⠨⠧				
koph (qoph)	Ϙ	⠨⠟				

4.11.1 **Code Switching with Greek Letters.** Even though the uncapitalized form of the Greek letters in Nemeth is identical to the uncapitalized form in UEB, you must switch to Nemeth when a Greek letter appears in a Nemeth transcription, even within the narrative. As with English letters, lowercase Greek letters are often printed in italics uniformly throughout a technical document or textbook. In both UEB and Nemeth, italics applied to a Greek letter are disregarded unless other circumstances require the typeface to be retained.

Greek letters used in the following examples and Practice are listed in the box below. Notice the placement of the capitalization indicator in the two capitalized letters. As stated in 4.10.2, the capitalization indicator is placed between the alphabetic indicator and the letter.

⠨⠠⠙	Delta	Δ
⠨⠍	mu	μ
⠨⠏	pi	π
⠨⠠⠎	Sigma	Σ
⠨⠞	tau	τ
⠨⠹	theta	θ

Example 4-15

The Greek letter θ (theta) represents a plane angle in geometry.

⠠⠮ ⠠⠛⠗⠑⠑⠅ ⠇⠗ ⠸⠩ ⠨⠹ ⠸⠱ ⠐⠣⠮⠞⠁⠐⠜
⠗⠑⠏⠗⠑⠎⠢⠞⠎ ⠁ ⠏⠇⠁⠝⠑ ⠁⠝⠛⠇⠑ ⠔ ⠛⠑⠕⠍⠑⠞⠗⠽⠲

Example 4-16

$\pi < 0 < 2\pi$

⠸⠩ ⠨⠏ ⠐⠅ ⠼⠴ ⠐⠅ ⠼⠆⠨⠏ ⠸⠱

Example 4-17

Find the button marked "π" on your calculator.

⠠⠋⠔⠙ ⠮ ⠃⠥⠞⠞⠕⠝ ⠍⠜⠅⠫ ⠸⠩ ⠦⠨⠏⠸⠴ ⠸⠱ ⠕⠝ ⠽⠗
⠉⠁⠇⠉⠥⠇⠁⠞⠕⠗⠲

Greek letters are mathematical symbols and are punctuated mathematically.

4.11.2 **Capital Greek Letters.** Several capital Greek letters look identical to capital English letters. Those Greek letters are generally not used as math symbols. You can safely assume they are English letters unless specifically identified as Greek letters in the text.

4.11.3 **Alternate Form of Greek Letters.** Some lowercase Greek letters occur in variant print forms. The Greek alphabet table in the Nemeth code book shows an alternate form for five of the Greek letters (alpha, beta, theta, sigma, and phi). The following indicator is used to identify the alternate forms.

⠨⠈	`Greek-letter Indicator (alternate form)`

The alternative form is used in braille only when both forms—standard and alternative—appear in the same print text. If a Greek letter is represented by its alternative form *instead of its standard form throughout* the print text—that is, only one form of the letter is used throughout—the symbol for the standard form is used in braille. Include a transcriber's note at the beginning of the text to inform the reader.

Sample transcriber's note on the Transcriber's Notes page: "The alternate form of the Greek letter theta is used exclusively in print. In braille, the standard form is used."

If a text shows an alternate form of a Greek letter that does not appear in the Nemeth Code table, follow the guidelines above to determine if you should substitute the regular form or if you should use the alternate Greek-letter indicator. If the alternate form is used in the braille transcription, list the symbol on the Special Symbols page, identifying it as a Nemeth symbol as you do for the Nemeth Code terminator and the single-word switch indicator.

Example 4-18

(Special Symbols page)

⠨⠿⠨⠈⠏ ⠠⠁⠇⠞⠻⠝⠁⠞⠑ ⠿⠍ ⠷ ⠠⠛⠗⠑⠑⠅ ⠇⠗ ⠏⠊
  ⠐⠣⠠⠝⠑⠍⠑⠹ ⠠⠉⠕⠙⠑ ⠎⠽⠍⠃⠕⠇⠐⠜

If the letter's identity is not clear from context, consult an expert in the field in order to determine its designation.

PRACTICE 4D

Although the handwritten form of phi (φ) may be found in source materials, only the standard form (ϕ) is used in this book.

Another circle constant, the Greek letter tau, τ, equals 2π, or approximately 6.28.

The symbol Σ indicates summation. Δ signifies change.

In statistics, μ denotes the population mean; in engineering, μ is the coefficient of friction. In number theory, μ represents the Möbius function whereas, in particle physics, μ is the symbol for the muon.

4.12 The German Alphabet

German letters used in mathematics are derived from the Gothic or "Fraktur" calligraphic style of the Latin alphabet. It is a dark font, but is not considered to be bold. These letters must be transcribed in Nemeth. The following indicator is used to identify a letter as being from the German alphabet.

⠸	`German-letter Indicator`

The three German Fractur letters most commonly encountered in specialized fields of mathematics and science are shown below.

⠸⠉	`tseh`	𝔠
⠸⠛	`gheh`	𝔤
⠸⠠⠧	`Fao`	𝔙

If other Fraktur letters are encountered in a text, refer to the alphabet list in Rule 6 of the Nemeth code book. The German letter may be associated with the same letter from the English alphabet, which may help you identify it.

Example 4-19

Capital German 𝔙 looks like the English letter "B" but in fact it is a "V"!

⠀⠀⠠⠉⠁⠏⠊⠞⠁⠇ ⠠⠛⠻⠍⠁⠝ ⠸⠩ ⠸⠠⠧ ⠸⠱ ⠇⠕⠕⠅⠎ ⠇ ⠮
⠠⠢⠛⠇⠊⠩ ⠇⠗ ⠦⠰⠠⠃⠴ ⠃ ⠔ ⠋⠁⠉⠞ ⠭ ⠊⠎ ⠁ ⠦⠰⠠⠧⠴⠖

Example 4-20

In set theory, the continuum (denoted by 𝔠), is an infinite cardinal number.

⠀⠀⠠⠔ ⠎⠑⠞ ⠮⠕⠗⠽⠂ ⠮ ⠒⠞⠔⠥⠥⠍ ⠐⠣⠙⠢⠕⠞⠫ ⠃⠽
⠸⠩ ⠸⠉ ⠸⠱⠐⠜⠂ ⠊⠎ ⠁⠝ ⠔⠋⠔⠊⠞⠑ ⠉⠜⠙⠔⠁⠇ ⠝⠥⠍⠃⠻⠲

German letters may be encountered in the study of set theory.

Example 4-21

$\mathfrak{g} = \mathrm{Lie}(G)$

⠸⠩ ⠸⠛ ⠨⠅ ⠠⠇⠊⠑⠷⠠⠛⠾ ⠸⠱

German letters may be encountered in the study of Lie algebra.

4.13 The Hebrew Alphabet

Hebrew letters used as mathematical symbols must be transcribed in Nemeth. The following indicator is used to identify a letter as being from the Hebrew alphabet.

⠠⠠ Hebrew-letter Indicator

The Hebrew alphabet has no capitalized form. The letter most commonly encountered in technical material is the aleph: ℵ The aleph is usually written with a subscript, which will be discussed in Lesson 6.

A complete list of the Hebrew letters and their braille equivalents can be found in *World Braille Usage,* which is available for download at Perkins.org.

⠠⠠⠁ aleph ℵ

Example 4-22

Georg Cantor created the cardinal number "aleph-null" which is an aleph ℵ with a subscript zero.

⠠⠛⠑⠕⠗⠛ ⠠⠉⠁⠝⠞⠕⠗ ⠉⠗⠂⠞⠫ ⠮ ⠉⠜⠙⠔⠁⠇ ⠝⠥⠍⠃⠻
⠦⠁⠇⠑⠏⠓⠤⠝⠥⠇⠇⠴ ⠱ ⠊⠎ ⠁⠝ ⠸⠩ ⠠⠠⠁ ⠸⠱ ⠾ ⠁
⠎⠥⠃⠎⠉⠗⠊⠏⠞ ⠵⠻⠕⠲

4.14 The Russian Alphabet

Russian (Cyrillic) letters used as mathematical symbols must be transcribed in Nemeth. The following indicator is used to identify a letter as being from the Russian alphabet.

⠈⠈ Russian-letter (Cyrillic) Indicator

Two Cyrillic letters in common usage are Sha which is used in number theory and Ell (also the lowercase ell) which is used in hyperbolic (Lobachevskian) geometry. The Sha usually keeps company with bold and barred letters, and so will be further discussed in Lesson 7. Note the similarity between the Cyrillic letter ell and the Greek letter pi. If the letter's identity is not clear from context, consult an expert in the field in order to determine its designation.

A complete list of the Russian letters and their braille equivalents can be found in *World Braille Usage,* which is available for download at Perkins.org.

⠈⠈⠇	ell	л
⠈⠈⠠⠇	Ell	Л
⠈⠈⠠⠱	Sha	Ш

Example 4-23

The Lobachevsky function *Л* is essentially the same function with a change of variable: $Л(x)$.

