ADDENDUM 2

GLOSSARY OF TERMS

This glossary contains a sampling of terminology encountered in K-12 mathematics which transcribers may find useful when communicating in workshops, forums, and blogs. There are many dictionaries of mathematical terms for those interested in a more comprehensive glossary.

Mathematical expression: A combination of mathematical symbols grouped together to designate the value of something.

Numerical expression: A mathematical expression containing only numbers and operation symbols. EXAMPLE $14 \div 2$

Algebraic expression: A mathematical expression containing variables, numbers, and operation symbols. EXAMPLE $3x + 2y - 7$

The Four Basic Operations

Addition

2 + 3 = 5 addend + addend = sum

```
 2   addend
+3   addend
 5   sum
```

Subtraction

7 – 1 = 6 minuend – subtrahend = difference

```
 7   minuend
-1   subtrahend
 6   difference
```

Multiplication

$2 \times 3 = 6$ multiplicand × multiplier = product

2	multiplicand	5.009	multiplicand
×3	multiplier	× .27	multiplier
6	product	35063	partial product
		10018	partial product
		1,352.43	product

Division

$40 \div 10 = 4$ dividend ÷ divisor = quotient

$10\overline{)40}$ $\qquad$ $\text{divisor}\overline{)\text{dividend}}$ $\qquad$ quotient

$9\overline{)40}$ $\qquad$ 4 r4 $\qquad$ the "r" number is the remainder

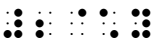
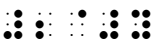
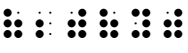
36 $\qquad$ partial quotient

4 $\qquad$ difference

Many Ways to Denote Multiplication

Print has several ways of denoting multiplication. The Nemeth code provides symbols for all of them, which enables us to follow print. Print may space between items for clarity, but factors are not spaced in braille unless abbreviations, function names, or certain symbols are contained in the expression.

All of the following mean "two times y".

$2 \times y$		(a)
$2 \cdot y$		(b)
$2 * y$		(c)
$2y$		(d)
$(2)(y)$		(e)

(a) 2×3 The multiplication cross is used the most in the lower grades.

(b) $2 \cdot 3$ The multiplication dot is used when the "x" variable is introduced, since the x and the multiplication cross look similar in print.

(c) $2 * 3$ The multiplication asterisk is used most often in calculator operations since, on calculator keys, the multiplication cross may be confused with the variable x and the multiplication dot may be confused with the decimal.

(d) $2y$ This is the form you will see most often when one of the factors is a variable, a constant, or a radical expression. $2xy$ means "two time x times y". 2π means "two times pi". $2\sqrt{5}$ means "two times the square root of 5".

(e) (2)(y) Grouping symbols are used to group factors when the multipliers require calculations.

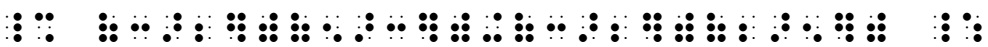
EXAMPLE $(x+y)(x-y)$ means "multiply $x+y$ times $x-y$".

If a factor uses parentheses, brackets group the outer factor.

EXAMPLE $5[(x+y)(x-y)]$ means "five times the product of $x+y$ times $x-y$".

The expression $(3\sqrt{2})(5\sqrt{3}) + (3\sqrt{2})(2\sqrt{5})$ can be analyzed as follows.

- The overall expression is the sum (addition) of two terms. Addition is indicated with a plus sign. __ + __
- Each addend is the product (multiplication) of two factors, indicated with side-by-side parentheses. (__)(__)
- Each multiplier is the product of a numeral and a square root. No multiplication sign is shown but multiplication is implied. _√_
- Spoken: "(Three times the square root of two TIMES five times the square root of three) PLUS (three times the square root of two TIMES two times the square root of five)."
- Transcription: The braille transcription contains no spaces.



Fractions

A fraction consists of a *numerator* and a *denominator* separated by a *fraction line*.

Simple Fraction

This fraction has a horizontal fraction line.

$\frac{3}{4}$ numerator
denominator

This fraction has a diagonal fraction line. $3/4$

Mixed Number

A mixed number is one quantity made up of a whole number and a simple fraction.

$7\frac{1}{2}$

Complex Fraction

A complex fraction's numerator and/or denominator is also a fraction.

$\frac{1/2}{4}$ numerator $\frac{4}{1/2}$
denominator

Geometry

Irregular polygon: A closed figure with at least two unequal sides and two unequal angles

Regular polygon: A closed figure with equal sides and equal angles

Triangles

Acute Triangle: All angles are less than 90°

Equilateral Triangle: Three equal sides; three equal angles (always 60°)

Isosceles Triangle: Two equal sides; two equal angles

Obtuse Triangle: Has one angle greater than 90°

Right Triangle: Contains one right angle (90°)

Scalene Triangle: No equal sides; no equal angles

Radical Expressions

$$\begin{array}{cc} 12 & \text{root} \\ \sqrt{144} & \sqrt{\text{radicand}} \end{array}$$

Radical sign: √

Vinculum: The line which extends above the radicand.

Index: A small number that may appear next to the radical sign is the index of the radical.

$\sqrt[3]{9}$ 3 is the index of this radical.

Statements and Functions

Exponential statement:	$b^e = x$	b is the base; e is the exponent.
Logarithmic statement:	$\log_b x = y$	x is the argument of the log.
Trigonometric function:	$\sin\theta = 1$	θ (theta) is the argument of the function.

