Operation and Property Tables

K-12 Mathematics Glossary

A

absolute value	The distance of a number from zero on the number line.
acute angle	An angle that measures less than 90 degrees.
addend	Any number being added.
additive inverse	The opposite of a number. When a number is added to its additive inverse, the sum is zero.
algorithm	A step-by-step method for computing or carrying out any mathematical procedure.
angle	Two rays that share an endpoint.
area	The measure of the interior region of a two-dimensional figure or the surface of a three-dimensional figure.
arithmetic series (progression)	A set of numbers in which the difference between any two consecutive numbers is the same.
array	An arrangement of objects in equal rows.
attribute	A characteristic.
axes	A reference line from which distances or angles are measured on a coordinate grid.
axis of symmetry	A line which divides the graph of an equation into two congruent halves.

B

bar graph	A graph that uses the height or length of rectangles to compare data.
base ten	A number system in which each place has ten times the value of the next place to its right.
box (box-and-whisker) plot	A way to display a distribution of data values but using the median, quartiles, and extremes of the data set. A box shows the middle 50% of the data.

C

capacity	The greatest amount that a container can hold.
coordinate plane (cartesian)	A two-dimensional system in which a location is described by its distances from two intersecting, usually perpendicular, straight lines called axes.
causation	An act of bringing about a desired result.
circumference	Perimeter of a circle.
classify	Categorize things or objects.
combination	A group of items or events. Placing these items or events in a different order does not create a new combination.
common denominator	For two or more fractions, a common denominator is a common multiple of the denominators.
common fraction	Any fraction whose numerator and denominator are natural numbers (¼, ½, ⅓…).
common multiple	A number that is a multiple of two or more numbers.
commutative property	Changing the order does not change the end result (applies to addition and multiplication).
complementary events	Two or more mutually exclusive events that together cover all possible outcomes. The sum of the probabilities of complementary events is 1.
complex number	A number in the form a + bi where a and b are real numbers and $i = \sqrt{-1}$.
composite functions	Combination of two functions, where you apply the first function and get an answer, and then fill *that answer* into the second function.
composite number	A number greater than zero that has more than two different factors
compound events	A combination of simple events.
compute	To find a numerical result, usually by adding, subtracting, multiplying or dividing.
cone	A three-dimensional figure with one curved surface, one flat surface(usually a circle), one curved edge, and one vertex.
congruent	Having exactly the same size and shape.
constant	A quantity that always stays the same.
contextualized problems	Solving real life situations using mathematics.
coordinate grid (cartesian)	A two-dimensional system in which a location is described by its distances from two intersecting, usually perpendicular, straight lines called axes.
correlation	An association between two variables used in statistics.

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correlation coefficient	A numerical value between -1 and 1 inclusive that measures the strength and direction of a linear relationship between two variables.
customary system	A system of measurement used in the United States. The system includes units for measuring length, capacity, weight, and temperature.
cylinder	A three-dimensional figure with two circular bases that are parallel and congruent.

D

data	Information, especially numerical information.

degrees
  a) angle measurement
  b) temperature measurement
	a) A unit used to measure angles.
	b) A measurement of hotness or coldness (Celsius, Fahrenheit, Kelvin).

dependent events	Two events in which the outcome of the first event affects the outcome of the second event.
digit	Any one of the ten symbols: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.
dilation	A transformation that shrinks or enlarges a figure.
dimension	Measurement in one direction.
domain	In a function, $f(x)$, the possible values for x in the given situation.
dot/line plot	A way to display data values where each is shown as a dot or mark above a number line.

E

empirical rule	Based on or characterized by observation and experiment instead of theory.
equation	A mathematical sentence with an equal sign.
equivalent	Having the same value.
estimate	A number close to an exact amount; an estimate tells about how much or about how many.
experimental probability	A statement of probability based on the results of a series of trials.
exponential notation	A way of writing numbers using exponents.
exponents	The number that tells how many equal factors.

expression
  a) algebraic
  b) numerical
	A combination of variables, numbers, and operation symbols that represents a mathematical relationship.
	a) for example a + b
	b) for example 6 + 4

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F

face A flat surface on a solid figure.

fact families Number sentences that relate addition and subtraction or multiplication and division. Each number sentence in the fact family has the same numbers.

factor An integer that divides evenly into another.

factorial The product of a whole number and every positive whole number less than itself. Abbreviated n! and say: n factorial 4! = 4 x 3 x 2 x 1 = 24.

factoring Rewriting a polynomial expression as a product.

fluently Efficiently and accurately.

fraction A way of describing a part of a whole or a group.

frequency chart A way to display how often an item, number, or range of numbers occurs.

function A relation in which every value of x has a unique value of y.

fundamental counting principal If one event can happen in x ways and a second, independent, event can happen in y ways, the two can occur together in a x • y ways.

