New York State Testing Program

Educator Guide to the 2018 Grades 3–8 Mathematics Tests

updated Jan. 2018

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Betty A. Rosa, *Chancellor*, B.A., M.S. in Ed., M.S. in Ed., M.Ed., Ed.D.	Bronx
T. Andrew Brown, *Vice Chancellor*, B.A., J.D.	Rochester
Roger Tilles, B.A., J.D.	Great Neck
Lester W. Young, JR., B.S., M.S., Ed.D.	Beechhurst
Christine D. Cea, B.A., M.A., Ph.D.	Staten Island
Wade S. Norwood, B.A.	Rochester
Kathleen M. Cashin, B.S., M.S., Ed.D.	Brooklyn
James E. Cottrell, B.S., M.D.	New York
Josephine Victoria Finn, B.A., J.D.	Monticello
Judith Chin, M.S. in Ed.	Little Neck
Beverly L. Ouderkirk, B.S. in Ed., M.S. in Ed.	Morristown
Catherine Collins, R.N., N.P., B.S., M.S. in Ed., Ed.D.	Buffalo
Judith Johnson, B.A., M.A., C.A.S.	New Hempstead
Nan Eileen Mead, B.A.	Manhattan
Elizabeth S. Hakanson, A.S., M.S., C.A.S.	Syracuse
Luis O. Reyes, B.A., M.A., Ph.D.	New York
Susan W. Mittler, B.S., M.S.	Ithaca

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Executive Deputy Commissioner
Elizabeth R. Berlin

Senior Deputy Commissioner, Office of Education Policy
Jhone Ebert

Deputy Commissioner, Office of Instructional Services
Angelica Infante-Green

Assistant Commissioner, Office of State Assessment
Steven E. Katz

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2018 Mathematics Tests

As part of the New York State Board of Regents Reform Agenda, the New York State Education Department (NYSED) embarked on a comprehensive reform initiative to ensure that schools prepare students with the knowledge and skills they need to succeed in college and in their careers. To realize the goals of this initiative, changes have occurred in standards, curricula, and assessments. These changes impact pedagogy and, ultimately, student learning.

The New York State P–12 Learning Standards call for changes in what is expected from a teacher's instructional approach. In mathematics courses, the Learning Standards demand that teachers focus their instruction on fewer, more central standards as indicated on the EngageNY web site (http://engageny.org/resource/math-content-emphases/), thereby providing room to build core understandings and connections between mathematical concepts and skills.

More specifically, the Learning Standards demand six key shifts in instruction in mathematics, summarized in the chart below. A more detailed description can be found at Common Core Shifts (http://engageny.org/resource/common-core-shifts/).

Shifts in Mathematics		
Shift 1	Focus	Teachers significantly narrow and deepen the scope of how time and energy are spent in the mathematics classroom. They do so in order to focus deeply on only the concepts that are prioritized in the standards.
Shift 2	Coherence	Principals and teachers carefully connect the learning within and across grades so that students can add new understanding onto foundations built in previous years.
Shift 3	Fluency	Students are expected to have speed and accuracy with simple calculations; teachers structure class time and/or homework time for students to memorize core functions.
Shift 4	Deep Understanding	Students deeply understand and can operate easily within a math concept before moving on. They learn more than the procedure to get the answer right. They learn the math.
Shift 5	Application	Students are expected to use math and choose the appropriate concept for application even when they are not prompted to do so.
Shift 6	Dual Intensity	Students are practicing procedures and understanding concepts. There is more than a balance between these two things in the classroom—both are occurring with intensity.

Beginning with the 2013 administration, the Grades 3–8 English Language Arts (ELA) and Mathematics New York State Testing Program (NYSTP) was redesigned to measure student learning aligned with the instructional shifts necessitated by the standards. Since that time, several revisions have been made to improve the quality of the tests. Based on extensive feedback, NYSED removed time limits from the tests in 2016. Additionally, NYSED has been expanding the number of opportunities for NYS educators to become involved in the development of the Mathematics Tests and has significantly increased the number of State educators involved in the test development process. NYSED remains committed to improving the quality of the State's assessments and the experiences that students have taking these tests.

This document provides specific details about the 2018 Grades 3–8 Mathematics Tests and the standards that they measure.

Option for Schools to Administer the Mathematics Tests on Computer

Beginning in 2017, schools have had the option to administer the Grades 3–8 Mathematics Tests on computer or paper. More information about this option is available at the NYSED computer-based testing (CBT) Support web site (https://cbtsupport.nysed.gov/).

Reduction in the Number of Test Sessions

In June 2017, the Board of Regents decided to reduce the number of days of student testing on the Grades 3–8 English Language Arts and Mathematics Tests from three sessions for each test to two. This change takes effect beginning with the tests that will be administered in 2018. In addition to reducing the number of sessions, the Board's decision also reduces scoring time for teachers and may help enable more schools to transition sooner to CBT.

