

LESSON 5

- SIGNS OF OPERATION, cont.
- SIGNS OF COMPARISON, cont.

Format

- Instructions
- Simple Tables

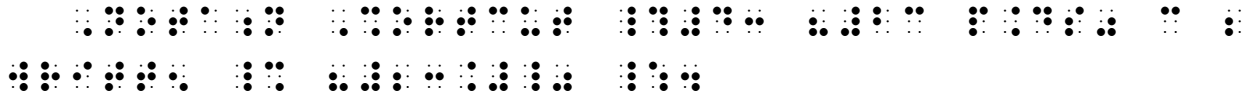
Answers to Practice Material

LESSON PREVIEW

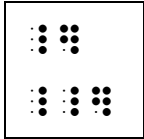
Many more operation signs and signs of comparison are explored, including negated forms. Table format is introduced, with a table consisting of mathematical symbols and their names. Mathematical use of the colon meaning "such that" is shown. The concept of symbols compounded vertically and symbols compounded horizontally is introduced with certain signs of comparison. Considerations for format of instructions are investigated.

Example 5-8

Notation Shortcut #4: "23 pounds" can be written "23#".



5.3.4 **Dagger and Double Dagger**



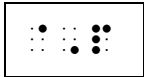
a. The dagger and double dagger may be used as operation symbols in binary operations.

➤ $A † B = B † A$

➤ $A ‡ B = B ‡ A$

b. The dagger used as a reference marker will be discussed in Lesson 13.

5.3.5 **Paragraph Mark**

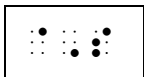


In mathematical context, the Nemeth symbol is used. A numeric indicator is required before a numeral following a paragraph mark.

➤ $A § B$

➤ $3 § 4 = 4 § 3$

5.3.6 **Section Mark**



In mathematical context, the Nemeth symbol is used. A numeric indicator is required before a numeral following a section mark.

➤ $A § B$

➤ $3 § 4 = 4 § 3$

Instructions: Review the spacing rules for operation signs before transcribing the practice.
Transcribe this entire list in Nemeth Code.

PRACTICE 5A

$$4 \pm 1, 400 \pm 10, 6 \mp 1, 600 \mp 10$$

$$\mu \pm 1.645 \sigma$$

$$50 - +5 = 45$$

$$50 + -5 = ?$$

$$-3 - -3 = 0$$

$$A \& B = B \& A$$

$$a * (b * c) = (a * b) * c$$

$$(1 + 2) * (3 + 4) = 3 * 7$$

$$\#A = \#B$$

$$.5\#9 = .9\#5$$

$$[(p \dagger p) \dagger (q \dagger q)]$$

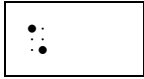
$$s \upharpoonright t = u \upharpoonright v$$

$$1 \upharpoonright 3 = 4 \upharpoonright 3$$

$$m \S y = y \S m = y$$

$$5 \S 6 = 6 \S 5 = 6$$

5.4.2 Dot



In addition to operating as a multiplication sign, the dot may also be used to denote "and" in the study of logic. In either case, the symbol is transcribed without a space.

Example 5-11

In logic, $p \cdot q$ is read "p and q".

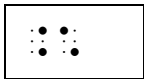


Example 5-12

Torque is expressed as $N \cdot m$.



5.4.3 Hollow Dot



The hollow dot may be used as a sign of operation. It is also seen in function notation. The raised hollow dot used to represent degrees will be discussed in Lesson 6.

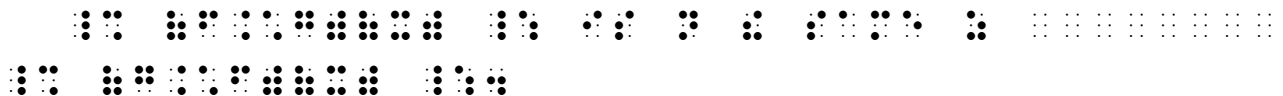
Example 5-13

$$a \circ (b \circ c) = (a \circ b) \circ c$$



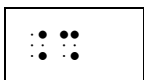
Example 5-14

$(f \circ g)(x)$ is not the same as $(g \circ f)(x)$.



Be sure to transcribe the hollow dot symbol – this is not the letter "o".

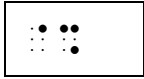
5.4.4 Intersection



This operation symbol is also called a "cap".

$$\Rightarrow A \cap B = B \cap A$$

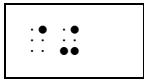
5.4.5 Logical Product



In the study of logic, this operation sign means "and" or "meet".

$$\gg p \wedge q \wedge r \quad \dots \dots \dots \dots \dots \dots$$

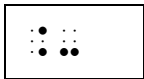
5.4.6 Logical Sum



In the study of logic, this operation sign means "or" or "join".

$$\gg p \vee q \vee r \quad \dots \dots \dots \dots \dots \dots$$

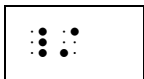
5.4.7 Minus with Dot Over



This operation sign means "proper difference".

$$\gg x \dot{-} y = 0 \quad \dots \dots \dots \dots \dots \dots$$

5.4.8 Slash



The term "slash" refers to the forward slash, which slants from lower left to upper right. In Nemeth, no space is left between the slash and any numeral, word, part of a word, or abbreviation to which it applies.