⠀⠀⠠⠮ ⠠⠇⠕⠃⠁⠡⠑⠧⠎⠅⠽ ⠋⠥⠝⠉⠰⠝ ⠸⠩ ⠈⠈⠠⠇ ⠸⠱ ⠊⠎
⠑⠎⠎⠢⠞⠊⠁⠇⠇⠽ ⠮ ⠎⠁⠍⠑ ⠋⠥⠝⠉⠰⠝ ⠾ ⠁ ⠡⠁⠝⠛⠑ ⠷
⠧⠜⠊⠁⠃⠇⠑⠒ ⠸⠩ ⠈⠈⠠⠇⠷⠭⠾ ⠸⠱⠲

Note: The Russian alphabet table in *World Braille Usage* shows how to transcribe the Cyrillic letters in sentence 2: dots 1, 12, 2456, 1245, 145, 15, 245, 1356, 24, and 13.

PRACTICE 4E

1) Be sure to differentiate between the Cyrillic letters "ell" *Л* and "Ell" *Л* and the Greek letters "pi" π and "Pi" Π.
2) The first ten uncapitalized Cyrillic letters are: ah а, beh б, veh в, gheh г, deh д, yeh е, zheh ж, zeh з, ee и, and kah к.

4.15 A Sequence of Unspaced Letters

a. **Non-English Letters.** The effect of an alphabetic indicator extends only to the letter which follows it. Thus, in a sequence of unspaced letters from non-English-letter alphabets, the appropriate alphabetic indicator is used before each letter.

Example 4-24

The first seven lowercase Greek letters are: $\alpha\beta\gamma\delta\varepsilon\zeta\eta$.

⠀⠀⠠⠮ ⠋⠌ ⠎⠑⠧⠢ ⠇⠪⠻⠉⠁⠎⠑ ⠠⠛⠗⠑⠑⠅ ⠇⠗⠎ ⠜⠑⠒
⠸⠩ ⠨⠁⠨⠃⠨⠛⠨⠙⠨⠑⠨⠵⠨⠱ ⠸⠱⠲

b. **English Letters.** An English letter in regular type which appears in an unspaced sequence of terms does not require a letter indicator. Recall that mathematical letters which are consistently *printed* in italics are transcribed in regular type.

Example 4-25

$C = 2\pi r$ is the formula for the circumference of a circle.

⠀⠀⠸⠩ ⠠⠉ ⠨⠅ ⠼⠆⠨⠏⠗ ⠸⠱ ⠊⠎ ⠮ ⠿⠍⠥⠇⠁ ⠿ ⠮
⠉⠊⠗⠉⠥⠍⠋⠻⠰⠑ ⠷ ⠁ ⠉⠊⠗⠉⠇⠑⠲

Example 4-26

The "change in y" is denoted as "Δy".

⠠⠮ ⠦⠡⠁⠝⠛⠑ ⠔ ⠰⠽⠴ ⠊⠎ ⠙⠢⠕⠞⠫ ⠵
⠸⠩ ⠦⠨⠠⠙⠽⠸⠴ ⠸⠱⠲

4.15.1 **Derivatives.** The English letter combinations "dx", "dy", etc. often used in differential notation are usually spaced away from surrounding characters in print in order to enhance recognition. The space is omitted in braille unless another Nemeth rule requires a space. Print may show the letter d in italics or in regular type. Either way, the letter is not italicized in braille.

Example 4-27

$(x + y)\ \mathrm{d}x\ \mathrm{d}y = \_\_\_$

⠸⠩ ⠷⠭⠬⠽⠾⠙⠭⠙⠽ ⠨⠅ ⠤⠤⠤⠤ ⠸⠱

In print, there is a space before each "d".

4.16 Mathematical Constant

A mathematical constant is a special number whose value is nonvarying ("constant") and is represented by a certain alphabetic character. Two common examples are the Greek lowercase pi π and the English letter i. Constants are usually printed in italics uniformly throughout a document. In both UEB and Nemeth, constants are transcribed as regular type unless other circumstances require the typeface to be retained.

Example 4-28

$i(a + bi) = -b + ai$

⠸⠩ ⠊⠷⠁⠬⠃⠊⠾ ⠨⠅ ⠤⠃⠬⠁⠊ ⠸⠱

Example 4-29

$C = 2\pi r + \pi\Delta r$

⠸⠩ ⠠⠉ ⠨⠅ ⠼⠆⠨⠏⠗⠬⠨⠏⠨⠠⠙⠗ ⠸⠱

Linage and judicious placement of code switches is the challenge in this practice. After transcribing each sentence, write down your reasons for switching where you did. Then compare your decisions to the answer key and commentary at the end of the lesson.

PRACTICE 4F

1. Variables a and b are inversely related.
2. There exists a constant N such that no bit of Ω after the Nth can be proven to be 1 or 0.
3. Randall replied, "$12 - n, 11 - n, 10 - n$ ... which is correct?"
4. "$12 - n, 11 - n, 10 - n, \ldots$"
5. Which is correct: "$4x + 3y$, " "$3x + 4y$, " or "$4x + 4y$"?
6. What is the remainder when 101 is divided by 3 $(101 \div 3)$?
7. The result is $(ax + by)(cx + dy)$, where all components are real.
8. Δx means "the change in x" and Δy means "the change in y". When x increases by Δx, y increases by Δy as expressed in the equation $y = \Delta y = f(x + \Delta x)$.
9. ($4x + 3y$ is the denominator.)

ENCLOSED LISTS

4.17 Special Case—Definition of an "Enclosed List"

Special provision is made for the transcription of a sequence of mathematical items enclosed within grouping signs. All of the following must be true in order to apply this rule.

i. The sequence must begin and end with a sign of grouping. The grouping signs do not have to be of the same kind.

ii. The list must have at least two items and the items must be separated by commas.

iii. An item of the list may be any sign used for omission – for example, an ellipsis or a long dash.

iv. The list cannot contain any punctuation mark other than the separating commas. (The omission ellipsis or long dash are not considered to be punctuation.)

v. The list cannot contain any words, abbreviations, ordinal endings, or plural endings. (An exception applies to set notation containing words.)

vi. The list cannot contain a sign of comparison.

An enclosed list must be transcribed in Nemeth even if the items in the list are simple numerals or letters. The enclosure symbols are part of the mathematical notation, using the appropriate Nemeth grouping symbols.

4.17.1 **Nonuse of the Numeric Indicator in an Enclosed List.** A numeric indicator is not used before a numeral or before a decimal point and a numeral in an enclosed list.

Example 4-30

{2, 4, 6, 8}

⠸⠩ ⠨⠷⠆⠠ ⠲⠠ ⠖⠠ ⠦⠨⠾ ⠸⠱

Example 4-31

(−3.1, −2, −.9, 0, .9, 2, 3.1)

⠸⠩ ⠷⠤⠒⠨⠂⠠ ⠤⠆⠠ ⠤⠨⠔⠠ ⠴⠠ ⠨⠔⠠ ⠆⠠ ⠒⠨⠂⠾ ⠸⠱

Example 4-32

Consider the set {5 + 5, 10 + 10}.

⠠⠒⠎⠊⠙⠻ ⠮ ⠎⠑⠞ ⠸⠩ ⠨⠷⠢⠬⠢⠠ ⠂⠴⠬⠂⠴⠨⠾ ⠸⠱⠲

Example 4-33

(5, 12] means do **not** include 5, but **do** include 12.

⠸⠩ ⠷⠢⠠ ⠂⠆⠈⠾ ⠸⠱ ⠍⠂⠝⠎ ⠙ ⠘⠂⠝ ⠔⠉⠇⠥⠙⠑ ⠼⠑⠂ ⠃
⠘⠂⠙ ⠔⠉⠇⠥⠙⠑ ⠼⠁⠃⠲

a. The next two examples do not satisfy the definition of an enclosed list. A numeric indicator is transcribed where required.

Example 4-34

Create two different sets from these numbers: [3, 4, 5; .3, .4, .5]

⠠⠉⠗⠂⠞⠑ ⠞⠺⠕ ⠙⠊⠖⠻⠢⠞ ⠎⠑⠞⠎ ⠋ ⠘⠮ ⠝⠥⠍⠃⠻⠎⠒
⠸⠩ ⠈⠷⠒⠠ ⠼⠲⠠ ⠼⠢⠸⠆ ⠼⠨⠒⠠ ⠼⠨⠲⠠ ⠼⠨⠢⠈⠾ ⠸⠱

This is not an enclosed list because a semicolon is used. A numeric indicator is required before all but the first numeral.

Example 4-35

To show the probability of spinning a 3 and a 7, calculate P(3 AND 7).

⠠⠞⠕ ⠩⠪ ⠮ ⠏⠗⠕⠃⠁⠃⠊⠇⠰⠽ ⠷ ⠎⠏⠔⠝⠬ ⠁ ⠼⠉ ⠯ ⠁
⠼⠛⠂ ⠉⠁⠇⠉⠥⠇⠁⠞⠑ ⠸⠩ ⠠⠏⠷⠒ ⠠⠠⠁⠝⠙ ⠼⠶⠾ ⠸⠱⠲

This is not an enclosed list because there are no commas and because it contains a word. A numeric indicator is required before the numeral 7. The word AND has mathematical significance and is transcribed in Nemeth without contractions. (The words AND, OR, and NOT may be used as mathematical operators in the fields of probability and logic.)

