# Nemeth Code Symbols Used in High School and Strategies for Supporting Math Learning

## Lesson 2: Symbols for Advanced Math, Part 2


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## Objectives

Participants will be able to:

- Read and write problems containing
  1. enlarged grouping symbols
     a. piecewise functions
     b. systems of equations
     c. matrices
     d. determinants
  2. set theory notation (e.g., empty set, subset, union, intersection)
- Determine when enlarged grouping symbols are or are not to be used.

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## Enlarged Grouping Symbols

- ⠸⠣ opening (left) parenthesis (
- ⠸⠜ closing (right) parenthesis )
- ⠸⠨⠣ opening (left) bracket [
- ⠸⠨⠜ closing (right) bracket ]
- ⠸⠨⠪ opening (left) brace {
- ⠸⠨⠕ closing (right) brace }
- ⠸⠳ vertical bar |

- Used when a grouping symbol groups 2 or more print lines.
- The corresponding grouping symbol is indicated as enlarged by use of a dot 6.

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## Rules for Enlarged Grouping Symbols

In general:

- The arrangement is considered to be spatial, and blank lines must be left above and below it.
- At least one enlarged sign of grouping must appear on each line of the arrangement.
- All other materials (such as problem numbers, signs of operation, signs of comparison, and punctuation) should be shown on the top line in braille, even though it is centered in print.
- Place a dot 6 before each ⠸⠣ or ⠸⠜ or ⠸⠳ to enlarge it and line up the grouping symbols vertically.

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## Enlarged Grouping Symbols (Continued)

- If only the opening or closing grouping symbol is shown in print, only that symbol should be shown in braille.
- Line up the variables in piecewise functions and systems of equations, if they are lined up in print.
- All of these examples using enlarged grouping symbols could be read many different ways, so consult your math teacher to determine how they would like the problems to be read.

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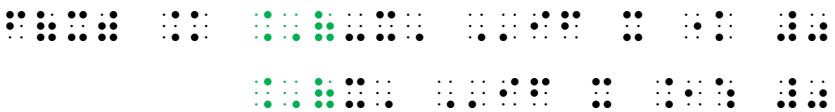
## Piecewise Functions

Unaligned piecewise function with left brace



$$f(x)=\begin{cases}-x, \text{if } x<0\\ x, \text{ if } x\geq 0\end{cases}$$

Possibly read: When x<0, f(x) is equal to –x.

When $x \geq 0$, f(x) is equal to x.

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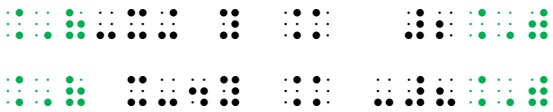
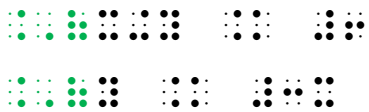
## Systems of Equations

- Aligned system of equations with left and right braces



$$\begin{cases} -x + y = 2 \\ x - 4y = -8 \end{cases}$$

- Unaligned system of equations with left brace



$$\begin{cases} x + y = 6 \\ y = 3x \end{cases}$$

- To read the above systems, you could say: We have a system of two equations. The first equation is… The second equation is…

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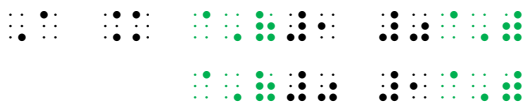
## Matrices and Determinants

- Each entry must be moved as far left as possible in its column.
- One column of blank cells must be left between the columns of the arrangement.
- The numeric indicator must be used with numeric entries in a determinant or matrix.

Matrices



$$A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

Possibly read: Matrix A is a 2 by 2 matrix with the numbers 1 0 in row 1 and the numbers 0 1 in row 2.

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# Matrices and Determinants (Continued)

- Determinants

$$\begin{vmatrix} 3 & -2 \\ -6 & 4 \end{vmatrix}$$

Possibly read: This is a 2 by 2 determinant with the numbers 3 -2 in row 1 and the numbers -6 4 in row 2.

- Adding Matrices – notice the location of the + sign.

$$\begin{bmatrix} -6 & 3 \\ -9 & 5 \end{bmatrix} + \begin{bmatrix} -2 & 0 \\ 4 & -1 \end{bmatrix}$$

Possibly read: Two 2 by 2 matrices have been added together. The first matrix has numbers -6 3 in row 1…

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# Activity 2A

Braille the following items.

$$y = \begin{cases} x, & x \leq 0 \\ 3, & x > 0 \end{cases}$$

$$\begin{cases} 5x + 3y = 8 \\ x - y = 6 \end{cases}$$

$$\begin{bmatrix} d & e & f \\ g & h & i \end{bmatrix}$$

$$\begin{vmatrix} 12 & 2 & 3 \\ 4 & 6 & 5 \\ 8 & 7 & -9 \end{vmatrix}$$

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## Activity 2A: Answer Key

$$y = \begin{cases} x, & x \leq 0 \\ 3, & x > 0 \end{cases}$$

$$\begin{cases} 5x + 3y = 8 \\ x - y = 6 \end{cases}$$

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## Activity 2A: Answer Key (Continued)

$$\begin{bmatrix} d & e & f \\ g & h & i \end{bmatrix}$$

$$\begin{vmatrix} 12 & 2 & 3 \\ 4 & 6 & 5 \\ 8 & 7 & -9 \end{vmatrix}$$

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## Non-Use of Enlarged Grouping Symbols