G

generalization A statement or conclusion that is derived from and applies equally to a number of cases.

geometric series (progression) A sequence of terms in which each term is created by multiplying the previous term by a constant.

greatest common divisor The greatest number that divides into two or more numbers with no remainder.

H

histogram A bar graph in which the labels for the bars are consecutive groups of numbers.

I

identity property of addition If you add zero to a number the sum is the same as that number.

imaginary number The square root of a negative real number. It cannot be shown on the number line.

independent events Two events in which the outcome of the first event does not affect the outcome of the second event.

inequality A mathematical sentence that compares two amounts using the symbols; >, <, ≤, ≥, or ≠.

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inference	Judge whether the number you found is the number you expected.
integers	Whole numbers and their opposites (…-3, -2, -1, 0, 1, 2, 3…)
inverse function	A function in which two variables are inversely proportional.
irrational numbers	Numbers that cannot be written as a ratio of two integers. If you try to write an irrational number as a decimal, the digits never terminate and never repeat. (EX $\sqrt{2}$ = 1.41421356…)

J

K

L

least common multiple	The smallest number, greater than zero, found in all the list of multiples of two or more numbers.
likelihood	The chance of something happening.
line	A set of connect points continuing without end in both directions.
line graph	A graph used to show change over time with points connected by line segments.
line of symmetry	A line that divides a figure into two congruent halves that are mirror images of each other.
line segment	A part of a line with two endpoints.
linear equation	An equation in two variables whose graph in a coordinate plane is a straight line.

M

magnitude	Size and scale reflected by a value.
maximum of function	A point at which a function attains its greatest value.
mean (average)	A measure of center in a set of numbers, computed by adding the values in the list and then dividing by the number of values in the list.
median	The middle number when numbers are arranged from least to greatest. When the set has two middle numbers, the median is the mean of the two middle numbers.
metric system	A system of measurement which units are based on tens.
minimum of function	The least value of a function.

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mode	A number that appears most frequently in a set of numbers. There may be, one, more than one, or no mode.
monomial	The product of constants and variables.
multiple	The product of a whole number and any other whole number.
multiplicative inverse	Two numbers whose product is 1 are multiplicative inverses of one another.
mutually exclusive	Two events that cannot occur at the same time.

N

natural numbers	The counting numbers; 1, 2, 3, 4...
nonstandard unit	Using common objects for a unit of measure such as a blocks and pencils.
non-Euclidean geometry	Shapes and constructions that do not map directly to any n-dimensional system.
normal distribution	A bell shaped probability distribution. There are as many values less than the mean as there are values greater than the mean.
number line	A diagram that represents numbers as points on a line.
numeral	A symbol or set of symbols representing or naming a number.

O

obtuse angle	An angle that measures greater than 90 degrees and less than 180.
one to one correspondence	Used to compare two sets in which one element matches one and only one element in the other set.
operational symbols	Symbols representing the operations of addition, subtraction, multiplication and division.
order of operations	A set of rules. It tells you the order in which to compute so that you will get the same answer than anyone else will get.
ordered pair	A pair of numbers that gives the coordinates of a point on a grid in this order (horizontal coordinate, vertical coordinate).
ordinal number	A whole number that names the position of an object in sequence (first, second, third…).
outcome	One of the possible events in a probability situation.
outlier	A piece of numerical data that is much smaller or larger than the rest of the data in a set.

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P

parabola   The graph of a quadratic function. It is a symmetric curve.

parallel   Always the same distance apart.

parallelogram   A quadrilateral with two pairs of parallel and congruent sides.

percentile   A division of ordered data into 100 equal parts. About 1% of the data are in each part.

perfect square   The product of an integer and itself.

perimeter   The distance around a figure.

permutation   An ordered arrangement of elements from a set.

perpendicular   Forming right angles.

pictograph   A graph that uses pictures or symbols to show data.

plane   A flat surface that exceeds infinitely in all directions.

plot   Mark points on a graph.

point slope form   The equation of a line in the form $y-y_1 =m(x-x_1)$ where m represents the slope of the line and (x_1, y_1) is a known point on the line.

polyhedron   A solid figure in which all the faces are polygons.

polynomial   The sum of monomials.

population   A group of people (or objects or events) that fit a particular description.

positive number   A number that is greater than zero. Positive numbers are right of zero on a number line.

postulate   A mathematical statement that is accepted as true without proof.

powers   The number of times a number is repeated as a factor.

prediction   A statement of what somebody thinks will happen in the future.

prime factorization   The expression of a number as a product of prime factors.

prime number   A number that has exactly has two different positive factors, itself and 1.

prism   A three-dimensional figure that has two congruent and parallel faces that are polygons. The rest of the faces are parallelograms.

probability   The chance of an event happening.

product   The result of multiplication.

