

# excessively formal k-12 mathematics methods

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year	topics covered	methods
k	classification of groups of objects, ordering of objects by size or quantity, sorting, numerals 0-10 (and creation of custom numerals), counting with groups (sequences), comparison of quantities specified by numerals, shapes (straight and curved lines, corners/vertices, sides, 2-d shapes, 3-d shapes), addition, subtraction, understanding numeral bases (e.g., 10)	set theory, well-ordered sets, sorting algorithms, number theory (peano arithmetic and natural numbers with succ and 0, etc.), sequences/series, definition of n-gons and planes and lines, 2- and 3-space, addition and subtraction defined inductively on natural numbers, numerical bases
1	comparing numbers using place value, partitioning sets (e.g., fourths, halves, etc.), telling time	implications of numerical bases, partitioning sets using equivalence classes, modular arithmetic (clock arithmetic) and beginning number theory
2	measurement of quantities (e.g., length) with various units, solving problems with money, creating and identifying 2- and 3-d shapes (and piecing together the shapes from constituent pieces), modeling equal shares of shapes	type theory (units) and type checking, finance, methods of creation of equal pieces of shapes by way of tiling
3	multiplication and division, area and perimeter, fractions	definition of multiplication as repeated addition (again using natural numbers), definition of division in the number-theoretical sense, discussion of rational, real, and irrational numbers and their closures under various operators (foray into group theory), calculation of area using integrals, and calculation of perimeter using line integrals
4	factoring, conversion of fractions to decimals, perpendicular lines, symmetry in polygons, understanding of angles (complementary, supplementary)	factorization of numbers (prime factorization uniqueness), conversion of bases and decimal base definitions (floating point arithmetic with mantissas etc.), angles and perpendicularity (trigonometry, linear algebra – dot and cross products and perpendicularity)
5	classifying quadrilaterals using a tree structure (understanding of heirarchies), graphing on the cartesian plane	subset definition, definition of points in 2-space
6	area, surface area, ratios, expressions and equations, data and distributions	(again) integration for areas, integration for surface areas (and derivative of volume), definition of ASTs and grammar for expressions and equations, data science a-la orie 3120
7	inequalities, probability and sampling	set cardinality inequalities, well-ordering (again), probabilities a-la engrd 2700

year	topics covered	methods
8	rigid transformations and congruence, dilations, similarity, slope of lines, linear relationships, linear equations and systems, functions and volume, scientific notation, pythagorean theorem	scaling of shapes in 2-space (trivial proofs), tangent line slopes (derivatives), linear algebra and matrices, functions (cartesian product of sets, images, injection/surjection/bijection, left- and right-inverses, recursion), proof of pythagorean theorem, disproof of fermat's last theorem
9	sequences, linear and exponential functions, quadratic functions, modeling data	sequences and series, data analysis and modeling with Python
10	solving quadratics and other equations, fractional exponents, trigonometry, probability	CAS tools for solving equations, approximations with derivatives, orie 3500 level probability
11	polynomials, calc A	linear algebra and multi
12	calc BC	real analysis