4.17.2 **Nonuse of the English-letter Indicator in an Enclosed List.** In an enclosed list, the English-letter indicator is not used with any English letter or combination of English letters in regular type. This rule includes Roman numerals. (Note that a letter from a non-English alphabet must retain its appropriate alphabetic indicator.)

Example 4-36

$(a, 2x, \ldots, b, ab)$

⠸⠩ ⠷⠁⠠ ⠆⠭⠠ ⠄⠄⠄⠠ ⠃⠠ ⠁⠃⠾ ⠸⠱

Example 4-37

Write the coordinates of the points as ordered pairs (x, y).

⠠⠺⠗⠊⠞⠑ ⠮ ⠉⠕⠕⠗⠙⠔⠁⠞⠑⠎ ⠷ ⠮ ⠏⠕⠔⠞⠎ ⠵ ⠕⠗⠙⠻⠫
⠏⠁⠊⠗⠎ ⠸⠩ ⠷⠭⠠ ⠽⠾ ⠸⠱⠲

Example 4-38

(i, ii, iii, iv)

⠸⠩ ⠷⠊⠠ ⠊⠊⠠ ⠊⠊⠊⠠ ⠊⠧⠾ ⠸⠱

Example 4-39

(α, a, β, b)

⠸⠩ ⠷⠨⠁⠠ ⠁⠠ ⠨⠃⠠ ⠃⠾ ⠸⠱

The Greek letters alpha and beta are in this enclosed list. The Greek-letter indicator is required.

Situations which require a numeric indicator or an English-letter indicator in an enclosed list will be discussed in later lessons.

4.17.3 **Format—Keep Together.** Items in an enclosed list must not be divided between braille lines if the entire list will fit on a single braille line.

Example 4-40

Fill in the missing numerals. (1, 3, ?, ?, 9)

⠠⠋⠊⠇⠇ ⠔ ⠮ ⠍⠊⠎⠎⠬ ⠝⠥⠍⠻⠁⠇⠎⠲ ⠸⠩
⠷⠂⠠ ⠒⠠ ⠿⠠ ⠿⠠ ⠔⠾ ⠸⠱

Example 4-41

The replacement set is $\{m, n, o, p, q, r, s, t, u, v, w\}$.

⠠⠮ ⠗⠑⠏⠇⠁⠉⠑⠰⠞ ⠎⠑⠞ ⠊⠎ ⠸⠩
⠨⠷⠍⠠ ⠝⠠ ⠕⠠ ⠏⠠ ⠟⠠ ⠗⠠ ⠎⠠ ⠞⠠ ⠥⠠ ⠧⠠ ⠺⠨⠾ ⠸⠱⠲

a. **Division Between Lines.** If the enclosed list will not fit on a single braille line, use as much of the current line as possible and begin a runover line after a comma. When the items in an enclosed list must be divided between braille lines, neither the numeric indicator nor the English-letter indicator is used before the runover on the new line.

Example 4-42

Does $\{\ldots, -4, -3, -2, -1, 0, 1, 2, 3, 4, \ldots\}$ represent a set of integers?

⠠⠙⠕⠑⠎ ⠸⠩ ⠨⠷⠄⠄⠄⠠ ⠤⠲⠠ ⠤⠒⠠ ⠤⠆⠠ ⠤⠂⠠ ⠴⠠ ⠂⠠
⠆⠠ ⠒⠠ ⠲⠠ ⠄⠄⠄⠨⠾ ⠸⠱ ⠗⠑⠏⠗⠑⠎⠢⠞ ⠁ ⠎⠑⠞ ⠷
⠔⠞⠑⠛⠻⠎⠦

Remember, if a math expression will fit on one line, do not divide it. See how this rule applies in an itemized format.

Example 4-43

Now we will discuss these three sets.
1. {25, 50, 75, 100, 125, ...}
2. {100, 150, 200, 250, 300, 350 ...}
3. {100, 200, 300, 400, 500, 600, 700, ...}

⠠⠝⠪ ⠺⠑ ⠺ ⠲⠉⠥⠎⠎ ⠘⠮ ⠹⠗⠑⠑ ⠎⠑⠞⠎⠲ ⠸⠩

⠼⠂⠸⠲ ⠨⠷⠆⠢⠠ ⠢⠴⠠ ⠶⠢⠠ ⠂⠴⠴⠠ ⠂⠆⠢⠠ ⠄⠄⠄⠨⠾
⠼⠆⠸⠲
⠨⠷⠂⠴⠴⠠ ⠂⠢⠴⠠ ⠆⠴⠴⠠ ⠆⠢⠴⠠ ⠒⠴⠴⠠ ⠒⠢⠴ ⠄⠄⠄⠨⠾
⠼⠒⠸⠲ ⠨⠷⠂⠴⠴⠠ ⠆⠴⠴⠠ ⠒⠴⠴⠠ ⠲⠴⠴⠠ ⠢⠴⠴⠠ ⠖⠴⠴⠠
⠶⠴⠴⠠ ⠄⠄⠄⠨⠾ ⠸⠱

Item 1 requires no division.
Item 2: When the enclosed list is brought down to the next line (starting in the runover cell, cell 3) no division is needed. This keeps the enclosed list together on one line.
In item 3, division is unavoidable.

b. **Set Notation Containing Words.** When words are part of set notation, the expression is treated as an enclosed list. A switch to Nemeth is required. The items in each set should not be divided between braille lines. If this is not possible, division is made after a comma.

Example 4-44

Now we must find the domain and range of the following relation.
{(Ford, –9), (Nixon, –5), (Taft, –11), (Polk, –23)}

⠠⠝⠪ ⠺⠑ ⠍⠌ ⠋⠔⠙ ⠮ ⠙⠕⠍⠁⠔ ⠯ ⠗⠁⠝⠛⠑ ⠷ ⠮
⠋⠕⠇⠇⠪⠬ ⠗⠑⠇⠁⠰⠝⠲ ⠸⠩ ⠨⠷⠷⠠⠋⠕⠗⠙⠂ ⠤⠔⠾⠠
⠷⠠⠝⠊⠭⠕⠝⠂ ⠤⠢⠾⠠ ⠷⠠⠞⠁⠋⠞⠂ ⠤⠂⠂⠾⠠ ⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀
⠷⠠⠏⠕⠇⠅⠂ ⠤⠆⠒⠾⠨⠾ ⠸⠱

The set enclosed between braces will not fit on one line. It is divided after a comma. Note that, even though "(Polk," will fit on line 3, the pair enclosed in parentheses "(Polk, –23)" is kept together on one braille line.

Instructions: First determine if each item is or is not an enclosed list. Write YES if the item is an enclosed list and NO if it is not. Then transcribe the YES items in Nemeth.

PRACTICE 4G

$\{a, b, c, d\}$
$(-1, -2, -3)$
(h ft, k in)
(ab, cd, ef)
$1, i, -1, -i$
(1, i, 2, ii)
(1st, 2nd, 3rd)
(A, A', B, B', C)
{____, .13, .15, .17, ____}
$(1 + h, 2 + k, 0)$
$(x = 1, 2, \dots, 10)$
$(a, b]$
(1 2 3)
[0, 1]
$(u, v; x, y)$
{(Denver, 19), (Utah, 27), (Minnesota, 24), (San Antonio, 28)}
$(a, b, \dots)$
$(x + 1, x + 2, ?, ?, x + 5)$
$\langle -1,\ 0]$
(2, 4, 6, ____, 10)
$(0, a, 1, b, 2)$
{1's, 2's, 3's}

MORE ABOUT ENGLISH LETTERS

4.18 An English Letter Touching Only One Grouping Symbol

In Lesson 3, you learned that the English-letter indicator is not needed when a "single letter" is enclosed between mathematical grouping symbols.

⫸ (c) ⠷⠉⠾ compare to "c" ⠦⠰⠉⠸⠴

However, when a "single letter" is in direct contact with only one grouping sign, and the letter is not an item in an enclosed list as defined above, rules regarding the English-letter indicator are applied as though the grouping sign was not present.

Example 4-45

$(k = 1, 2, \ldots, n)$.

⠸⠩ ⠷⠅ ⠨⠅ ⠼⠂⠠ ⠼⠆⠠ ⠄⠄⠄⠠ ⠰⠝⠾ ⠸⠱⠲

Without the left parenthesis, the letter k would not need an English-letter indicator because it is followed by an equals sign. Without the right parenthesis, the letter n would need an English-letter indicator because it is preceded by a space and followed by punctuation.

Example 4-46

Consider the set $\{m \text{ and } n\}$.

⠠⠒⠎⠊⠙⠻ ⠮ ⠎⠑⠞ ⠸⠩ ⠨⠷⠰⠍ ⠁⠝⠙ ⠰⠝⠨⠾ ⠸⠱⠲

Without the left brace, the letter m would need an English-letter indicator because it is preceded and followed by a space. Without the right brace, the letter n would need an English-letter indicator because it is preceded by a space and followed by punctuation. Set notation is mathematical and so a switch to Nemeth Code is required. The word "and" is part of the math.

Example 4-47

If two events are mutually exclusive we write $P(A\ AND\ B) = 0$ where $P(A\ AND\ B)$ means "the probability of A and B occurring at the same time".