- a. With Numerals When a slash represents a fraction line in a fraction where the numerator and denominator are printed on the baseline of writing, a switch to Nemeth Code is required. The numeric indicator is not needed for the numeral immediately following the slash.

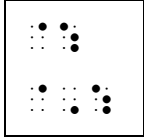
Example 5-15

3/8 of the class are girls.



- b. With Words When a slash between words or abbreviations means "divided by", "per", or "over", the slash is a mathematical operation sign and a switch to Nemeth Code is required.

5.4.9 Tilde and Extended Tilde



- a. The simple tilde has one peak. In logic, the tilde may be used as a sign of operation meaning "not".

➤ $\sim p$ ⠠⠨⠏

➤ $\sim(\sim p)$ ⠠⠨⠠⠨⠏

- b. When two symbols for the tilde follow one another, a multipurpose indicator (dot 5) is inserted between them to indicate that they are written horizontally.

➤ $\sim\sim p \vee q$ ⠠⠨⠨⠠⠎⠠⠕⠗

- c. The extended tilde has more than one peak.

➤ $\sim\sim s \vee t$ ⠠⠨⠨⠠⠎⠠⠕⠗

- d. When the tilde symbol is used to replace the word "approximately", "about", or "around" it is transcribed as an unspaced symbol.

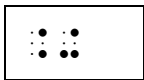
Example 5-20

The test will begin in ~15 seconds.



- e. The tilde is also used as a sign of comparison. Consider the context to determine its meaning. (See 5.6.12.) When the tilde's meaning cannot be determined from context, follow print spacing.

5.4.10 Union



This operation symbol is also called a "cup".

➤ $A \cup B = B \cup A$ ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

5.4.11 Vertical Bar



- a. When the vertical bar means "is a factor" or "divides", it is functioning as an operation sign.

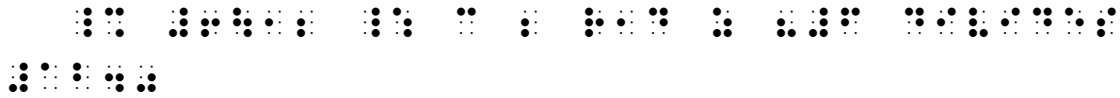
Example 5-21

In $b|a$, b is a factor of a .



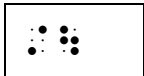
Example 5-22

$6|12$ can be read as "6 divides 12."



- b. The vertical bar is also used as a sign of grouping and as a sign of comparison. Consider the context to determine its meaning. (See Lesson 2. See also [5.6.14](#).) When the vertical bar's meaning cannot be determined from context, follow print spacing.

5.4.12 Vertical Bar, Negated



This symbol means "does not divide".



Format: Simple Tables

5.5 Introduction to Table Format

In this lesson, we look at a simple table where the items in column one must be transcribed in Nemeth. General guidelines for the layout of tables are given in *Braille Formats*. There you will find the definition of a table, margins used, column separation lines, space between columns, use of guide dots, and considerations when a table is too wide to fit on the braille page.

The following symbols may be used in a table, in either UEB or Nemeth Code.

⠠⠠⠠	Column Separation Line (width varies)
⠠⠠⠠	Guide Dots (a minimum of two)

Instructions: Include the box lines for this table.

PRACTICE 5B

<u>Name</u>	<u>Symbol</u>
Dot	•
Vertical Bar	
Logical Product	\wedge
Simple Tilde	\sim
Logical Sum	\vee
Extended Tilde	\rightsquigarrow
Backslash	\backslash
Slash	/
Hollow Dot	◦
Intersection	\cap
Union	\cup
Minus with Dot Over	$\dot{-}$

SIGNS OF COMPARISON, cont.

Five comparison signs were presented in the Preliminary Lesson.

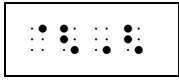
⠠⠨⠠	Equals	=
⠠⠨⠠⠨	Greater Than	>
⠠⠨⠠⠨	Less Than	<
⠠⠨⠠⠨	Proportion	::
⠠⠨⠠	Ratio	:

5.6 More Comparison Signs

⠠⠨⠠⠨⠠⠨⠠	Equivalence	≡
⠠⠨⠠⠨⠠⠨	Greater Than with Curved Sides	⋙
⠠⠨⠠	Identity	≡
⠠⠨⠠⠨	Inclusion	⊂
⠠⠨⠠⠨	Less Than with Curved Sides	⋘
⠠⠨⠠	Membership	∈
		(also ε or ℰ)
⠠⠨⠠	Parallel to	∥
⠠⠨⠠	Perpendicular to	⊥
⠠⠨⠠	Relation	R
⠠⠨⠠⠨	Reverse Inclusion	⊃
⠠⠨⠠	Reverse Membership	∋
⠠⠨⠠	Tilde, Simple	~
⠠⠨⠠⠨	Tilde, Extended	≈
⠠⠨⠠	Variation	∝
⠠⠨⠠	Vertical Bar	

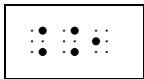
Examples of each symbol are shown below. Note that, as with the other comparison signs you have learned, these signs are preceded and followed by a space regardless of the spacing shown in print.

