

## **LESSON 5**

[SIGNS OF OPERATION](#)

[SIGNS OF COMPARISON](#)

*Format*

[Nemeth 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 of symbols compounded horizontally is introduced with certain signs of comparison. Considerations for format of instructions are investigated.











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**PRACTICE 5A**

*Instructions:* Before transcribing the practice, review the spacing rules for operation signs in [Section 5.1](#) and in Section P8.1 in the Preliminary Lesson. Transcribe this entire list in Nemeth.

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

$$\mu \pm 1.645 \sigma$$

$$50 - +5 = 45$$

$$50 + -5 = ?$$

$$-3 - -3 = 0$$

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

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

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

$$\#A = \#B$$

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

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

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

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

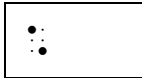
$$m \S y = y \S m = y$$

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

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## 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".

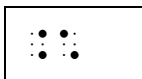
Example 5-12

Torque is expressed as  $N \cdot m$ .



*An English-letter indicator is required for the single-letter abbreviations N (Newton) and m (meter). See Section 4.21 in Lesson 4. The operation sign is not spaced because N and m have no related value. See Section 4.20.1.b in Lesson 4.*

## 5.4.3 Hollow Dot



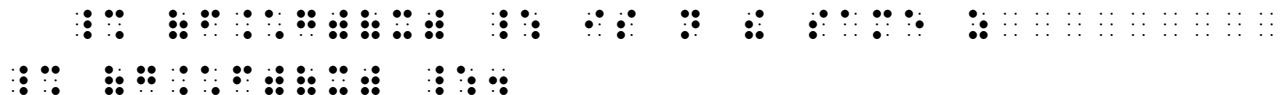
The hollow dot may be used as a sign of operation. It is also seen in function notation. The raised hollow dot used to represent degrees will be discussed in Lesson 6.

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".*











*Line 2: The column headings are not mathematical. Contractions are used.*

*Line 3: Column separation lines are inserted according to Braille Formats guidelines.*

*Line 4: The opening Nemeth Code indicator is placed in cell 1.*

*Line 5: The first row is transcribed in Nemeth. Guide dots are inserted according to Braille Formats guidelines.*

*Line 6: Words in Nemeth are uncontracted.*

*Line 7: The ellipsis indicates that there will be further entries in your transcription.*

*Line 8: Terminate Nemeth on the line after the completion of the table, in cell 1.*

- 5.5.1 **Omissions in a Simple Table.** In a table transcribed in Nemeth, when a dash, underscore, ellipsis, or other omission symbol is printed in an otherwise blank entry field, the appropriate Nemeth symbol is transcribed. (See Lesson 1.) Guide dots are inserted, as needed. When the entry field is blank, follow Braille Formats regarding the insertion of a series of guide dots across the width of a column.

### PRACTICE 5B

*Instructions:* Include the box lines for this table.

<u>Name</u>	<u>Symbol</u>
Dot	•
Vertical Bar	
Logical Product	∧
Simple Tilde	~
Logical Sum	∨
Extended Tilde	≈
Backslash	\
Slash	/
Hollow Dot	◦
Intersection	∩
Union	∪
Minus with Dot Over	÷

**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 Ε)
⠠⠨⠠	Parallel to	∥
⠠⠨⠠	Perpendicular to	⊥
⠠⠨⠠	Relation	R
⠠⠨⠠⠨	Reverse Inclusion	⊃
⠠⠨⠠	Reverse Membership	∋
⠠⠨⠠	Tilde, Simple	~
⠠⠨⠠⠨	Tilde, Extended	≈
⠠⠨⠠	Variation	∝
⠠⠨⠠	Vertical Bar	













## 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 this section are transcribed in accordance with this principle.

### 5.8.1 Greater Than or Equal To

$\overline{>}$	Bar Over Greater Than	$\overline{>}$ or $\overline{>}$
$\overline{=}$	Equals Sign Over Greater Than	$\overline{=}$ or $\overline{=}$
$\underline{>}$	Bar Under Greater Than	$\underline{>}$ or $\underline{>}$
$\underline{=}$	Equals Sign Under Greater Than	$\underline{=}$ or $\underline{=}$

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).

$$\begin{aligned} \Rightarrow a > b & \quad \dots \overline{>} \dots \\ \Rightarrow a \overline{=} b & \quad \dots \overline{=} \dots \\ \Rightarrow x \geq y & \quad \dots \underline{>} \dots \\ \Rightarrow |x| \underline{=} 0 & \quad \dots \underline{=} \dots \end{aligned}$$