1 ⠠⠊⠋ ⠞⠺⠕ ⠑⠧⠢⠞⠎ ⠜⠑ ⠍⠥⠞⠥⠁⠇⠇⠽ ⠑⠭⠉⠇⠥⠎⠊⠧⠑ ⠺⠑
2 ⠺⠗⠊⠞⠑ ⠸⠩ ⠠⠏⠷⠠⠁ ⠠⠠⠁⠝⠙ ⠠⠃⠾ ⠨⠅ ⠼⠴ ⠠⠄⠐⠱
3 ⠠⠏⠷⠠⠁ ⠠⠠⠁⠝⠙ ⠰⠠⠃⠾ ⠸⠱ ⠍⠂⠝⠎ ⠦⠮ ⠏⠗⠕⠃⠁⠃⠊⠇⠰⠽ ⠷
4 ⠠⠁ ⠯ ⠰⠠⠃ ⠕⠒⠥⠗⠗⠬ ⠁⠞ ⠮ ⠎⠁⠍⠑ ⠐⠞⠴⠲

Line 2: Without the left parenthesis, the letter A would not need an English-letter indicator because it immediately follows the letter P. Without the right parenthesis, the letter B would not need an English-letter indicator because it is followed by a comparison sign.

Line 3: Without the left parenthesis, the letter A would not need an English-letter indicator because it immediately follows the letter P. Without the right parenthesis, the letter B would need an English-letter indicator because it is preceded and followed by a space.
Line 4: Letters A and B follow the rules of UEB in the narrative.

a. **Roman Numerals.** The same rule applies to a Roman numeral that is in direct contact with only an opening or closing grouping sign. The English-letter indicator is used or is not used as though the grouping sign was absent. The following example illustrates Roman numerals used as identifiers, assuming uninterrupted mathematical context.

⫸ i) ⠰⠊⠾

⫸ iv) ⠰⠊⠧⠾

⫸ v) ⠰⠧⠾

b. **Modified Grouping Sign.** If the grouping sign includes a prime or other modifying symbol, the English-letter indicator is not used with the single English letter that touches the grouping symbol.

⫸ $t]'$ ⠞⠈⠾⠄

Example 4-48

$t]'$ and $v]'$ have unique meaning.

⠸⠩ ⠞⠈⠾⠄ ⠠⠄⠯ ⠧⠈⠾⠄ ⠸⠱ ⠓ ⠥⠝⠊⠟⠥⠑ ⠍⠂⠝⠬⠲

4.19 English Letters with Plural, Possessive, or Ordinal Endings

When a "single letter" has a plural, possessive, or ordinal ending, in mathematical context the English-letter indicator rules of the Nemeth Code are applied as though such endings were not present. The following examples illustrate proper use of the English-letter indicator, assuming mathematical context. Note that the expressions are punctuated mathematically. The presence of a plural, possessive, or ordinal ending does not change the fact that the punctuation mode is mathematical.

a. Plural

⫸ $\mathrm{p}s, \mathrm{q}s, \mathrm{r}s$ ⠰⠏⠎⠠ ⠰⠟⠎⠠ ⠰⠗⠎

Think: p, q, r – English-letter indicator is required

⫸ $X\mathrm{s}, Y\mathrm{s}, Z\mathrm{s}$ ⠰⠠⠭⠎⠠ ⠰⠠⠽⠎⠠ ⠰⠠⠵⠎

Think: X, Y, Z – English-letter indicator is required

b. Possessive

Reminders: A punctuation indicator is required before an apostrophe; otherwise dot 3 is read as a prime sign.

⫸ p’s, q’s, r’s ⠰⠏⠸⠄⠎⠠ ⠰⠟⠸⠄⠎⠠ ⠰⠗⠸⠄⠎

Think: p, q, r – English-letter indicator is required

⫸ X’s, Y’s, Z’s ⠰⠠⠭⠸⠄⠎⠠ ⠰⠠⠽⠸⠄⠎⠠ ⠰⠠⠵⠸⠄⠎

Think: X, Y, Z – English-letter indicator is required

c. Ordinal

⫸ nth, 2nth ⠰⠝⠞⠓⠠ ⠼⠆⠝⠞⠓

Think: n – English-letter indicator is required; 2n – English-letter indicator is not required

d. Letter Combinations

Reminder: Letter combinations require a switch to Nemeth Code, but no English-letter indicator is needed. Capital letters are individually capitalized.

⫸ ABs and GHs ⠠⠁⠠⠃⠎ ⠠⠄⠯ ⠠⠛⠠⠓⠎

⫸ AB’s and GH’s ⠠⠁⠠⠃⠸⠄⠎ ⠠⠄⠯ ⠠⠛⠠⠓⠸⠄⠎

⫸ ab’s and gh’s ⠁⠃⠸⠄⠎ ⠠⠄⠯ ⠛⠓⠸⠄⠎

⫸ abth and jkth ⠁⠃⠞⠓ ⠠⠄⠯ ⠚⠅⠞⠓

Instructions: Stay in Nemeth Code to transcribe items C) and E).

PRACTICE 4H

A) Find all ABs, CDs, and EFs; draw XYZs.

B) Find all AB’s, CD’s, and EF’s; draw XYZ’s.

C) (1st, 2nd, ... nth, ... 49th)

D) Does $|a| \times |b| = |ab|$?

E) If Q, then {[NOT-P] OR P}.

MORE ABOUT ABBREVIATIONS

Abbreviation Reminders

- Abbreviations are not mathematical expressions although they may be part of a mathematical expression.
- A space comes between an abbreviation and its related value, even if no space is shown in print.
- An abbreviation and its related value must not be divided between braille lines.
- Between a two-word abbreviation, follow the same spacing as used in print. Do not divide the abbreviation between lines.
- Abbreviations are punctuated in literary mode, even in mathematical context.

4.20 More Spacing Rules

4.20.1 **Spacing of Abbreviations with Operation Signs.** Spacing between an abbreviation and an operation symbol depends upon whether the abbreviation has a related value.

a. A space is required between an abbreviation and a sign of operation when the abbreviation has a related value.

Example 4-49

7 in. + 9 in. = 16 in. or 1 ft. 4 in.

⠸⠩ ⠼⠶ ⠊⠝⠲ ⠬⠔ ⠊⠝⠲ ⠨⠅ ⠼⠂⠖ ⠊⠝⠲ ⠠⠄⠕⠗
⠼⠂ ⠋⠞⠲ ⠼⠲ ⠊⠝⠲ ⠸⠱

b. No space comes between an abbreviation and a multiplication dot when the second abbreviation has no related value. No space comes between an abbreviation and a slash which applies to the abbreviation.

Example 4-50

Momentum is expressed in kg·m/s.

⠠⠍⠕⠰⠞⠥⠍ ⠊⠎ ⠑⠭⠏⠗⠑⠎⠎⠫ ⠔ ⠸⠩ ⠅⠛⠡⠰⠍⠸⠌⠰⠎ ⠸⠱⠲

4.20.2 **Spacing of Omission Symbols with Abbreviations.** When a sign of omission represents an abbreviation, or a missing item next to an abbreviation, the omission symbol is spaced according to the spacing rules for abbreviations. Spacing in the print copy often does not follow this design and must be disregarded when applying spacing to the braille transcription.

Example 4-50

Fill in the blank: 3gal.5qt. = 4____1qt.

⠠⠋⠊⠇⠇ ⠔ ⠮ ⠃⠇⠁⠝⠅⠒
⠸⠩ ⠼⠒ ⠛⠁⠇⠲ ⠼⠢ ⠟⠞⠲ ⠨⠅ ⠼⠲ ⠤⠤⠤⠤ ⠼⠂ ⠟⠞⠲ ⠸⠱

In print, the abbreviations and the low line are unspaced.

Example 4-51

Plus or minus? 14 cm _?_ 12 cm = 2 cm

⠠⠏⠇⠥⠎ ⠕⠗ ⠍⠔⠥⠎⠦
⠸⠩ ⠼⠂⠲ ⠉⠍ ⠿⠂⠆ ⠉⠍ ⠨⠅ ⠼⠆ ⠉⠍ ⠸⠱

This omission represents an operation sign. It is preceded by a space because the abbreviation the precedes it must be spaced.

4.21 Single-Letter Abbreviations

Even though contractions are not used within the switches, for clarity, a single-letter abbreviation from the English alphabet must always begin with an English-letter indicator. This rule applies regardless of the presence (or lack) of a related period. The presence of grouping signs does not change this rule. In other words, the rules regarding nonuse of the English-letter indicator with mathematical "single letters" do not apply to abbreviations.

⫸ 20.9 g ⠼⠆⠴⠨⠔ ⠰⠛

⫸ meters (m) ⠍⠑⠞⠑⠗⠎ ⠷⠰⠍⠾

⫸ 3.5 c. ⠼⠒⠨⠢ ⠰⠉⠲

Reminder: Abbreviations are punctuated in literary mode, even in mathematical context.

Example 4-52

Add the weights. $10\text{ g} + 10\text{ g} = 20\text{ g}$

⠠⠁⠙⠙ ⠮ ⠺⠑⠊⠣⠞⠎⠲

⠸⠩ ⠼⠂⠴ ⠰⠛ ⠬⠂⠴ ⠰⠛ ⠨⠅ ⠼⠆⠴ ⠰⠛ ⠸⠱

Even the "g" that is immediately followed by a comparison sign requires an English-letter indicator because "g" is a single-letter abbreviation.