- Do not use enlarged grouping symbols when grouping symbols have been enlarged in print to:
  - Cover a fraction.

$$\left(\frac{1}{x+2}\right)\left(\frac{1}{x-2}\right)$$

Read: open parenthesis open fraction 1 over x+2 close fraction close parenthesis open parenthesis open fraction 1 over x-2 close fraction close parenthesis

  - Write a binomial coefficient.

$$\binom{8}{5}$$

Read: 8 choose 5

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## Non-Use of Enlarged Grouping Symbols (Continued)

- Do not use enlarged grouping symbols when grouping symbols have been enlarged in print to:
  - Write material occupying a large amount of vertical space. Notice there is no dot 6 even though the first square root symbol is larger.

$$\sqrt{\sqrt{16}}$$

Read: the square root of the square root of 16 end root end root

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## Activity 2B

Look at these four problems. For each one, determine if you do or do not use enlarged grouping symbols.

$$f\ x\ = \begin{cases} 2x+4 \\ 3-x \end{cases}$$

$$\begin{pmatrix} 8 \\ 2 \end{pmatrix}$$

$$\left(\frac{3}{y+2}\right)\left(\frac{2}{y-2}\right)$$

$$\begin{vmatrix} 4 & 0 \\ 0 & -4 \end{vmatrix}$$

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## Activity 2B: Answer Key

$$f\ x\ = \begin{cases} 2x+4 \\ 3-x \end{cases}$$ Enlarged

$$\begin{pmatrix} 8 \\ 2 \end{pmatrix}$$ Not Enlarged

$$\left(\frac{3}{y+2}\right)\left(\frac{2}{y-2}\right)$$ Not Enlarged

$$\begin{vmatrix} 4 & 0 \\ 0 & -4 \end{vmatrix}$$ Enlarged

Now braille the four problems.

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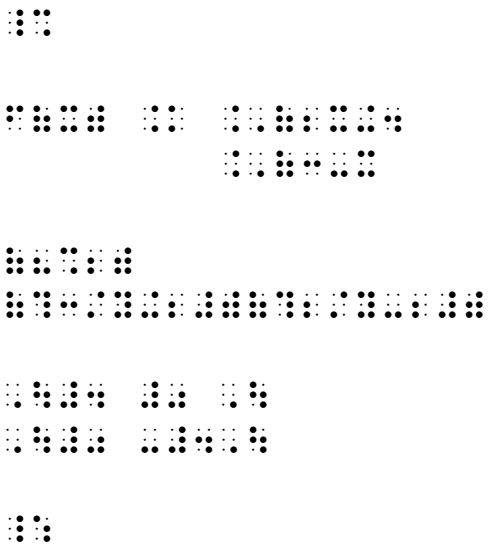
## Activity 2B: Answer Key (Continued)

$$f\ x\ = \begin{cases} 2x+4 \\ 3-x \end{cases}$$

$$\binom{8}{2}$$

$$\left(\frac{3}{y+2}\right)\left(\frac{2}{y-2}\right)$$

$$\begin{vmatrix} 4 & 0 \\ 0 & -4 \end{vmatrix}$$



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## Set Theory (Empty Set and Signs of Operation)

 { } braces for the empty set

 $\varnothing$ empty set symbol (or null set)

The following two symbols are signs of operation, so there is no space before or after.

 $\cup$ union

 $\cap$ intersection

 $A \cup B$

 $C \cap D$

Note that union includes a plus sign because union is adding or combining the two sets together.

Note that intersection includes the "sh" contraction because it is using only the elements that are in the first set and shared in the second set as well.

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## Set Theory (Signs of Comparison)

The following two symbols are signs of comparison, so they need a space before and after.

$\subseteq$ is a subset of

$\in$ is an element of

$E \subseteq F$ Read: E is a subset of F

$3 \in \{1,3,5\}$

Read: 3 is an element of the set containing 1, 3, and 5.

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## Examples of Set Theory

$A \cup B = \{-1,0,1\}$

Read: A union B equals the set containing -1, 0, and 1.

$\{\text{Mary,Sally}\} \subseteq C$

Read: The set containing the elements Mary and Sally is a subset of C.

$\{1,3\} \cap \{2,5\} = \varnothing$

Read: The intersection of the set containing 1 and 3 and the set containing 2 and 5 is the empty set.

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## Activity 2C

Braille the problems.

1. $C \cap D = \varnothing$

2. $A \cup B = \{1,2,3,4,5\}$

3. $\{5,7\} \subseteq D$

4. If $x \in C$ and $x \in D$, then $x \in C \cap D$.

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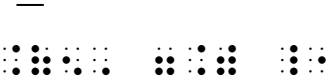
## Activity 2C: Answer Key

1. $C \cap D = \varnothing$

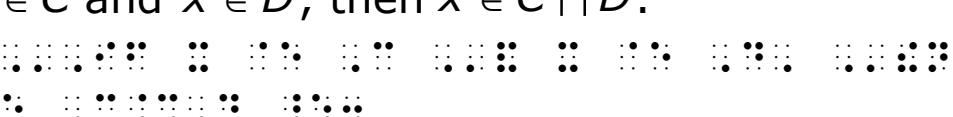


2. $A \cup B = \{1,2,3,4,5\}$

3. $\{5,7\} \subseteq D$



4. If $x \in C$ and $x \in D$, then $x \in C \cap D$.



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