### 5.8.2 Inclusion ("is a subset of")

$\overline{\subseteq}$	Bar Over Inclusion	$\overline{\subseteq}$
$\overline{=}$	Equals Sign Over Inclusion	$\overline{=}$
$\underline{\subseteq}$	Bar Under Inclusion	$\underline{\subseteq}$
$\underline{=}$	Equals Sign Under Inclusion	$\underline{=}$

$$\begin{aligned} \Rightarrow C \overline{\subseteq} B' & \quad \dots \overline{\subseteq} \dots \\ \Rightarrow C \underline{=} B' & \quad \dots \underline{=} \dots \\ \Rightarrow (D \cap E) \underline{\subseteq} (E \times E) & \quad \dots \underline{\subseteq} \dots \end{aligned}$$

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



### 5.8.3 Intersection

⠠⠠⠠⠠	Bar Under Intersection	⠨⠠
⠠⠠⠠⠠⠠	Equals Sign Under Intersection	⠨⠠⠨

- 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".

➤  $X \bar{\cap} Y$       ⠠⠠    ⠠⠠⠠⠠    ⠠⠠

➤  $X \underline{\cap} Y$       ⠠⠠    ⠠⠠⠠⠠⠠    ⠠⠠

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

### 5.8.4 Less Than or Equal To

⠠⠠⠠⠠	Bar Over Less Than	⠨⠠ or ⠨⠠
⠠⠠⠠⠠⠠	Equals Sign Over Less Than	⠨⠠⠨ or ⠨⠠⠨
⠠⠠⠠⠠	Bar Under Less Than	⠠⠨ or ⠠⠨
⠠⠠⠠⠠⠠	Equals Sign Under Less Than	⠠⠨⠨ or ⠠⠨⠨

➤  $v - 1 \bar{<} 5$       ⠠⠠⠠⠠    ⠠⠠⠠⠠    ⠠⠠

➤  $v - 1 \underline{<} 5$       ⠠⠠⠠⠠    ⠠⠠⠠⠠⠠    ⠠⠠

➤  $6 \leq x \leq 9$       ⠠⠠    ⠠⠠⠠⠠    ⠠⠠    ⠠⠠⠠⠠    ⠠⠠

➤  $6 \leq x \leq 9$       ⠠⠠    ⠠⠠⠠⠠⠠    ⠠⠠    ⠠⠠⠠⠠⠠    ⠠⠠

## 5.8.5 Logical Product

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

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

$$\gg ABD \bar{\wedge} A'B'D'$$

⠠⠠⠠⠠⠠⠠ ⠠⠠⠠⠠ ⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

$$\gg \{A\} \underline{\wedge} K$$

⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠⠠

$$\gg p \underline{=} q$$

⠠⠠ ⠠⠠⠠⠠⠠⠠ ⠠⠠

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





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**PRACTICE 5D**

*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 expression 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.

*Signs of Comparison Compounded Vertically*

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

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## 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 this section 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	<=>

⦿  $n < > 1$     ⠠⠠⠠⠠⠠⠠    ⠠⠠

⦿  $n < = > 1$     ⠠⠠⠠⠠⠠⠠⠠⠠⠠    ⠠⠠

## 5.10 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, ⠠⠠ represents any of the print negation lines. ⠠⠠ is placed immediately before the sign of comparison being negated. Some samples are shown in the box below. Negated signs of comparison not illustrated here are transcribed according to the same principle.

⠠⠠⠠⠠	Negated Equals Sign	≠ or ≠
⠠⠠⠠⠠	Negated Parallel To	∦
⠠⠠⠠⠠	Negated Perpendicular To	⊥
⠠⠠⠠⠠⠠	Negated "Bar Under Greater Than"	≧̄
⠠⠠⠠⠠	Negated Membership	∉ or ∋



**Format: Nemeth Instructions****5.11 Margins for Instructions Preceding Itemized Material (5-3)**

The 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.

In [Example 5-30](#), the dashed line indicates a print page turn.

Example 5-30

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

1.  $3 : 2 = 75 : 50$

2.  $6 : 4 = 15 : 30$

Which math sentence is true? Which is false?