Example 4-53

How many liters? 2 quarts (qt.) = ? liters (l)?

⠠⠓⠪ ⠸⠍ ⠇⠊⠞⠻⠎⠦

⠸⠩ ⠼⠆ ⠟⠥⠁⠗⠞⠎ ⠷⠟⠞⠲⠾ ⠨⠅ ⠿ ⠇⠊⠞⠑⠗⠎ ⠷⠰⠇⠾ ⠸⠱⠦

Even "l" enclosed within parentheses requires an English-letter indicator because "l" is a single-letter abbreviation.

Example 4-54

Teaspoons and tablespoons: $1\text{ t.} + 2\text{ t.} = 3\text{ t.} = 1\text{ T.}$

⠠⠞⠂⠎⠏⠕⠕⠝⠎ ⠯ ⠞⠁⠃⠇⠑⠎⠏⠕⠕⠝⠎⠒

⠸⠩ ⠼⠂ ⠰⠞⠲ ⠬⠆ ⠰⠞⠲ ⠨⠅ ⠼⠒ ⠰⠞⠲ ⠨⠅ ⠼⠂ ⠰⠠⠞⠲ ⠸⠱

4.22 Abbreviations Whose Letters Correspond to a Shortform

Because contractions are not used in Nemeth, a letter combination which corresponds to a shortform will not be read as a word when it occurs between the switches. Therefore, an abbreviation whose letters correspond to a shortform does not need an English-letter indicator.

⫸ 1 yr. = 12 mo. ⠼⠂ ⠽⠗⠲ ⠨⠅ ⠼⠂⠆ ⠍⠕⠲

⫸ 1 lt-yr $= 9.461e + 12$ km

⠼⠂ ⠇⠞⠤⠽⠗ ⠨⠅ ⠼⠔⠨⠲⠖⠂⠑⠬⠂⠆ ⠅⠍

The letter "e" is a constant and follows the rules of a "single letter".

Example 4-55

How many days? 1 year (yr.) = ? days (da.); 2 yrs. = ? da.

⠠⠓⠪ ⠸⠍ ⠐⠙⠎⠦

⠸⠩ ⠼⠂ ⠽⠑⠁⠗ ⠷⠽⠗⠲⠾ ⠨⠅ ⠿ ⠙⠁⠽⠎ ⠷⠙⠁⠲⠾⠸⠆

⠼⠆ ⠽⠗⠎⠲ ⠨⠅ ⠿ ⠙⠁⠲ ⠸⠱

4.23 Context Clues

Look for context clues when an abbreviation ends a sentence. When in doubt about the function of a period at the end of a sentence, assume that the period applies to the abbreviation as well. Compare these three examples.

Example 4-56

Fact: 8 oz. = 1 c.

⠠⠋⠁⠉⠞⠒ ⠸⠩ ⠼⠦ ⠕⠵⠲ ⠨⠅ ⠼⠂ ⠰⠉⠲ ⠸⠱

Because the abbreviation "oz." has a related period, treat the period after "c." in the same manner. The related period is transcribed before the Nemeth Code terminator.

Example 4-57

Fact: 8 oz = 1 c.

⠠⠋⠁⠉⠞⠒ ⠸⠩ ⠼⠦ ⠕⠵ ⠨⠅ ⠼⠂ ⠰⠉ ⠸⠱⠲

Because the abbreviation "oz" does not have a period, treat the period after "c" as an end-of-sentence period only. The period is transcribed outside of the switch.

Example 4-58

Fact: 8 ounces = 1 c.

⠠⠋⠁⠉⠞⠒ ⠸⠩ ⠼⠦ ⠕⠥⠝⠉⠑⠎ ⠨⠅ ⠼⠂ ⠰⠉⠲ ⠸⠱

Within this example, there are no context clues to determine if this period applies to the single-letter abbreviation "c". When in doubt, assume that the period does apply to the abbreviation. The period is transcribed inside the switch.

In the next example, s is the abbreviation (printed in normal typeface) and a and b are the variables (printed in italics). Review 4.1.2, "Abbreviation or Variable?"

Example 4-59

How many seconds (s) does $b - a$ represent if $a = 4.3$ s and $b = 7.0$ s?

⠀⠀⠠⠓⠪ ⠸⠍ ⠎⠑⠉⠕⠝⠙⠎ ⠐⠣⠰⠎⠐⠜ ⠙⠕⠑⠎ ⠸⠩ ⠃⠤⠁ ⠸⠱
⠗⠑⠏⠗⠑⠎⠢⠞ ⠊⠋ ⠸⠩ ⠁ ⠨⠅ ⠼⠲⠨⠒ ⠰⠎ ⠠⠄⠯
⠃ ⠨⠅ ⠼⠶⠨⠴ ⠰⠎ ⠸⠱⠦

The single-letter abbreviation requires an English-letter indicator; the variables do not because they are either touching a sign of operation or next to a sign of comparison.

4.24 Fully Capitalized Abbreviations – Acronyms and Initialisms

An abbreviation consisting of more than one capital letter is capitalized as a unit using the double capitalization indicator of the Nemeth Code. Nemeth rules for spacing and punctuation of acronyms and initialisms follow the same rules as those for abbreviations.

Example 4-60

LCM means "least common multiple." In the problem below, LCM = 12.

⠀⠀⠠⠠⠇⠉⠍ ⠍⠂⠝⠎ ⠦⠇⠂⠌ ⠉⠕⠍⠍⠕⠝ ⠍⠥⠇⠞⠊⠏⠇⠑⠲⠴ ⠠⠔ ⠮
⠏⠗⠕⠃⠇⠑⠍ ⠆⠇⠂ ⠸⠩ ⠠⠠⠇⠉⠍ ⠨⠅ ⠼⠂⠆ ⠸⠱⠲

On line 2, the three-letter abbreviation (initialism) is part of the math.

4.24.1 **UEB vs. Nemeth Code.** In literary mode, apply UEB rules regarding use of the grade 1 indicator with abbreviations. In Nemeth mode, apply Nemeth rules regarding use of the English-letter indicator with abbreviations. In both modes, the linage rules of Nemeth are followed.

Example 4-61

In this equation, SD stands for Standard Deviation: SD × $c = 0$.

⠀⠀⠠⠔ ⠹ ⠑⠟⠥⠁⠰⠝⠂ ⠰⠠⠠⠎⠙ ⠌⠯⠎ ⠿ ⠠⠌⠯⠜⠙
⠠⠙⠑⠧⠊⠁⠰⠝⠒ ⠸⠩ ⠠⠠⠎⠙ ⠈⠡⠉ ⠨⠅ ⠼⠴ ⠸⠱⠲

In UEB, SD needs a grade 1 indicator in order not to be read as "SAID". In Nemeth, an English-letter indicator is not needed because contractions are not allowed inside the switches. Abbreviations—initialisms included—are spaced away from operation signs; variables are not.

4.25 Initiating Nemeth Code Before Itemized Material, Following a Heading

As seen in Lesson 2, in order to ensure that identifiers each begin in the same cell, the opening Nemeth Code indicator is placed at the end of the text that precedes the listed items. When an itemized set of problems immediately follows a heading, the following layouts are recommended.

4.25.1 **Centered Heading.** An opening Nemeth Code indicator cannot be placed at the end of a centered heading. When itemized material immediately follows a centered heading, place the opening Nemeth Code indicator alone on the line immediately before the first identifier. A switch indicator alone on a line does not replace a necessary blank line.

Example 4-62

Problem Set A

(a) 7 > 4 > -?-
(b) |−6| __ 6 (Use =, >, or <)
(c) 2 : 4 :: 6 : ?

```
            ⠠⠏⠗⠕⠃⠇⠑⠍ ⠠⠎⠑⠞ ⠠⠁
⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀⠀
⠸⠩
⠷⠁⠾ ⠼⠶ ⠨⠂ ⠼⠲ ⠨⠂ ⠿
⠷⠃⠾ ⠳⠤⠖⠳ ⠤⠤⠤⠤ ⠼⠖ ⠷⠠⠄⠠⠥⠎⠑ ⠨⠅⠠ ⠨⠂⠠ ⠠⠄⠕⠗
  ⠐⠅⠾
⠷⠉⠾ ⠼⠆ ⠐⠂ ⠼⠲ ⠰⠆ ⠼⠖ ⠐⠂ ⠿ ⠸⠱
```

Line 2 is the blank line which is required following a centered heading.

4.25.2 **Cell-5 and Cell-7 Heading.** An opening Nemeth Code indicator may be placed at the end of a cell-5 or cell-7 heading. If the indicator does not fit on the line with the heading, it may be placed on the next line in the runover position. This is especially useful when itemized math material immediately follows the heading. The first identifier will then be transcribed in Nemeth.