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property	A rule about numbers that is always true when you compute no matter which numbers you use.
proportion	An equation showing that two ratios are equal.
pyramid	A polyhedron whose base is a polygon and whose other bases are triangles that share a common vertex.

Q

quadrant	The four sections of a coordinate grid that are separated by the axes.
quadratic function	A function with a second degree variable (x^2).
quadrilateral	A four-sided polygon.
quantitative	Capable of being measured or expressed in numerical terms.
quantitative change	A relationship that can be expressed in numerical terms.
quantitative relationships	Numbers that can be expressed or compared in a meaningful way.
quantity	An amount.
quartiles	Along with the median, the quartiles divide the ordered set of data into four equal sized groups.

R

range
   a) for data
   b) for function
	a) The difference between the greatest and the least value in a set of data.
	b) The possible values for y in a function.

rate of change	The ratio of change in one quantity to the corresponding change in another quantity. (see also slope)
ratio	A comparison of two numbers or measures using division.
rational expressions	An algebraic expression that can be written as a fraction whose numerator and denominator are polynomials.
rational number	A number that can be expressed as a ratio of two integers where the denominator is non-zero.
ray	A part of a line that has one endpoint and goes on forever in one direction.
real numbers	The combined set of the rational and irrational numbers.
rectangular prism	A prism with six rectangular faces.
reflection	A transformation creating a mirror image of a figure on the opposite side of a line.

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regression line (line of best fit)	A line, segment, or ray drawn on a scatter plot to estimate the relationship between two sets of data.
relation	A set of ordered pairs for which all x and y are related in the same way.
relational symbols	Symbols included are >, <, ≤, ≥, ≠, and =.
relative position	Determines location of a number when comparing numbers (5 is between 1 and 10 or 6 is less than 8).
remainder	The part that is left over after trying to divide into equal groups.
right angle	An angle that measures exactly 90 degrees.

root
    a) exponents
    b) of a function
	a) The inverse of a power. $a^x=b$ or $\sqrt[x]{b}=a$, a is the xth root of b.
	b) The value which makes the equation equivalent to zero.

rotation	A transformation in which a figure is turned a given angle and direction around a point.

S

sample	A number of people, objects, or events chosen from a given population to represent the entire group.
sample space	A list of all possible outcomes of an activity.

scale
    a) measuring device
    b) unit of measure
    c) dimensional sizing
	a) An instrument used for weighing.
	b) A system of marks at fixed intervals used in measurement or graphing.
	c) The ratio of length used in a drawing, map, or model to the length of the object in reality.

scatter plot	A graph with one point for each item being measured.
scientific notation	A form of writing as the product of a power of ten and a decimal number greater than or equal to one and less than ten.
side	A line segment connected to other segments to form a polygon.
similar (figures)	Figures that have the same shape, but not necessarily the same size.
sketch	A drawing completed quickly, but still recognizable.
skewed distribution	Distribution that shows bunching at one end and a long tail stretching out the other direction.
slope	The measures of steepness of a line as you look at it from left to right. A numerical value for slope is found using two points on the line and dividing the change in y-value by the change in x-value.
slope intercept form	A form of a linear equation, $y=mx + b$, where m is the slope of the line and b is the y-intercept.

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solid figure	A figure with three dimensions.
sphere	A solid figure made up of points that are the same distance from a point called the center.
square root	The number when multiplied by itself results in a given number.
standard deviation	The measure of dispersion equal to the square root of the variance.

standard form for equations
   a) linear
   b) quadratic
	a) $ax + by + c = 0$, where a, b, and c are integers and a is > 0
	b) $ax^2 + bx + c = 0$, where a, b, and c are integers (not multiples of each other) and $a > 0$

stem-and-leaf plot	A way to organize the numbers in a data set so that the numbers themselves make the display.
strategies	Purposeful manipulations that may be chosen for specific problems, may not have a fixed order, and may be aimed at converting one problem into another.
sum	The result of addition.
symbols	Something that represents something else.

symmetry
   a) line
   b) point
	a) A figure has line symmetry when it can be folded along a line so the two halves match exactly.
	b) A figure has point symmetry when it can be turned exactly 180 degrees about a point and fit exactly on itself.

system of linear equations	Two or more related linear equations for which you seek a common solution.

