

Shipping Grade 5 Representing Numbers in Other Bases Clarification

CCSSM: Grade 5

DOMAIN: Number and Operations in Base Ten

Cluster: Understand the place value system

Standard: 5.NBT.1 Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left.

Clarification of Math Discussion Terms

A mathematical **EXPRESSION** may contain numbers, operations, and/or variables. For example: $5n + 3$, $x - 7$, 15, and $2y^3$ are all expressions. In the expression $5n + 3$, n is a variable and 3 is a constant.

A mathematical **EQUATION** is a statement of equality between two expressions. For example: $5n + 3 = x - 7$ or $2y^3 = 16$ are equations.

A **DIGIT** is a number symbol. For example 3 is a single-digit number, 37 is a two-digit number, and 378 is a three-digit number. The 3, the 7, and the 8 are the digits.

A **NUMERATION SYSTEM** is a group of symbols used to represent numbers. The position of each symbol determines its value. We usually use a **DECIMAL** number system which is based on ten **UNIQUE DIGITS**: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. Numbers greater than 9 are represented using a combination of these nine digits.

The **ROMAN NUMERAL** system uses the symbols I, V, X, L, C, D, and M. The **ORDER** and **POSITION** of these symbols determines the value of the number. For example, 1999 in the decimal system would be MCMXCIX in Roman Numerals.

The **MAYAN NUMBER SYSTEM** is based on the number 20 and uses dots and lines in various positions to describe the value of the number.

Decimal System	Mayan System
1	•
2	••
3	•••
4	••••
5	—
6	• —

Decimal System	Mayan System
7	•• —
8	••• —
9	•••• —
10	— —
11	• — —

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The position of a digit in the Decimal number system determines its place value. A number can be written in **EXPANDED FORM** to show the place value. Since our number system is based on ten, the powers of 10 determine the place values. For example, 34,792 in expanded form is $(3 \times 10^4) + (4 \times 10^3) + (7 \times 10^2) + (9 \times 10^1) + (2 \times 10^0)$.

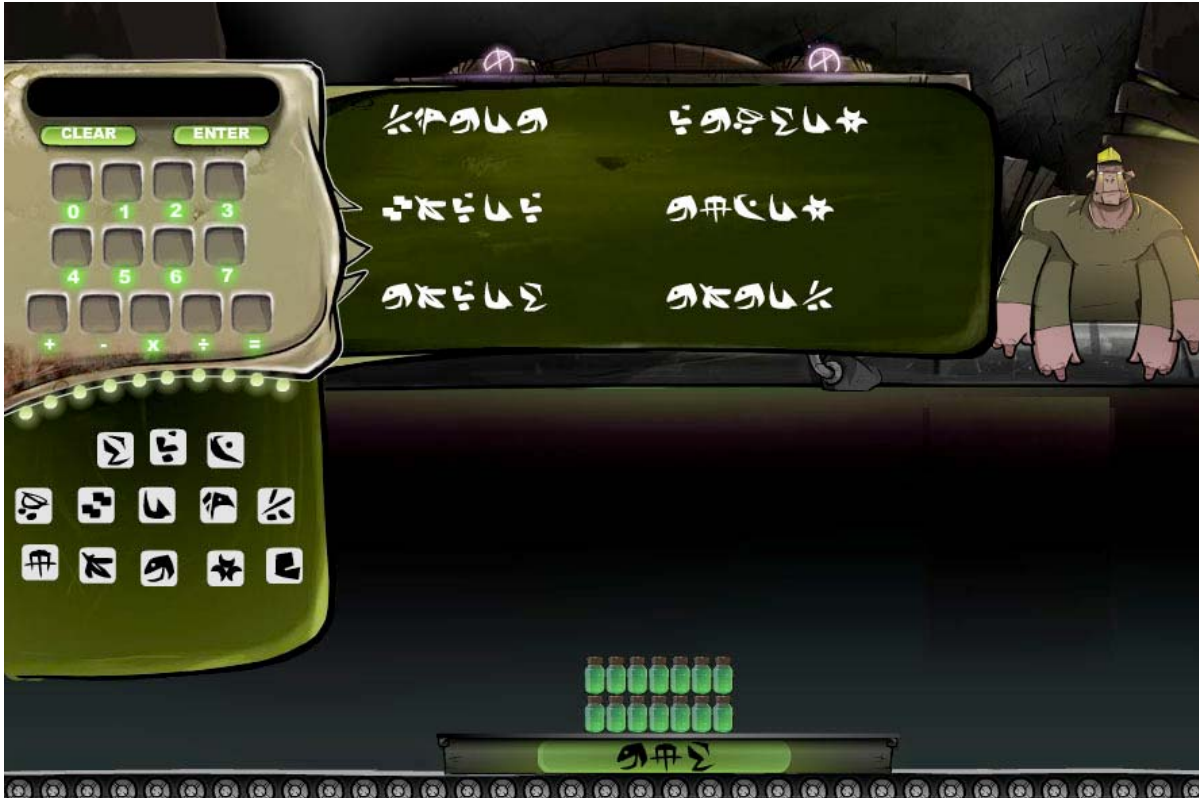
The Math in the Puzzle

In the Shipping puzzle, players must determine the values for a new set of symbols. By using the properties of mathematics, players determine whether a symbol represents a numerical value or an operation. Players are given a hint at the bottom of the screen to help them establish the values for a few of the symbols.



Level 3 does not use the ten digits of the decimal number system. The screen shot below shows a calculator for which the greatest number is 7. The player uses this information to determine that these expressions and equations will use a Base-8 Number System.

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The table below shows the numerical representations for numbers in the Decimal system and their corresponding representations in a Base-8 system.

Decimal System	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Base-8 System	0	1	2	3	4	5	6	7	10	11	12	13	14	15	16	17	20	21



In the example, the jars represent the expression 2 times 7. Using the place values in Base-8, the product, 14, translates to one group of 8 and six groups of 1 or 16.