5.6.1 **Equivalence ("is equivalent to")**



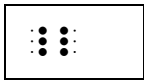
➤ $x \cong y$ ⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨

5.6.2 **Greater Than with Curved Sides ("is greater than")**



➤ $7 > 4 > 3$ ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

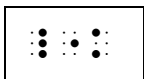
5.6.3 **Identity (Triple Bar)**



This symbol is used in several different contexts. Most commonly it means "is identical with" or "is congruent to". The transcriber uses the same symbol regardless of its meaning. Do not confuse the triple bar with the Greek letter Xi or the triple bond in Chemistry.

➤ $A + B \equiv B + A$ ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

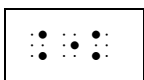
5.6.4 **Inclusion**



This symbol is generally used for sets and their elements, meaning "is contained in" or "is a subset of".

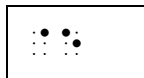
➤ $A \subset D$ ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

5.6.5 **Less Than with Curved Sides ("is less than")**



➤ $5 < 9 < 11$ ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

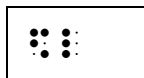
5.6.6 Membership



This symbol is generally used for sets and their elements, meaning "is an element of" or "belongs to". It must not be mistaken for the Greek uncapitalized epsilon even though it may be referred to as such.

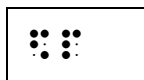
$\Rightarrow 5 \in B$ [Braille]

5.6.7 Parallel To ("is parallel to")



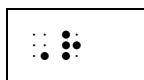
$\Rightarrow AB \parallel CD$ [Braille]

5.6.8 Perpendicular To ("is perpendicular to")



$\Rightarrow PQ \perp RS$ [Braille]

5.6.9 Relation



When a letter R is used between two expressions to show relation ("is related to"), the letter is treated as a sign of comparison with a space before and after it regardless of print spacing. Read the surrounding narrative to realize the meaning of the letter "R" in order to transcribe it correctly. Note that other letters or signs may also be used to show relation.

Example 5-23

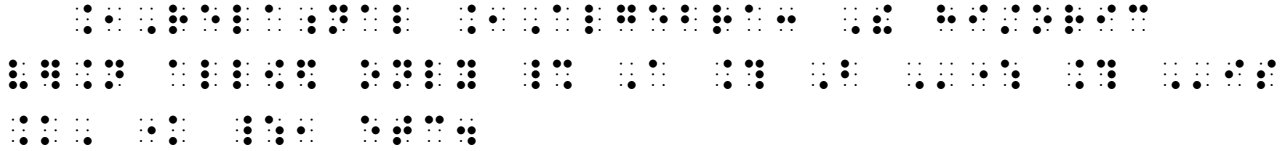
The statement $(x, y) \in G$ is read "x is R-related to y", and is denoted by xRy.

[Braille transcription of (x, y) ∈ G]

The letter R is functioning as a comparison sign here, so it is preceded and followed by a space in the transcription.

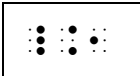
Example 5-24

Relational Algebra: The historic version allowed only $A\theta B$ where θ is =, <, etc.



Greek letter theta is the relation symbol in this example. As a sign of comparison, it is preceded and followed by a space in the transcription.

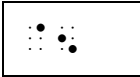
5.6.10 Reverse Inclusion



This symbol may mean "contains" or, in logic, "implies".



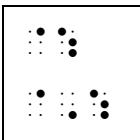
5.6.11 Reverse Membership



This symbol means "contains the element".



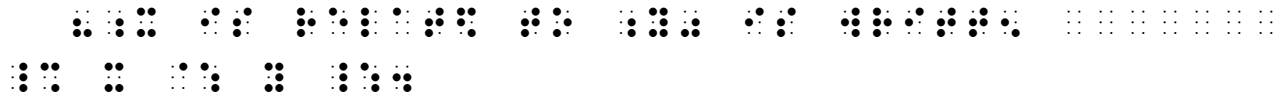
5.6.12 Tilde and Extended Tilde



- a. The simple tilde has one peak. When used as a comparison sign, the tilde means "is related to" or "is similar to".

Example 5-25

"x is related to y" is written $x \sim y$.



- b. The extended tilde has more than one peak.