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

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

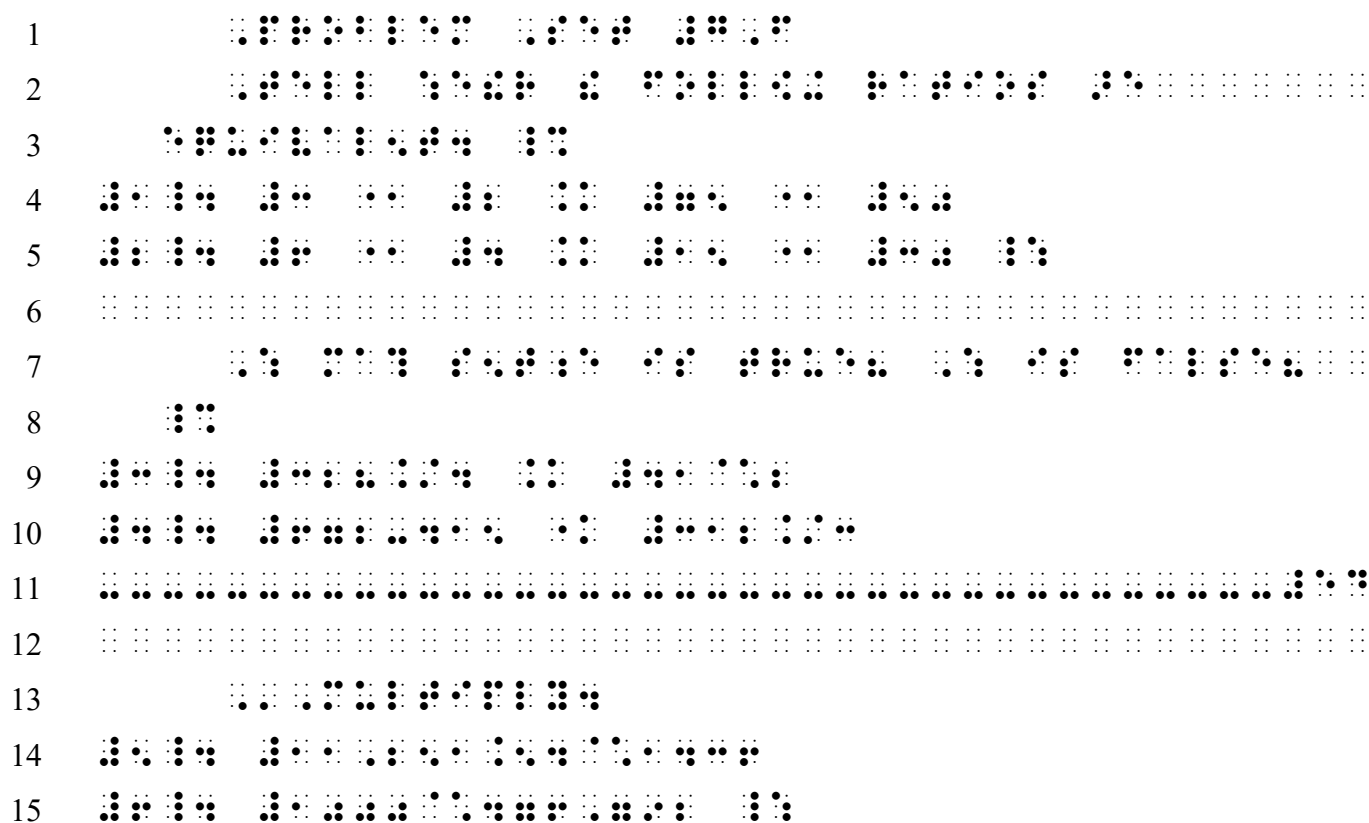
-----

54

Multiply.

5.  $11,251.54 \times 1436$

6.  $1000 \times 476,792$



*Line 1: Cell-5 heading*

*Lines 2-3: Instructions (5-3) immediately following a cell-5 heading*

*Lines 4-5: Itemized material following instructions*

*Line 6: A blank line precedes instructions*

*Line 7: Instructions begin in cell 5. The opening switch does not fit on this line.*

*Line 8: The opening Nemeth Code indicator is in the runover cell of the instructions (cell 3).*

*Lines 9-10: Itemized material following instructions*

*Line 12: Blank line precedes instructions*

*Line 13: Instructions (5-3, no runover)*

*Lines 14-15: Itemized material following instructions*

**5.11.1 Keep Together.** An exercise set consists of instructions followed by related itemized problems.

If an exercise set will fit on one page, it should not be divided between braille pages. If an exercise set requires more than one braille page, *Braille Formats* states that the instructions (directions) should be on the same braille page as at least one of the questions or problems to which they apply.

**5.11.2 Code Switching and Instructions.** The opening Nemeth Code indicator may be placed after the last word of the instructions. If there is no room on the line, place the switch indicator in the runover cell of the instructions (cell 3). (An exception applies to spatially arranged material, which will be covered in Lesson 9.)

If instructions end with a Nemeth expression and the subsequent math problem starts with a Nemeth expression, Nemeth may be left in effect between the end of the instructions and the start of the problem.







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**PRACTICE 5F**

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

***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)  $-6 + -5 = \underline{\hspace{2cm}}$
  - 2)  $5 + -19 = \underline{\hspace{2cm}}$
  - 3)  $-7 - -13 = \underline{\hspace{2cm}}$
  - 4)  $29 - -24 = \underline{\hspace{2cm}}$
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*For further practice, see Addendum 1—Reading Practice.*

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Submit Exercise 5 to your instructor.
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## PRACTICE 5C

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

Notes regarding the last item: The words are part of the math and so are transcribed uncontracted without switching out of Nemeth. 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.