T

table	An arrangement of information or data into columns and rows or a condensed list.
theoretical probability	Finding the probability of an event without doing an experiment or analyzing data.
three-dimensional	Existing in three dimensions; having length, width, and height.
transformation	A rule for moving every point in a plane figure to a new location.
translation (slide)	A transformation that slides a figure a given distance in a given direction.
trapezoid	A quadrilateral with exactly two parallel sides. OR A quadrilateral with one pair of parallel sides and one pair of sides that is not parallel.
triangular prism	A prism with triangular bases.
two-dimensional	Having length and width.

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U

unit — A precisely fixed quantity used for measure.

V

variable — A quantity that can have different values.

variance — A measure of dispersion of data centered about the mean.

vertex (vertices) — The point at which two line segments, lines, or rays, meet to form an angle.

vertex of quadratic equation — Highest or lowest point

volume — A number of cubic units of space a solid figure takes up.

W

whole number — Any of the numbers 0, 1,2,3,4 and so on.

X

x-axis — On a coordinate grid, the horizontal axis.

x-intercept — A value of x in an ordered pair describing the point at which a line or the graph of a function intersects the x-axis.

Y

y-axis — On a coordinate grid, the vertical axis.

y-intercept — A value of y in an ordered pair describing the point at which a line or the graph of a function intersects the y-axis.

Z

zeros of a function — Values of the variable for which the value of a function is zero. Also called roots of a function.

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Operation and Property Tables

Table 1. Common addition and subtraction situations.[6]

	Result Unknown	Change Unknown	Start Unknown
Add to	Two bunnies sat on the grass. Three more bunnies hopped there. How many bunnies are on the grass now? $2 + 3 = ?$	Two bunnies were sitting on the grass. Some more bunnies hopped there. Then there were five bunnies. How many bunnies hopped over to the first two? $2 + ? = 5$	Some bunnies were sitting on the grass. Three more bunnies hopped there. Then there were five bunnies. How many bunnies were on the grass before? $? + 3 = 5$
Take from	Five apples were on the table. I ate two apples. How many apples are on the table now? $5 - 2 = ?$	Five apples were on the table. I ate some apples. Then there were three apples. How many apples did I eat? $5 - ? = 3$	Some apples were on the table. I ate two apples. Then there were three apples. How many apples were on the table before? $? - 2 = 3$
	Total Unknown	**Addend Unknown**	**Both Addends Unknown**[1]
Put Together/ Take Apart[2]	Three red apples and two green apples are on the table. How many apples are on the table? $3 + 2 = ?$	Five apples are on the table. Three are red and the rest are green. How many apples are green? $3 + ? = 5, 5 - 3 = ?$	Grandma has five flowers. How many can she put in her red vase and how many in her blue vase? $5 = 0 + 5, 5 = 5 + 0$ $5 = 1 + 4, 5 = 4 + 1$ $5 = 2 + 3, 5 = 3 + 2$
	Difference Unknown	**Bigger Unknown**	**Smaller Unknown**
Compare[3]	("How many more?" version): Lucy has two apples. Julie has five apples. How many more apples does Julie have than Lucy? ("How many fewer?" version): Lucy has two apples. Julie has five apples. How many fewer apples does Lucy have than Julie? $2 = ? = 5, 5 - 2 = ?$	(Version with "more"): Julie has three more apples than Lucy. Lucy has two apples. How many apples does Julie have? (Version with "fewer"): Lucy has 3 fewer apples than Julie. Lucy has two apples. How many apples does Julie have? $2 + 3 = ?, 3 + 2 = ?$	(Version with "more"): Julie has three more apples than Lucy. Julie has five apples. How many apples does Lucy have? (Version with "fewer"): Lucy has 3 fewer apples than Julie. Julie has five apples. How many apples does Lucy have? $5 - 3 = ?, ? + 3 = 5$

[1]These take apart situations can be used to show all the decompositions of a given number. The associated equations, which have the total on the left of the equal sign, help children understand that the = sign does not always mean makes or results in but always does mean is the same number as.
[2]Either addend can be unknown, so there are three variations of these problem situations. Both Addends Unknown is a productive extension of this basic situation, especially for small numbers less than or equal to 10.
[3]For the Bigger Unknown or Smaller Unknown situations, one version directs the correct operation (the version using more for the bigger unknown and using less for the smaller unknown). The other versions are more difficult.
[6]Adapted from Box 2 – 4 of National Research Council (2009, op. cit., pp. 32, 33).