Example 4-63

Problem Set A
(a) $7 > 4 >$ -?-
(b) $|-6|$ ___ 6 (Use =, >, or <)
(c) $2 : 4 :: 6 : ?$

```
    ⠠⠏⠗⠕⠃⠇⠑⠍ ⠠⠎⠑⠞ ⠠⠁ ⠸⠩
⠷⠁⠾ ⠼⠶ ⠨⠂ ⠼⠲ ⠨⠂ ⠿
⠷⠃⠾ ⠳⠤⠖⠳ ⠤⠤⠤⠤ ⠼⠖ ⠷⠠⠄⠠⠥⠎⠑ ⠨⠅⠠ ⠨⠂⠠ ⠠⠄⠕⠗
  ⠐⠅⠾
⠷⠉⠾ ⠼⠆ ⠐⠂ ⠼⠲ ⠰⠆ ⠼⠖ ⠐⠂ ⠿ ⠸⠱
```

The opening Nemeth Code indicator is transcribed after the last word in the cell-5 heading.

Example 4-64

Problem Set A [CC 7.11.d]
(a) $7 > 4 >$ -?-
(b) $|-6|$ ___ 6 (Use =, >, or <)

```
    ⠠⠏⠗⠕⠃⠇⠑⠍ ⠠⠎⠑⠞ ⠠⠁ ⠨⠣⠠⠠⠉⠉ ⠼⠛⠲⠁⠁⠲⠰⠙⠨⠜
    ⠸⠩
⠷⠁⠾ ⠼⠶ ⠨⠂ ⠼⠲ ⠨⠂ ⠿
⠷⠃⠾ ⠳⠤⠖⠳ ⠤⠤⠤⠤ ⠼⠖ ⠷⠠⠄⠠⠥⠎⠑ ⠨⠅⠠ ⠨⠂⠠ ⠠⠄⠕⠗
  ⠐⠅⠾ ⠸⠱
```

This opening Nemeth Code indicator is transcribed in cell 5, the runover position of the cell-5 heading.

4.26 Transcriber's Notes

Transcriber's note indicators are UEB symbols and therefore must be transcribed outside of the Nemeth switches. When the note itself contains mathematical material, code switching occurs within the note. Nemeth Code must be terminated before the closing transcriber's note indicator is transcribed. If mathematical material follows the transcriber's note, the opening Nemeth Code indicator may be placed following the closing transcriber's note indicator only if it fits on the same line.

Instructions: Review the "keep together" format rule for abbreviations and a preceding or following numeral to which it applies, (Lesson 3). In item G, assume that the letters of ARPA are pronounced individually.

PRACTICE 4I

A. 1 m = 100 cm

B. 3 yrs = 365 × 3 days

C. Draw three triangles using the given side lengths: (i) 1.5 cm, 5 cm, and 4.5 cm (ii) 4.5 cm, 5 cm, and 7.5 cm (iii) 1.5 cm, 4.5 cm, and 7 cm.

D. 1 square mile converted to acres: 1 sq mi = 640 ac

E. 5 in + 25 in = 30 in

F. **Two Types of Tons.** Compare the long ton with the short ton: 1 l. t. = 2240 lb.; 1 sh. t. = 2000 lb.

G. Fill in the missing information in the Customer Lifetime Value (CLV) Formula using Average revenue per account (ARPA). CLV = ____ × ARPA

H. Specific heat is expressed in J/kg·K.

For further practice, see Appendix A—Reading Practice.

EXERCISE 4

Prepare Exercise 4 for your grader.

ANSWERS TO PRACTICE MATERIAL

PRACTICE 4A

⠼⠁⠲ ⠠⠑⠭⠏⠗⠑⠎⠎ ⠰⠽ ⠔ ⠞⠻⠍⠎ ⠷ ⠰⠭ ⠊⠋
⠀⠀⠸⠩ ⠼⠆⠭⠤⠒⠽ ⠨⠅ ⠼⠂⠆⠸⠲
⠼⠆⠸⠲ ⠠⠄⠠⠊⠋ ⠠⠁ ⠨⠅ ⠇⠈⠡⠇ ⠸⠱⠂ ⠱⠁⠞ ⠊⠎ ⠮ ⠇⠢⠛⠹
⠀⠀⠐⠣⠰⠇⠐⠜ ⠷ ⠁ ⠎⠊⠙⠑ ⠔⠡⠑⠎ ⠊⠋ ⠮ ⠜⠑⠁ ⠐⠣⠠⠁⠐⠜
⠀⠀⠷ ⠁ ⠎⠟⠥⠜⠑ ⠊⠎ ⠸⠩ ⠼⠶⠨⠒ ⠎⠟⠲⠋⠞⠲ ⠸⠱⠦
⠼⠉⠲ ⠠⠭ ⠊⠎ ⠍⠡ ⠑⠁⠎⠊⠻ ⠞⠕ ⠗⠑⠍⠑⠍⠃⠻
⠀⠀⠸⠩ ⠠⠁ ⠨⠅ ⠇⠺
⠀⠀⠷⠠⠁⠗⠑⠁ ⠨⠅ ⠇⠑⠝⠛⠞⠓⠈⠡⠺⠊⠙⠞⠓⠾ ⠸⠱ ⠹⠁⠝ ⠭ ⠊⠎
⠀⠀⠞⠕ ⠗⠑⠍⠑⠍⠃⠻ ⠸⠩ ⠠⠃ ⠨⠅ ⠚⠞ ⠸⠱ ⠱⠢ ⠞⠗⠽⠬ ⠞⠕
⠀⠀⠋⠊⠛⠥⠗⠑ ⠳ ⠓⠪ ⠍⠡ ⠉⠜⠏⠑⠞ ⠞⠕ ⠃⠥⠽ ⠿ ⠮ ⠇⠊⠧⠬
⠀⠀⠗⠕⠕⠍⠲
⠼⠙⠲ ⠠⠱⠁⠞ ⠊⠎ ⠮ ⠜⠑⠁ ⠠⠁ ⠷ ⠞⠗⠁⠏⠑⠵⠕⠊⠙ ⠰⠠⠞ ⠾
⠀⠀⠥⠏⠏⠻ ⠃⠁⠎⠑ ⠸⠩ ⠁ ⠨⠅ ⠼⠒ ⠰⠍ ⠸⠱⠂ ⠇⠪⠻ ⠃⠁⠎⠑
⠀⠀⠸⠩ ⠃ ⠨⠅ ⠼⠖ ⠰⠍ ⠸⠱⠂ ⠯ ⠓⠑⠊⠣⠞
⠀⠀⠸⠩ ⠓ ⠨⠅ ⠼⠂⠒ ⠰⠍ ⠸⠱⠦

PRACTICE 4B

⠊⠲ ⠠⠞⠗⠊⠁⠝⠛⠇⠑ ⠸⠩ ⠠⠁⠠⠃⠠⠉ ⠸⠱ ⠔ ⠠⠟⠥⠁⠙⠗⠁⠝⠞
  ⠠⠠⠊⠧ ⠊⠎ ⠗⠑⠋⠇⠑⠉⠞⠫ ⠔ ⠠⠟⠥⠁⠙⠗⠁⠝⠞ ⠠⠠⠊⠊⠊ ⠵
  ⠠⠞⠗⠊⠁⠝⠛⠇⠑ ⠸⠩ ⠠⠁⠄⠠⠃⠄⠠⠉⠄⠸⠲
⠰⠊⠊⠸⠲ ⠊⠧⠬⠧⠊ ⠨⠅ ⠭
⠰⠊⠊⠊⠸⠲ ⠠⠭ ⠨⠅ ⠼⠂⠴⠠ ⠠⠇ ⠨⠅ ⠼⠢⠴⠠ ⠠⠉ ⠨⠅ ⠼⠂⠴⠴⠠
  ⠠⠄⠯ ⠠⠙ ⠨⠅ ⠼⠢⠴⠴ ⠸⠱⠲
⠊⠧⠲ ⠠⠗⠑⠧⠊⠑⠺ ⠊⠞⠑⠍⠎ ⠰⠧ ⠯ ⠧⠊⠲
⠰⠧⠲ ⠠⠑⠭⠏⠇⠁⠔ ⠱⠽ ⠸⠩ ⠠⠠⠍⠉ ⠨⠅ ⠼⠂⠂⠴⠴⠠ ⠠⠄⠃
  ⠠⠠⠉⠍ ⠨⠅ ⠼⠔⠴⠴ ⠸⠱⠲
⠧⠊⠲ ⠠⠥⠎⠑ ⠠⠿⠍⠥⠇⠁⠎ ⠸⠩ ⠠⠊⠄ ⠠⠄⠯ ⠠⠠⠊⠊⠊⠄ ⠸⠱ ⠞⠕
  ⠏⠗⠕⠧⠑ ⠮ ⠌⠁⠞⠑⠰⠞⠲

PRACTICE 4C

⠠⠊⠲ ⠠⠔ ⠮ ⠓⠑⠭⠁⠙⠑⠉⠊⠍⠁⠇ ⠎⠽⠌⠑⠍ ⠐⠣⠃⠁⠎⠑ ⠼⠁⠋⠐⠜⠂
  ⠮ ⠝⠥⠍⠃⠻ ⠦⠐⠕ ⠹⠳⠎⠯⠴ ⠊⠎ ⠺⠗⠊⠞⠞⠢ ⠵
  ⠸⠩ ⠼⠒⠑⠦ ⠸⠱⠲
⠠⠠⠊⠊⠲ ⠠⠒⠧⠻⠞ ⠓⠑⠭ ⠸⠩ ⠼⠶⠁⠂ ⠸⠱ ⠞⠕ ⠙⠑⠉⠊⠍⠁⠇
  ⠝⠥⠍⠻⠁⠰⠝⠲ ⠈⠨⠣⠁ ⠊⠎ ⠉⠁⠏⠊⠞⠁⠇⠊⠵⠫ ⠔ ⠏⠗⠔⠞⠲⠈⠨⠜