Instructions: Review the spacing rules for comparison signs before transcribing the practice. Assume all tildes and vertical bars are comparison signs in these examples.

PRACTICE 5C

$$A \ni x$$

$$\{x \in A \mid x \sim a\}$$

$$j \approx k$$

$$r \propto s$$

$$f(x) \equiv D(x) \cdot q(x)$$

$$-12 < -4 < 0$$

$$.9 > .5$$

$$(A \cup E) \subset (F \cup B)$$

$$Q \supset Z$$

$$PQR \sim P'Q'R'$$

$$AB \parallel MN$$

$$CD \perp OP$$

$$EF \parallel GH \perp QR$$

$$\{m \mid 3(m - 6) = -9\}$$

$$\{x : x \text{ has the property } T\}$$

5.8 Signs of Comparison Compounded Vertically

When two or more simple signs of comparison are arranged one under the other, the combination becomes a single comparison sign compounded vertically. The symbol for the uppermost sign is written first, immediately followed by and unspaced from the symbol for the lower sign. Comparison signs compounded vertically not shown in the lists below are transcribed in accordance with this principle.

5.8.1 Greater Than or Equal To

⠠⠠⠠⠠⠠	Bar Over Greater Than	$\bar{>}$ or $\bar{>}$
⠠⠠⠠⠠⠠⠠⠠	Equals Sign Over Greater Than	$\bar{=}$ or $\bar{=}$
⠠⠠⠠⠠⠠	Bar Under Greater Than	\geq or \geq
⠠⠠⠠⠠⠠⠠⠠	Equals Sign Under Greater Than	\cong or \cong

The "equal to" sign may be printed as an equals sign or as a single line – either a horizontal bar or an oblique line. Note that both the horizontal bar and the oblique line are represented by the same braille symbol (dots 156).

$$\begin{aligned} \Rightarrow a \bar{>} b & \quad \cdot\cdot \quad \cdot\cdot\cdot\cdot\cdot\cdot \quad \cdot\cdot \\ \Rightarrow a \bar{=} b & \quad \cdot\cdot \quad \cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot \quad \cdot\cdot \\ \Rightarrow x \geq y & \quad \cdot\cdot \quad \cdot\cdot\cdot\cdot\cdot\cdot \quad \cdot\cdot \\ \Rightarrow |x| \cong 0 & \quad \cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot \quad \cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot \quad \cdot\cdot\cdot\cdot \end{aligned}$$

5.8.2 Inclusion ("is a subset of")

⠠⠠⠠⠠⠠⠠	Bar Over Inclusion	$\bar{\subset}$
⠠⠠⠠⠠⠠⠠⠠	Equals Sign Over Inclusion	$\bar{=} \subset$
⠠⠠⠠⠠⠠	Bar Under Inclusion	\subseteq
⠠⠠⠠⠠⠠⠠⠠	Equals Sign Under Inclusion	\subseteq

$$\begin{aligned} \Rightarrow C \bar{\subset} B' & \quad \cdot\cdot\cdot\cdot \quad \cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot \quad \cdot\cdot\cdot\cdot\cdot\cdot \\ \Rightarrow C \bar{=} B' & \quad \cdot\cdot\cdot\cdot \quad \cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot \quad \cdot\cdot\cdot\cdot\cdot\cdot \\ \Rightarrow (D \cap E) \subseteq (E \times E) & \quad \cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot \quad \cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot \quad \cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot \end{aligned}$$

$$\gg (D \cap E) \subseteq (E \times E)$$

$$\begin{matrix} \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \end{matrix}$$

5.8.3 Intersection

$\cdot\cdot & \cdot\cdot & \cdot\cdot$	Bar Under Intersection	\cap
$\cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot$	Equals Sign Under Intersection	\cap

- a. The intersection sign is a sign of comparison when modified by a bar or equals sign below it. It is also called a "cap".

$$\gg X \cap Y \quad \begin{matrix} \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \end{matrix}$$

$$\gg X \cap Y \quad \begin{matrix} \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \end{matrix}$$

- b. An unmodified intersection sign is a sign of operation. See [5.4.4](#).

5.8.4 Less Than or Equal To

$\cdot\cdot & \cdot\cdot & \cdot\cdot$	Bar Over Less Than	\gtrsim or \lessgtr
$\cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot$	Equals Sign Over Less Than	\gtrsim or \lessgtr
$\cdot\cdot & \cdot\cdot & \cdot\cdot$	Bar Under Less Than	\leq or \lessgtr
$\cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot$	Equals Sign Under Less Than	\leq or \lessgtr

$$\gg v - 1 \gtrsim 5 \quad \begin{matrix} \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \end{matrix}$$

$$\gg v - 1 \lesseqgtr 5 \quad \begin{matrix} \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \end{matrix}$$

$$\gg 6 \leq x \leq 9 \quad \begin{matrix} \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \end{matrix}$$

$$\gg 6 \lesseqgtr x \lesseqgtr 9 \quad \begin{matrix} \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \\ \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot & \cdot\cdot \end{matrix}$$