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Table 2. Common multiplication and division situations.[7]

	Unknown Product 3 x 6 = ?	Group Size Unknown ("How many in each group?" Division) 3 x ? = 18, and 18 ÷ 3 = ?	Number of Groups Unknown ("How many groups?" Division) ? x 6 = 18, and 18 ÷ 6 = ?
Equal Groups	There are 3 bags with 6 plums in each bag. How many plums are there in all? *Measurement example:* You need 3 lengths of string, each 6 inches long. How much string will you need altogether?	If 18 plums are shared equally into 3 bags, then how many plums will be in each bag? *Measurement example:* You have 18 inches of string, which you will cut into 3 equal pieces. How long will each piece of string be?	If 18 plums are to be packed 6 to a bag, then how many bags are needed? *Measurement example:* You have 18 inches of string, which you will cut into pieces that are 6 inches long. How many pieces of string will you have?
Arrays[4], Area[5]	There are 3 rows of apples with 6 apples in each row. How many apples are there? *Area example:* What is the area of a 3 cm by 6 cm rectangle?	If 18 apples are arranged into 3 equal rows, how many apples will be in each row? *Area example:* A rectangle has area 18 square centimeters. If one side is 3 cm long, how long is a side next to it?	If 18 apples are arranged into equal rows of 6 apples. How many rows will there be? *Area example:* A rectangle has 18 square centimeters. If one side is 6 cm long, how long is a side next to it?
Compare	A blue hat costs $6. A red hat costs 3 times as much as the blue hat. How much does the red hat cost? *Measurement example:* A rubber band is 6 cm long. How long will the rubber band be when it is stretched to be 3 times as long?	A red hat costs $18 and that is 3 times as much as a blue hat costs. How much does a blue hat cost? *Measurement example:* A rubber band is stretched to be 18 cm long and that is 3 times as long as it was at first. How long was the rubber band at first?	A red hat costs $18 and a blue hat costs $6. How many times as much does the red hat cost as the blue hat? *Measurement example:* A rubber band was 6 cm long at first. Now it is stretched to be 18 cm long. How many times as long is the rubber band now as it was at first?
General	a x b = ?	a x ? = p, and p ÷ a = ?	? x b = p, and p ÷ b = ?

[4]The language in the array examples shows the easiest form of array problems. A harder form is to use the terms rows and columns: The apples in the grocery window are in 3 rows and 6 columns. How many apples are in there? Both forms are valuable.

[5]Area involves arrays of squares that have been pushed together so that there are no gaps or overlaps, so array problems include these especially important measurement situations.

[7]The first examples in each cell are examples of discrete things. These are easier for students and should be given before the measurement examples.

Table 3. The properties of operations. Here a, b and c stand for arbitrary numbers in a given number system. The properties of operations apply to the rational number system, the real number system, and the complex number system.

Associative property of addition	(a + b) + c = a + (b + c)
Commutative property of addition	a + b = b + a
Additive identity property of 0	a + 0 = 0 + a = a
Existence of additive inverses	For every a there exists –a so that a + (-a) = (-a) + a = 0
Associative property of multiplication	(a x b) x c = a x (b x c)
Commutative property of multiplication	a x b = b x a
Multiplicative identity property of 1	a x 1 = 1 x a = a
Existence of multiplicative inverses	For every a $\neq$ 0 there exists $\frac{1}{a}$ so that a x $\frac{1}{a}$ = $\frac{1}{a}$ x a = 1
Distributive property of multiplication over addition	a x (b + c) = a x b + a x c

Table 4. The properties of equality. Here a, b and c stand for arbitrary numbers in the rational, real, or complex number systems.

Reflexive property of equality	a = a
Symmetric property of equality	If a = b, then b = a
Transitive property of equality	If a – b and b – c, then a = c
Addition property of equality	If a = b, then a + c = b + c
Subtraction property of equality	If a = b, then a – c = b – c
Multiplication property of equality	If a = b, then a x c = b x c
Division property of equality	If a = b and c $\neq$ 0, then a $\div$ c = b $\div$ c
Substitution property of equality	If a = b, then b may be substituted for a In any expression containing a

Table 5. The properties of inequality. Here a, b and c stand for arbitrary numbers in the rational or real number systems.

Exactly one of the following is true: a < b, a = b, a > b
If a > b and b > c, then a > c
If a > b, then b < a
If a > b, then -a < -b
If a > b, then a $\pm$ c > b $\pm$ c
If a > b and c > 0, then a x c > b x c
If a > b and c < 0, then a x c < b x c
If a > b and c > 0, then a + c > b + c
If a > b and c < 0, then a + c < b + c