PRACTICE 4D

⠠⠁⠇⠹ ⠮ ⠓⠯⠺⠗⠊⠞⠞⠢ ⠿⠍ ⠷ ⠏⠓⠊ ⠸⠩ ⠷⠨⠈⠋⠾ ⠸⠱
⠍⠁⠽ ⠆ ⠋⠨⠙ ⠔ ⠎⠳⠗⠉⠑ ⠍⠁⠞⠻⠊⠁⠇⠎⠂ ⠕⠝⠇⠽ ⠮ ⠌⠯⠜⠙
⠿⠍ ⠸⠩ ⠷⠨⠋⠾ ⠸⠱ ⠊⠎ ⠥⠎⠫ ⠔ ⠹ ⠃⠕⠕⠅⠲

⠠⠁⠝⠕⠮⠗ ⠉⠊⠗⠉⠇⠑ ⠒⠌⠁⠝⠞⠂ ⠮ ⠠⠛⠗⠑⠑⠅ ⠇⠗ ⠞⠁⠥⠂
⠸⠩ ⠨⠞⠠ ⠠⠄⠑⠟⠥⠁⠇⠎ ⠼⠆⠨⠏ ⠸⠱⠂ ⠕⠗
⠁⠏⠏⠗⠕⠭⠊⠍⠁⠞⠑⠇⠽ ⠸⠩ ⠼⠖⠨⠆⠦ ⠸⠱⠲

⠠⠔ ⠌⠁⠞⠊⠌⠊⠉⠎⠂ ⠸⠩ ⠨⠍ ⠸⠱ ⠙⠢⠕⠞⠑⠎ ⠮
⠏⠕⠏⠥⠇⠁⠰⠝ ⠍⠂⠝⠆ ⠔ ⠢⠛⠔⠑⠻⠬⠂ ⠸⠩ ⠨⠍ ⠸⠱ ⠊⠎ ⠮
⠉⠕⠑⠖⠊⠉⠊⠢⠞ ⠷ ⠋⠗⠊⠉⠰⠝⠲ ⠠⠔ ⠝⠥⠍⠃⠻ ⠮⠕⠗⠽⠂
⠸⠩ ⠨⠍ ⠸⠱ ⠗⠑⠏⠗⠑⠎⠢⠞⠎ ⠮ ⠠⠍⠘⠒⠕⠃⠊⠥⠎ ⠋⠥⠝⠉⠰⠝
⠐⠱⠁⠎⠂ ⠔ ⠐⠏⠊⠉⠇⠑ ⠏⠓⠽⠎⠊⠉⠎⠂ ⠸⠩ ⠨⠍ ⠸⠱ ⠊⠎ ⠮
⠎⠽⠍⠃⠕⠇ ⠿ ⠮ ⠍⠥⠕⠝⠲

PRACTICE 4E

⠼⠁⠐⠜ ⠠⠆ ⠎⠥⠗⠑ ⠞⠕ ⠙⠊⠖⠻⠢⠞⠊⠁⠞⠑ ⠆⠞ ⠮
⠠⠉⠽⠗⠊⠇⠇⠊⠉ ⠇⠗⠎ ⠦⠑⠇⠇⠴ ⠸⠩ ⠈⠈⠇ ⠸⠱ ⠯ ⠦⠠⠑⠇⠇⠴
⠸⠩ ⠈⠈⠠⠇ ⠸⠱ ⠯ ⠮ ⠠⠛⠗⠑⠑⠅ ⠇⠗⠎ ⠦⠏⠊⠴
⠸⠩ ⠨⠏ ⠸⠱ ⠯ ⠦⠠⠏⠊⠴ ⠸⠩ ⠨⠠⠏ ⠸⠱⠲
⠼⠃⠐⠜ ⠠⠮ ⠋⠌ ⠞⠢ ⠥⠝⠉⠁⠏⠊⠞⠁⠇⠊⠵⠫ ⠠⠉⠽⠗⠊⠇⠇⠊⠉ ⠇⠗⠎
⠜⠑⠒ ⠁⠓ ⠸⠩ ⠈⠈⠁⠠ ⠠⠄⠃⠑⠓ ⠈⠈⠃⠠ ⠠⠄⠧⠑⠓ ⠈⠈⠺⠠
⠠⠄⠣⠑⠓ ⠈⠈⠛⠠ ⠠⠄⠙⠑⠓ ⠈⠈⠙⠠ ⠠⠄⠽⠑⠓ ⠈⠈⠑⠠
⠠⠄⠵⠓⠑⠓ ⠈⠈⠚⠠ ⠠⠄⠵⠑⠓ ⠈⠈⠵⠠ ⠠⠄⠑⠑ ⠈⠈⠊ ⠸⠱⠂ ⠯
⠅⠁⠓ ⠸⠩ ⠈⠈⠅ ⠸⠱⠲

PRACTICE 4F

⠼⠁⠲ ⠠⠧⠜⠊⠁⠃⠇⠑⠎ ⠁ ⠯ ⠰⠃ ⠜⠑ ⠔⠧⠻⠎⠑⠇⠽ ⠗⠑⠇⠁⠞⠫⠲

1. An unmodified, freestanding mathematical English letter in UEB context does not require a code switch. UEB rules are followed regarding use/nonuse of the grade 1 indicator.

⠼⠃⠲ ⠠⠐⠮ ⠑⠭⠊⠌⠎ ⠁ ⠒⠌⠁⠝⠞ ⠰⠠⠝ ⠎⠡ ⠞ ⠝⠕ ⠃⠊⠞ ⠷
⠸⠩ ⠨⠠⠺ ⠸⠱ ⠁⠋ ⠮ ⠠⠝⠹ ⠉ ⠆ ⠏⠗⠕⠧⠢ ⠞⠕ ⠆ ⠼⠁
⠕⠗ ⠼⠚⠲

2. Greek letters, whether capital or lowercase, require a switch to Nemeth Code. The single-letter ordinal "Nth" does not require a switch.

⠼⠉⠲ ⠠⠗⠯⠁⠇⠇ ⠗⠑⠏⠇⠊⠫⠂ ⠦⠸⠩ ⠼⠂⠆⠤⠝⠠ ⠼⠂⠂⠤⠝⠠
⠼⠂⠴⠤⠝ ⠸⠱ ⠲⠲⠲ ⠱ ⠊⠎ ⠉⠕⠗⠗⠑⠉⠞⠦⠴

3. Placing the opening quotation mark before the opening Nemeth Code indicator aligns with the UEB practice of nested symbols. The commas following each math item are transcribed in Nemeth because we are still inside the switches. The three separate math items do not need to fall on the same braille line. The ellipsis follows the Nemeth Code terminator because it is not part of the mathematical expression – it indicates that the speaker is pausing.

⠼⠙⠲ ⠸⠩ ⠦⠼⠂⠆⠤⠝⠠ ⠼⠂⠂⠤⠝⠠ ⠼⠂⠴⠤⠝⠠ ⠄⠄⠄⠸⠴ ⠸⠱

4. This ellipsis is part of a mathematical series and so Nemeth Code is not terminated until after the ellipsis. The quotation marks are placed inside the code switch indicators along with the technical material to which they apply. There is no space between the ellipsis and the quotation mark. A punctuation indicator is required before the closing quotation mark.

⠼⠑⠲ ⠠⠱ ⠊⠎ ⠉⠕⠗⠗⠑⠉⠞⠒ ⠸⠩ ⠦⠼⠲⠭⠬⠒⠽⠠⠸⠴
⠦⠼⠒⠭⠬⠲⠽⠠⠸⠴ ⠠⠄⠕⠗ ⠦⠼⠲⠭⠬⠲⠽⠸⠴ ⠸⠱⠦

5. The quotation marks enclose each expression and so are transcribed inside the switches. A punctuation indicator is required before each closing quotation mark. The question mark is placed after the Nemeth Code terminator because it applies to the whole sentence.

⠼⠋⠲ ⠠⠱⠁⠞ ⠊⠎ ⠮ ⠗⠑⠍⠁⠔⠙⠻ ⠱⠢ ⠼⠁⠚⠁ ⠊⠎ ⠙⠊⠧⠊⠙⠫
⠃⠽ ⠼⠉ ⠸⠩ ⠷⠂⠴⠂⠨⠌⠒⠾ ⠸⠱⠦

6. An isolated mathematical expression is enclosed in parentheses. Nemeth grouping symbols are used even though, technically, they are nonmathematical.

⠼⠛⠲ ⠠⠮ ⠗⠑⠎⠥⠇⠞ ⠊⠎ ⠸⠩ [illegible]
⠐⠱ ⠁⠇⠇ ⠉⠕⠍⠏⠕⠝⠢⠞⠎ ⠜[illegible]

Practice 4F, continued

7. The function of the parentheses is to group the factors, specifying multiplication. Grouping symbols that are part of the mathematical expression must be transcribed as Nemeth symbols.