5.8.5 Logical Product

⠠⠠⠠⠠	Bar Over Logical Product	$\overline{\wedge}$
⠠⠠⠠⠠⠠	Bar Over and Bar Under Logical Product	$\overline{\underline{\wedge}}$
⠠⠠⠠⠠⠠⠠	Bar Over and Equals Sign Under Logical Product	$\overline{\underline{=}}$
⠠⠠⠠⠠	Bar Under Logical Product	$\underline{\wedge}$
⠠⠠⠠⠠⠠	Equals Sign Over Logical Product	$\overline{=}$
⠠⠠⠠⠠⠠⠠	Equals Sign Over and Bar Under Logical Product	$\overline{\underline{=}}$
⠠⠠⠠⠠⠠⠠⠠	Equals Sign Over and Equals Sign Under Logical Product	$\overline{\underline{=}}$
⠠⠠⠠⠠⠠	Equals Sign Under Logical Product	$\underline{=}$

- a. The logical product sign is a sign of comparison meaning "meet" when modified by a bar or equals sign above or below it.

➤ $ABD \overline{\wedge} A'B'D'$

⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

➤ $\{A\} \underline{\wedge} K$ ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

➤ $p \underline{\wedge} q$ ⠠⠠ ⠠⠠⠠⠠⠠⠠ ⠠⠠⠠

- b. An unmodified logical product sign is a sign of operation. See [5.4.5](#).

5.8.6 **Logical Sum**

⠠⠠⠠⠠⠠	Bar Over Logical Sum	⠠⠠⠠
⠠⠠⠠⠠⠠⠠	Bar Over and Bar Under Logical Sum	⠠⠠⠠⠠
⠠⠠⠠⠠⠠⠠⠠	Bar Over and Equals Sign Under Logical Sum	⠠⠠⠠⠠⠠
⠠⠠⠠⠠	Bar Under Logical Sum	⠠⠠⠠
⠠⠠⠠⠠⠠⠠	Equals Sign Over Logical Sum	⠠⠠⠠⠠
⠠⠠⠠⠠⠠⠠⠠	Equals Sign Over and Bar Under Logical Sum	⠠⠠⠠⠠⠠
⠠⠠⠠⠠⠠⠠⠠⠠⠠	Equals Sign Over and Equals Sign Under Logical Sum	⠠⠠⠠⠠⠠⠠
⠠⠠⠠⠠⠠	Equals Sign Under Logical Sum	⠠⠠⠠

- a. The logical sum sign is a sign of comparison meaning "join" when modified by a bar or equals sign above or below it.

➤ $ABC \bar{\vee} A'B'C'$

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

➤ $P(E \underline{\vee} F)$ ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

- b. An unmodified logical sum sign is a sign of operation. See [5.4.6](#).

5.8.7 **Reverse Inclusion**

⠠⠠⠠⠠⠠	Bar Over Reverse Inclusion	⠠⠠⠠
⠠⠠⠠⠠⠠⠠	Equals Sign Over Reverse Inclusion	⠠⠠⠠
⠠⠠⠠⠠⠠	Bar Under Reverse Inclusion	⠠⠠⠠
⠠⠠⠠⠠⠠⠠	Equals Sign Under Reverse Inclusion	⠠⠠⠠

➤ $B \bar{\supset} A$ ⠠⠠⠠⠠⠠⠠⠠⠠

➤ $D \underline{\supset} C$ ⠠⠠⠠⠠⠠⠠⠠⠠

5.8.8 Tilde

⠠⠨⠠⠨	Bar Over Single Tilde	⠨⠨
⠠⠨⠠⠨⠠⠨	Equals Sign Over Single Tilde	⠨⠨⠨
⠠⠨⠠⠨⠠⠨	Double Tilde	⠨⠨
⠠⠨⠠⠨⠠⠨⠠⠨	Bar Over Double Tilde	⠨⠨⠨
⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨	Equals Sign Over Double Tilde	⠨⠨⠨⠨
⠠⠨⠠⠨	Bar Under Single Tilde	⠨⠨
⠠⠨⠠⠨⠠⠨	Equals Sign Under Single Tilde	⠨⠨⠨
⠠⠨⠠⠨⠠⠨⠠⠨	Bar Under Double Tilde	⠨⠨⠨
⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨	Equals Sign Under Double Tilde	⠨⠨⠨⠨

➤ 3.14159 ≈ 3.1416

⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨

➤ $ABC \cong DEF$ ⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨

5.8.9 Union

⠠⠨⠠⠨	Bar Under Union	⠨⠨
⠠⠨⠠⠨⠠⠨	Equals Sign Under Union	⠨⠨⠨

- a. The union sign is a sign of comparison when modified by a bar or equals sign above or below it. It may also be referred to as a "cup".