Learning Standards for Mathematics

Grade 3

In Grade 3, the Learning Standards focus on four critical areas: (1) developing understanding of multiplication and division and strategies for multiplication and division within 100; (2) developing understanding of fractions, especially unit fractions (fractions with numerator 1); (3) developing understanding of the structure of rectangular arrays and of area; and (4) describing and analyzing two-dimensional shapes.

1. Students develop an understanding of the meanings of multiplication and division of whole numbers through activities and problems involving equal-sized groups, arrays, and area models; multiplication is finding an unknown product, and division is finding an unknown factor in these situations. For equal-sized group situations, division can require finding the unknown number of groups or the unknown group size. Students use properties of operations to calculate products of whole numbers, using increasingly sophisticated strategies based on these properties to solve multiplication and division problems involving single-digit factors. By comparing a variety of solution strategies, students learn the relationship between multiplication and division.
2. Students develop an understanding of fractions, beginning with unit fractions. Students view fractions in general as being built out of unit fractions, and they use fractions along with visual fraction models to represent parts of a whole. Students understand that the size of a fractional part is relative to the size of the whole. For example, 1/2 of the paint in a small bucket could be less paint than 1/3 of the paint in a larger bucket, but 1/3 of a ribbon is longer than 1/5 of the same ribbon because when the ribbon is divided into 3 equal parts, the parts are longer than when the ribbon is divided into 5 equal parts. Students are able to use fractions to represent numbers equal to, less than, and greater than 1. They solve problems that involve comparing fractions by using visual fraction models and strategies based on noticing equal numerators or denominators.
3. Students recognize area as an attribute of two-dimensional regions. They measure the area of a shape by finding the total number of same-sized units of area required to cover the shape without gaps or overlaps, a square with sides of unit length being the standard unit for measuring area. Students understand that rectangular arrays can be decomposed into identical rows or into identical columns. By decomposing rectangles into rectangular arrays of squares, students connect area to multiplication and justify using multiplication to determine the area of a rectangle.
4. Students describe, analyze, and compare properties of two-dimensional shapes. They compare and classify shapes by their sides and angles, and connect these with definitions of shapes. Students also relate their fraction work to geometry by expressing the area of part of a shape as a unit fraction of the whole.

Grade 4

In Grade 4, the Learning Standards focus on three critical areas: (1) developing understanding and fluency with multi-digit multiplication, and developing understanding of dividing to find quotients involving multi-digit dividends; (2) developing an understanding of fraction equivalence, addition and subtraction of fractions with like denominators, and multiplication of fractions by whole numbers; and (3) understanding that geometric figures can be analyzed and classified based on their properties, such as having parallel sides, perpendicular sides, particular angle measures, and symmetry.

1. Students generalize their understanding of place value to 1,000,000, understanding the relative sizes of numbers in each place. They apply their understanding of models for multiplication (equal-sized groups, arrays, area models), place value, and properties of operations (in particular the distributive property) as they develop, discuss, and use efficient, accurate, and generalizable methods to compute products of multi-digit whole numbers. Depending on the numbers and the context, they select and accurately apply appropriate methods to estimate or mentally calculate products. They develop fluency with efficient procedures for multiplying whole numbers, understand and explain why the procedures work based on place value and properties of operations, and use them to solve problems. Students apply their understanding of models for division, place value, properties of operations, and the relationship of division to multiplication as they develop, discuss, and use efficient, accurate, and generalizable procedures to find quotients involving multi-digit dividends. They select and accurately apply appropriate methods to estimate and mentally calculate quotients, and interpret remainders based upon the context.
2. Students develop an understanding of fraction equivalence and operations with fractions. They recognize that two different fractions can be equal (e.g., 15/9 = 5/3), and they develop methods for generating and recognizing equivalent fractions. Students extend previous understandings about how fractions are built from unit fractions, composing fractions from unit fractions, decomposing fractions into unit fractions, and using the meaning of fractions and the meaning of multiplication to multiply a fraction by a whole number.
3. Students describe, analyze, compare, and classify two-dimensional shapes. Through building, drawing, and analyzing two-dimensional shapes, students deepen their understanding of properties of two-dimensional objects and the use of them to solve problems involving symmetry.

Grade 5

In Grade 5, the Learning Standards focus on three critical areas: (1) developing fluency with addition and subtraction of fractions, and developing understanding of multiplication of fractions and of division of fractions in limited cases (unit fractions divided by whole numbers and whole numbers divided by unit fractions); (2) extending division to 2-digit divisors, integrating decimal fractions into the place value system and developing understanding of operations with decimals to hundredths, and developing fluency with whole number and decimal operations; and (3) developing understanding of volume.