⠼⠓⠲ ⠸⠩ ⠨⠠⠙⠭ ⠸⠱ ⠍⠂⠝⠎ ⠦⠮ ⠡⠁⠝⠛⠑ ⠔ ⠰⠭⠴ ⠯
⠸⠩ ⠨⠠⠙⠽ ⠸⠱ ⠍⠂⠝⠎ ⠦⠮ ⠡⠁⠝⠛⠑ ⠔ ⠰⠽⠴⠲ ⠠⠱⠢ ⠰⠭
⠔⠉⠗⠂⠎⠑⠎ ⠃⠽ ⠸⠩ ⠨⠠⠙⠭ ⠸⠱⠂ ⠰⠽ ⠔⠉⠗⠂⠎⠑⠎ ⠃⠽
⠸⠩ ⠨⠠⠙⠽ ⠸⠱ ⠵ ⠑⠭⠏⠗⠑⠎⠎⠫ ⠔ ⠮ ⠑⠟⠥⠁⠰⠝
⠸⠩ ⠽ ⠨⠅ ⠨⠠⠙⠽ ⠨⠅ ⠋⠷⠭⠬⠨⠠⠙⠭⠾ ⠸⠱⠲

8. Variables x and y that are not associated with the Greek letter or within the equation are transcribed in UEB.

⠼⠊⠲ ⠐⠣⠸⠩ ⠼⠲⠭⠬⠒⠽ ⠸⠱ ⠊⠎ ⠮ ⠙⠢⠕⠍⠔⠁⠞⠕⠗⠲⠐⠜

9. The paired grouping symbols (parentheses) must be transcribed in the same code—in this case, UEB.

PRACTICE 4G

Code switch indicators are omitted from the illustrations in this Practice.

YES ⠨⠷⠁⠠ ⠃⠠ ⠉⠠ ⠙⠨⠾

YES ⠷⠤⠂⠠ ⠤⠆⠠ ⠤⠒⠾

NO (this list includes abbreviations)

YES ⠷⠁⠃⠠ ⠉⠙⠠ ⠑⠋⠾

NO (this sequence does not begin and end with a sign of grouping)

YES ⠷⠂⠠ ⠊⠠ ⠆⠠ ⠊⠊⠾

NO (this list contains ordinals)

YES ⠷⠠⠁⠠ ⠠⠁⠄⠠ ⠠⠃⠠ ⠠⠃⠄⠠ ⠠⠉⠾

YES ⠨⠷⠤⠤⠤⠤⠠ ⠨⠂⠒⠠ ⠨⠂⠢⠠ ⠨⠂⠶⠠ ⠤⠤⠤⠤⠨⠾

YES ⠷⠂⠬⠓⠠ ⠆⠬⠅⠠ ⠴⠾

NO (this list contains a sign of comparison)

YES ⠷⠉⠠ ⠃⠈⠾

Practice 4G, continued

NO (the items are not separated by commas)

YES ⠈⠷⠴⠠ ⠂⠈⠾

NO (there is a semicolon)

NO (this list contains words)

YES ⠷⠁⠠ ⠃⠠ ⠄⠄⠄⠾

YES ⠷⠭⠬⠂⠠ ⠭⠬⠆⠠ ⠿⠠ ⠿⠠ ⠭⠬⠢⠾

YES ⠨⠨⠷⠤⠂⠠ ⠴⠈⠾

YES ⠷⠆⠠ ⠲⠠ ⠖⠠ ⠤⠤⠤⠤⠠ ⠂⠴⠾

YES ⠷⠴⠠ ⠁⠠ ⠂⠠ ⠃⠠ ⠆⠾

NO (there are plural endings)

PRACTICE 4H

1 ⠠⠁⠐⠜ ⠠⠋⠔⠙ ⠁⠇⠇ ⠸⠩ ⠠⠁⠠⠃⠎⠠ ⠠⠉⠠⠙⠎⠠ ⠠⠄⠯
2 ⠠⠑⠠⠋⠎⠸⠆ ⠠⠄⠙⠗⠁⠺ ⠠⠭⠠⠽⠠⠵⠎ ⠸⠱⠲
3 ⠰⠠⠃⠐⠜ ⠠⠋⠔⠙ ⠁⠇⠇ ⠸⠩ ⠠⠁⠠⠃⠸⠄⠎⠠ ⠠⠉⠠⠙⠸⠄⠎⠠ ⠠⠄⠯
4 ⠠⠑⠠⠋⠸⠄⠎⠸⠆ ⠠⠄⠙⠗⠁⠺ ⠠⠭⠠⠽⠠⠵⠸⠄⠎⠸⠲
5 ⠰⠠⠉⠾ ⠷⠂⠎⠞⠠ ⠼⠆⠝⠙⠠ ⠄⠄⠄ ⠰⠝⠞⠓⠠ ⠄⠄⠄ ⠼⠲⠔⠞⠓⠾
6 ⠰⠠⠙⠾ ⠠⠄⠠⠙⠕⠑⠎ ⠳⠁⠳⠈⠡⠳⠃⠳ ⠨⠅ ⠳⠁⠃⠳⠸⠦
7 ⠰⠠⠑⠾ ⠠⠄⠠⠊⠋ ⠰⠠⠟⠠ ⠠⠄⠮⠝
8 ⠨⠷⠈⠷⠠⠠⠝⠕⠞⠤⠰⠠⠏⠈⠾ ⠠⠠⠕⠗ ⠰⠠⠏⠨⠾ ⠸⠱⠲

PRACTICE 4I

⠸⠩
⠰⠠⠁⠸⠲ ⠼⠂ ⠰⠍ ⠨⠅ ⠼⠂⠴⠴ ⠉⠍
⠰⠠⠃⠸⠲ ⠼⠒ ⠽⠗⠎ ⠨⠅ ⠼⠒⠖⠢⠈⠡⠒ ⠙⠁⠽⠎ ⠸⠱
⠰⠠⠉⠲ ⠠⠙⠗⠁⠺ ⠹⠗⠑⠑ ⠞⠗⠊⠁⠝⠛⠇⠑⠎ ⠥⠎⠬ ⠮ ⠛⠊⠧⠢
⠎⠊⠙⠑ ⠇⠢⠛⠹⠎⠒ ⠸⠩ ⠷⠊⠾ ⠼⠂⠨⠢ ⠉⠍⠂ ⠼⠢ ⠉⠍⠂ ⠠⠄⠯
⠼⠲⠨⠢ ⠉⠍ ⠷⠊⠊⠾ ⠼⠲⠨⠢ ⠉⠍⠂ ⠼⠢ ⠉⠍⠂ ⠠⠄⠯
⠼⠶⠨⠢ ⠉⠍ ⠷⠊⠊⠊⠾ ⠼⠂⠨⠢ ⠉⠍⠂ ⠼⠲⠨⠢ ⠉⠍⠂ ⠠⠄⠯
⠼⠶ ⠉⠍ ⠸⠱⠲
⠰⠠⠙⠲ ⠼⠁ ⠎⠟⠥⠜⠑ ⠍⠊⠇⠑ ⠒⠧⠻⠞⠫ ⠞⠕ ⠁⠉⠗⠑⠎⠒
⠸⠩ ⠼⠂ ⠎⠟ ⠍⠊ ⠨⠅ ⠼⠖⠲⠴ ⠁⠉
⠰⠠⠑⠸⠲ ⠼⠢ ⠊⠝ ⠬⠆⠢ ⠊⠝ ⠨⠅ ⠼⠒⠴ ⠊⠝ ⠸⠱
⠰⠠⠋⠲ ⠘⠶⠠⠞⠺⠕ ⠰⠞⠽⠏⠑⠎ ⠷ ⠠⠞⠕⠝⠎⠲⠘⠄ ⠠⠉⠕⠍⠏⠜⠑ ⠮
⠇⠰⠛ ⠞⠕⠝ ⠾ ⠮ ⠩⠕⠗⠞ ⠞⠕⠝⠒
⠸⠩ ⠼⠂ ⠰⠇⠲ ⠰⠞⠲ ⠨⠅ ⠼⠆⠆⠲⠴ ⠇⠃⠲⠆
⠼⠂ ⠎⠓⠲ ⠰⠞⠲ ⠨⠅ ⠼⠆⠴⠴⠴ ⠇⠃⠲ ⠸⠱
⠰⠠⠛⠲ ⠠⠋⠊⠇⠇ ⠔ ⠮ ⠍⠊⠎⠎⠬ ⠔⠿⠍⠁⠰⠝ ⠔ ⠮ ⠠⠉⠥⠌⠕⠍⠻
⠠⠇⠊⠋⠑⠐⠞ ⠠⠧⠁⠇⠥⠑ ⠐⠣⠠⠠⠉⠇⠧⠐⠜ ⠠⠿⠍⠥⠇⠁ ⠥⠎⠬
⠠⠁⠧⠻⠁⠛⠑ ⠗⠑⠧⠢⠥⠑ ⠏⠻ ⠁⠒⠨⠞ ⠐⠣⠠⠠⠁⠗⠏⠁⠐⠜⠲
⠸⠩ ⠠⠠⠉⠇⠧ ⠨⠅ ⠤⠤⠤⠤ ⠈⠡ ⠠⠠⠁⠗⠏⠁ ⠸⠱
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