➤ $A \underline{\cup} B$ ⠠⠨⠠⠨⠠⠨⠠⠨⠠⠨

- b. An unmodified union sign is a sign of operation. See [5.4.10](#).

Instructions: Transcribe "Signs of Comparison Compounded Vertically" as a cell-5 heading. Change the two-column format to a nested list by starting each phrase in cell 1, with each math example starting on a new line in cell 3. *Code Switching Guidelines:* To maintain clarity within the nested list layout, place the opening Nemeth Code indicator at the end of the UEB phrase, and place the Nemeth Code terminator on the same line with the related math.

PRACTICE 5D

Signs of Comparison Compounded Vertically

Greater Than or Equal To	$ab \overline{=} de$ $ y \geq 0$
Less Than or Equal To	$q - 7 \leq 5z$ $-6 \leq x \leq -1$
Inclusion and Reverse Inclusion	$C' \subseteq F'$ and $D \supseteq C$ $(B \cap E) \subseteq (E \times E)$
Intersection and Union ("Cup")	$X \cap Y$ $X \sqcap Y$ $A \cup B$ $A \sqcup B$
Logical Product and Logical Sum	$QRS \overline{\wedge} Q'R'S'$ $y \triangle z$ and $M(E \vee H)$ $ABC \overline{\vee} A'B'C'$
Tilde	$3.14159 \approx 3.1416$ $ABC \cong DEF$

5.9 Signs of Comparison Compounded Horizontally

When two or more signs of comparison are arranged side by side, the combination becomes a single comparison sign compounded horizontally. A multipurpose indicator (dot 5) is inserted between the unspaced symbols to indicate that they are printed horizontally, not vertically. Comparison signs compounded horizontally not shown in the lists below are transcribed in accordance with this principle.

5.9.1 Greater Than ...

⠠⠠⠠⠠⠠	Greater Than Followed by Less Than	><
⠠⠠⠠⠠⠠⠠⠠⠠	Greater Than Followed by Equals Followed by Less Than	>=<

⦿ $n > < 1$ ⠠⠠⠠⠠⠠ ⠠⠠

⦿ $n > = < 1$ ⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠

5.9.2 Less Than ...

⠠⠠⠠⠠⠠	Less Than Followed by Greater Than	<>
⠠⠠⠠⠠⠠⠠⠠⠠	Less Than Followed by Equals Followed by Greater Than	<=>

⦿ $n < > 1$ ⠠⠠⠠⠠⠠⠠⠠⠠

⦿ $n < = > 1$ ⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠

5.9.3 A Colon Used to Define an Object. A colon may be used with an equals sign to define an object. This notation that is borrowed from computer programming. Using the principle given above, suggested treatment is shown in the next example.

Example 5-31

$y:=7x+2$ means that y is defined to be $7x+2$.

⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠

⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠⠠

5.10 Negated Signs of Comparison

In print, a sign of comparison may be negated by a vertical or a slanted line drawn through it. The print negation symbol may be slanted in either direction. In braille, $\cdot\cdot\cdot$ represents any of the print negation lines. $\cdot\cdot\cdot$ is placed immediately before the sign of comparison being negated.

Some examples are shown below. Negated signs of comparison not illustrated here are transcribed according to the same principle.

$\cdot\cdot\cdot\cdot\cdot\cdot$	Negated Equals Sign	\neq or \neq
$\cdot\cdot\cdot\cdot\cdot\cdot$	Negated Parallel To	\nparallel
$\cdot\cdot\cdot\cdot\cdot\cdot$	Negated Perpendicular To	\nperp
$\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot$	Negated "Bar Under Greater Than"	\nlessgtr
$\cdot\cdot\cdot\cdot\cdot\cdot$	Negated Membership	\notin or \notin

$\gg 4 \times 13 \neq 14$ $\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot$
 $\gg 4 \nlessgtr 7$ $\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot$
 $\gg 9 \notin D$ $\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot\cdot$
 $\gg CD \nparallel EF \nperp GH$
 \cdot

Instructions: Use the principles learned in this section to construct symbols that are not shown in the examples.

PRACTICE 5E

- (1) $x \notin A$ means "x is not an element of A".
- (2) By typing \leq , the symbol \leq will appear. By typing \lessgtr , the symbol \lessgtr will appear.
- (3) $A \nsubseteq B$ means that at least one element of A is not an element of B.
- (4) $WXY \napprox VXW$
- (5) Since $L \nparallel M$ and $M \nparallel N$, does it follow that $L \nparallel N$?
- (6) The domain is all $x \neq -4, 0, 5$.

Format: Instructions

5.11 Margins for Instructions Preceding Itemized Material (5-3)

Nemeth Code makes a distinction regarding instructions preceding a set of itemized problems. Following a blank line, the instructions begin in cell 5 with runovers in cell 3. The related itemized material begins on the next line.