Algebra

The following algebraic expression is used as a sample in the definitions below. $3x + 2y - 7$

Coefficient: When a term is made up of a constant placed before a variable, the constant is called a coefficient. In the sample expression, the coefficient of *x* is 3. The coefficient of *y* is 2.

Constant: A constant is a number that is fixed and known, or a letter which stands for a fixed number, such as π. The constants in the sample expression are 3, 2, and 7.

Term: An algebraic expression is made up of terms. Each term is separated by a + or a − sign. The terms in the sample expression are 3*x*, 2*y*, and 7.

Variable: A variable is a symbol for an unknown number, usually a letter. The variables in the sample expression are *x* and *y*.

Other Terminology Used With Algebraic Expressions

Binomial: An algebraic expression consisting of the sum or the difference of two terms is a binomial. EXAMPLE 3x + 9

Degree: The degree of a term is the sum of the term's exponents. For example, the degree of the term $2y^3$ is 3. The degree of the term $16x^2y^3$ is 5.

Equality: An equality consists of two expressions which have the same value. EXAMPLE A = B

Equation: An equation is an equality which contains at least one variable. EXAMPLE $x + 1 = 4$

The process of finding out the variable value that makes the equation true is called *solving* the equation.

Equivalent equations: Two equations that have the same solution are called equivalent equations. EXAMPLE $x = 1$ and $2x = 2$.

Exponent: In x^2, the exponent is 2.

Factor: Factors are numbers which, when multiplied together, result in another number. A number can have many factors. For example, 3 and 4 are factors of 12 because $3 \times 4 = 12$. 2 and 6 are also factors of 12 because $2 \times 6 = 12$.

Inequality: An inequality consists of two expressions, one on each side of a comparison sign that is not an equals sign. EXAMPLES $3x < 10$ and $a \leq b$.

Like terms: Like terms are terms which have the same variable raised to the same exponent. For example, $3x^2$ and $9x^2$ are like terms.

Monomial: An algebraic expression consisting of one term is a monomial. Monomials include numbers, whole numbers and variables that are multiplied together, and variables that are multiplied together. EXAMPLE 3xy

Polynomial: An algebraic expression consisting of more than two terms is a polynomial. The sample expression $3x + 2y - 7$ is a polynomial. A polynomial may also include a term with exponents. EXAMPLE $x^2 - 4x + 7$.

ABOUT DR. ABRAHAM NEMETH

ABRAHAM NEMETH invented and developed a braille code for the depiction of mathematics in order to fill a need for his studies at Brooklyn College in the 1940s. Dr. Nemeth's invention has changed lives by enabling many blind people to learn, work, and excel in the STEM fields. I thought you might like to read a little bit about his life, and I encourage you to search for interviews and articles on the web about this remarkable, humble man and his work.

- **1918** Abraham Nemeth was born on the Lower Ease Side of Manhattan and was blind from birth. He attended the New York City public schools. He always liked math but various counselors told him that he couldn't have a career in math because he was blind.
- In his college years he majored in psychology and earned a B.A. in psychology from Brooklyn College and an M.A. in psychology from Columbia University. He was not able to get a job.
- His wife knew how much he loved math, and asked, "Wouldn't you rather be an unemployed mathematician than an unemployed psychologist?" He started taking math classes at night at Brooklyn College.
- He developed rules to tell his readers how to read mathematics aloud to him. MathSpeak continues to be a popular system for communicating math orally and is used by many screen readers to read mathematical expressions, such as those written in MathML.
- He was granted a teaching position at Brooklyn College and quickly realized that, in order to take notes, he needed a way to write things down. At the time people used the Taylor Code from England for writing mathematics in Braille. Abe Nemeth thought that the Taylor Code used too many symbols.
- **1946** He began working on his braille math code by simulating his rules for speech into a written code. As his own private braille code for braille mathematics began to evolve, he used it for his work in calculus and statistics as he worked toward a Ph.D. in mathematics at Columbia University.
- A blind nuclear physicist from Columbia University, Dr. Clifford Witcher, asked Abe Nemeth to teach him his private math braille code. Dr. Witcher was a member of the Mathematics Subcommittee of the Joint Uniform Type Committee. This committee, an ancestor of the Braille Authority of North America (BANA), was responsible for braille codes in the U.S. and in England.
- **1952** With Dr. Witcher's encouragement, Nemeth wrote a document proposing his braille math code to the Joint Uniform Type Committee. This document became the first official Nemeth Code book – the 1952 edition – and was adopted as the official braille math code in Canada and New Zealand as well as in the United States.
- **1950s** He moved to Michigan to teach mathematics at the University of Detroit, where he also completed his Ph.D. work and studied computer science. Dr. Nemeth remained in Detroit for 30 years, retiring in 1985.
- **1965** and **1972** APH published two newer editions of the Nemeth Code book in 1965 and 1972.
- **2000s** As Unified English Braille (UEB) was becoming the international standard, Dr. Nemeth devised a unified braille system that combined literary, math, and computer codes into a streamlined unambiguous system called the Nemeth Unified Braille System (NUBS). Efforts to adopt NUBS as the new code were unsuccessful.
- **2005** Dr. Nemeth was inducted into the APH Hall of Fame.
- **2016** When UEB replaced English Braille American Edition as the official literary braille code in the United States, development was underway to continue the use of the Nemeth Code within the UEB setting.
- **2024** The 2022 edition of the Nemeth Code is published by the Braille Authority of North America.