Exceptions: (a) Instructions may begin on line 1 if no running head is used. (b) When instructions immediately follow a cell-5 or a cell-7 heading, the blank line before the instructions is unnecessary. (c) If the itemized material itself requires a leading blank line, such as for spatial material (to be studied later in this course), a blank line is inserted.

The print document may use a distinctive typeform for instructions. Typeform used solely as a visual enhancement is disregarded in the braille transcription, according to UEB and *Braille Formats* guidelines.

We suggest that Nemeth instructions not be split between braille pages, and that the first complete item appear on the same braille page as the instructions. It is not necessary for the entire exercise to appear on the same braille page unless it is a multiple choice problem or other type of question/answer activity. (See Section 10.3 of *Braille Formats*.) Note that keeping an item together on one braille page is not a general rule; it is applied only to the first item following Nemeth instructions.

In the following example, the dashed line indicates a print page turn.

Example 5-32

Problem Set 7F Tell whether the following ratios are equivalent.

1. $3 : 2 = 75 : 50$

2. $6 : 4 = 15 : 30$

Which of the following sentences are true? Which are false?

3. $328 \div 4 = 41 \times 2$

4. $672 - 415 < 312 \div 3$

54

Multiply.

5. $11,251.54 \times 1436$

6. $1000 \times 476,792$

Example 5-33

Find two solutions for $6x + 2y$ by substituting the given values.

- a. $x = 2; y = 5$
- b. $x = 2; y = -5$

$6x + 2y = 6(2) + 2(5) = 12 + 10 = 22$
 $6x + 2y = 6(2) + 2(-5) = 12 - 10 = 2$

Example 5-34

Find two solutions for the expression $6x + 2y$ by substituting these values.

- a. $x = 2; y = 5$
- b. $x = 2; y = -5$

$6x + 2y = 6(2) + 2(5) = 12 + 10 = 22$
 $6x + 2y = 6(2) + 2(-5) = 12 - 10 = 2$

Example 5-35

Substitute the following values for x and y to solve the expression $6x + 2y$.

- A. $x = 2; y = 5$
- B. $x = 2; y = -5$
- C. $x = -2; y = -5$

$6x + 2y = 6(2) + 2(5) = 12 + 10 = 22$
 $6x + 2y = 6(2) + 2(-5) = 12 - 10 = 2$
 $6x + 2y = 6(-2) + 2(-5) = -12 - 10 = -22$

Reminder: When the print copy arranges itemized material side by side across the page and there are no subdivisions, Nemeth format rules dictate that all identifiers start in cell 1.

5.12 Narrative Directions

"Instruction" format (5-3) applies only to text that is followed by a set of numbered or lettered problems. If the material following the text is not numbered or lettered, if the directions themselves are numbered or lettered, or if the narrative is not giving explicit directions that apply to the following itemized material, then other established formats are followed as illustrated below. We may refer to such text as "directions".

5.12.1 Margins for Directions Preceding Unitemized Material (3-1). If there is no numbered or lettered exercise material following the directions, the text is treated as narrative material and is transcribed as a (3-1) paragraph. The (5-5) style of "directions" given in *Braille Formats* does not apply in a transcription that contains Nemeth.

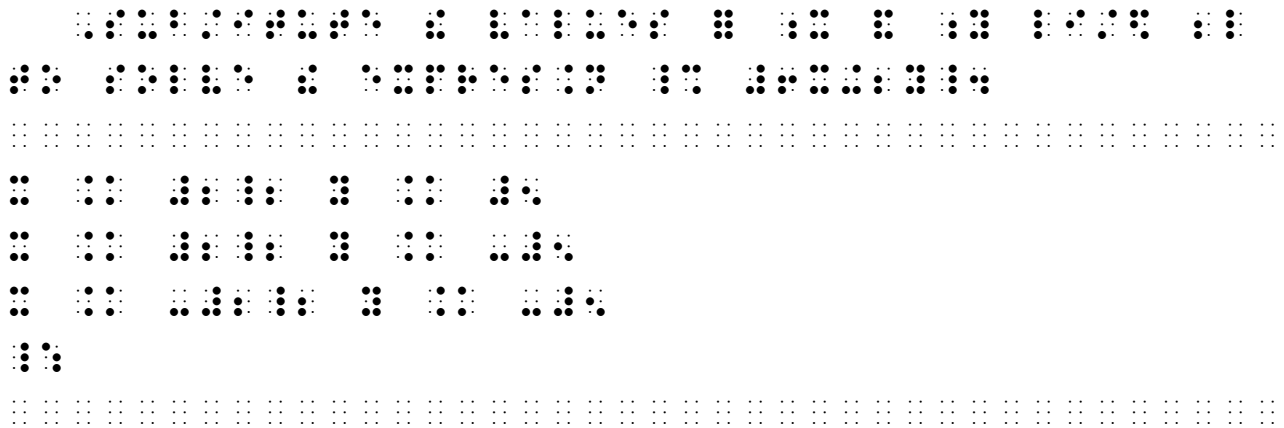
Example 5-36

Substitute the values for x and y listed below to solve the expression $6x + 2y$.

$x = 2; y = 5$

$x = 2; y = -5$

$x = -2; y = -5$

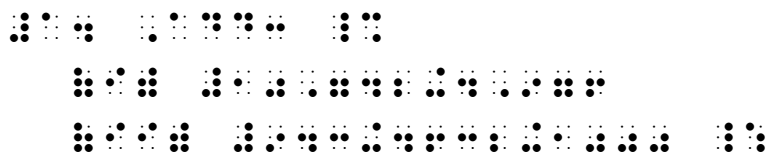


5.12.2 Itemized Directions. Directions that are preceded by a number or letter are formatted according to the Nemeth margin rules for itemized material.

Example 5-37

1. Add:

(i) $10,742 + 4,976$ (ii) $943 + 4632 + 1000$



5.12.3 **Margins for Narrative Preceding Itemized Material (3-1).** Only explicit textual matter is formatted as (5-3) "instructions". If the narrative is purely explanatory, regular paragraphing is applied and a blank line precedes the itemized material.

Example 5-38

Multiplication is a short way of adding quantities of the same size. For example, $6 + 6$ becomes two 6's or 2×6 and $7 + 7 + 7$ becomes three 7's or 3×7 .

1. What would $10 + 10 + 10$ become?
2. How is 5×5 obtained?
3. Express "4 sixes" in two ways—as addition; as multiplication.

Instructions: Treat "Signs of Comparison" and "Adding and Subtracting Integers" as cell-5 headings.

PRACTICE 5F

Signs of Comparison

These examples illustrate the basic spacing rules for comparison signs learned in this unit.

- (1) $5 < 9 < 11$
- (2) $11.7 > 1.17$
- (3) $550 : 11 :: ? : 12$

Adding and Subtracting Integers

Find the sum or difference as indicated by the signs.

- 1) $-6 + -5 = \underline{\quad}$
- 2) $5 + -19 = \underline{\quad}$
- 3) $-7 - -13 = \underline{\quad}$
- 4) $29 - -24 = \underline{\quad}$

For further practice, see Appendix A—Reading Practice.

EXERCISE 5

Prepare Exercise 5 for your grader.

ANSWERS TO PRACTICE MATERIAL

PRACTICE 5A

- 1 ⠠⠠
- 2 ⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠
- 3 ⠠⠠⠠⠠⠠⠠⠠⠠⠠
- 4 ⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠ ⠠⠠⠠⠠
- 5 ⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠ ⠠⠠
- 6 ⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠ ⠠⠠⠠
- 7 ⠠⠠⠠⠠⠠⠠ ⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠
- 8 ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠
- 9 ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠
- 10 ⠠⠠⠠⠠⠠ ⠠⠠⠠ ⠠⠠⠠⠠⠠
- 11 ⠠⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠⠠
- 12 ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠
- 13 ⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠
- 14 ⠠⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠⠠
- 15 ⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠ ⠠⠠
- 16 ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠ ⠠⠠⠠
- 17 ⠠⠠⠠

PRACTICE 5B

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

PRACTICE 5C

- 1 ⠠⠠
- 2 ⠠⠠ ⠠⠠ ⠠⠠
- 3 ⠠⠠⠠ ⠠⠠⠠ ⠠⠠⠠ ⠠⠠ ⠠⠠ ⠠⠠⠠ ⠠⠠⠠⠠
- 4 ⠠⠠ ⠠⠠⠠⠠⠠ ⠠⠠
- 5 ⠠⠠ ⠠⠠⠠ ⠠⠠
- 6 ⠠⠠⠠⠠⠠ ⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠
- 7 ⠠⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠
- 8 ⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠
- 9 ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠
- 10 ⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠
- 11 ⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠
- 12 ⠠⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠
- 13 ⠠⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠
- 14 ⠠⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠ ⠠⠠⠠ ⠠⠠⠠⠠⠠⠠
- 15 ⠠⠠⠠⠠ ⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠
- 16 ⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠
- 17 ⠠⠠⠠

Notes regarding the last item: The words are part of the math and so are transcribed uncontracted without switching out of Nemeth Code. Each single letter requires an English-letter indicator because each is preceded and followed by a space and/or punctuation (or begins a new line). The presence of a single grouping symbol is ignored when determining whether an English-letter indicator is needed.

PRACTICE 5F

1

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

2

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

3

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

4

⠠⠠

5

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

6

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

7

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

8

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

9

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

10

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

11

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

12

⠠⠠⠠⠠⠠⠠⠠⠠

13

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

14

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

15

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

16

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

Lines 2-4: This is a regular 3-1 narrative paragraph.

Lines 11-12: This paragraph fits the definition of "Nemeth instructions" and is formatted in 5-3.