1. Students apply their understanding of fractions and fraction models to represent the addition and subtraction of fractions with unlike denominators as equivalent calculations with like denominators. They develop fluency in calculating sums and differences of fractions, and make reasonable estimates of them. Students also use the meaning of fractions, of multiplication and division, and the relationship between multiplication and division to understand and explain why the procedures for multiplying and dividing fractions make sense. (Note: this is limited to the case of dividing unit fractions by whole numbers and whole numbers by unit fractions.)
2. Students develop understanding of why division procedures work based on the meaning of base-ten numerals and properties of operations. They finalize fluency with multi-digit addition, subtraction, multiplication, and division. They apply their understandings of models for decimals, decimal notation, and properties of operations to add and subtract decimals to hundredths. They develop fluency in these computations, and make reasonable estimates of their results. Students use the relationship between decimals and fractions, as well as the relationship between finite decimals and whole numbers (i.e., a finite decimal multiplied by an appropriate power of 10 is a whole number), to understand and explain why the procedures for multiplying and dividing finite decimals make sense. They compute products and quotients of decimals to hundredths efficiently and accurately.

3. Students recognize volume as an attribute of three-dimensional space. They understand that volume can be measured by finding the total number of same-sized units of volume required to fill the space without gaps or overlaps. They understand that a 1-unit by 1-unit by 1-unit cube is the standard unit for measuring volume. They select appropriate units, strategies, and tools for solving problems that involve estimating and measuring volume. They decompose three-dimensional shapes and find volumes of right rectangular prisms by viewing them as decomposed into layers of arrays of cubes. They measure necessary attributes of shapes in order to determine volumes to solve real-world and mathematical problems.

Grade 6

In Grade 6, instructional time should focus on four critical areas: (1) connecting ratio and rate to whole number multiplication and division and using concepts of ratio and rate to solve problems; (2) completing understanding of division of fractions and extending the notion of number to the system of rational numbers, which includes negative numbers; (3) writing, interpreting, and using expressions and equations; and (4) developing understanding of statistical thinking.

1. Students use reasoning about multiplication and division to solve ratio and rate problems about quantities. By viewing equivalent ratios and rates as deriving from, and extending, pairs of rows (or columns) in the multiplication table, and by analyzing simple drawings that indicate the relative size of quantities, students connect their understanding of multiplication and division with ratios and rates. Thus students expand the scope of problems for which they can use multiplication and division to solve problems, and they connect ratios and fractions. Students solve a wide variety of problems involving ratios and rates.
2. Students use the meaning of fractions, the meanings of multiplication and division, and the relationship between multiplication and division to understand and explain why the procedures for dividing fractions make sense. Students use these operations to solve problems. Students extend their previous understandings of numbers and the ordering of numbers to the full system of rational numbers, which includes negative rational numbers, and in particular negative integers. They reason about the order and absolute value of rational numbers and about the location of points in all four quadrants of the coordinate plane.
3. Students understand the use of variables in mathematical expressions. They write expressions and equations that correspond to given situations, evaluate expressions, and use expressions and formulas to solve problems. Students understand that expressions in different forms can be equivalent, and they use the properties of operations to rewrite expressions in equivalent forms. Students know that the solutions of an equation are the values of the variables that make the equation true. Students use properties of operations and the idea of maintaining the equality of both sides of an equation to solve simple one-step equations. Students construct and analyze tables, such as tables of quantities that are in equivalent ratios, and they use equations (such as $3x = y$) to describe relationships between quantities.
4. Building on and reinforcing their understanding of number, students begin to develop their ability to think statistically. Students recognize that a data distribution may not have a definite center and that different ways to measure center yield different values. The median measures center in the sense that it is roughly the middle value. The mean measures center in the sense that it is the value that each data point would take on if the total of the data values were redistributed equally, and also in the sense that it is a balance point. Students recognize that a measure of variability (interquartile range or mean absolute deviation) can also be useful for summarizing data because two very different sets of data can

have the same mean and median, yet be distinguished by their variability. Students learn to describe and summarize numerical data sets, identifying clusters, peaks, gaps, and symmetry, considering the context in which the data were collected. Students in Grade 6 also build on their work with area in elementary school by reasoning about relationships among shapes to determine area, surface area, and volume. They find areas of right triangles, other triangles, and special quadrilaterals by decomposing these shapes, rearranging or removing pieces, and relating the shapes to rectangles. Using these methods, students discuss, develop, and justify formulas for areas of triangles and parallelograms. Students find areas of polygons and surface areas of prisms and pyramids by decomposing them into pieces whose area they can determine. They reason about right rectangular prisms with fractional side lengths to extend formulas for the volume of a right rectangular prism to fractional side lengths. They prepare for work on scale drawings and constructions in Grade 7 by drawing polygons in the coordinate plane.

Grade 7

In Grade 7, the Learning Standards focus on four critical areas: (1) developing understanding of and applying proportional relationships; (2) developing understanding of operations with rational numbers and working with expressions and linear equations; (3) solving problems involving scale drawings and informal geometric constructions, and working with two- and three-dimensional shapes to solve problems involving area, surface area, and volume; and (4) drawing inferences about populations based on samples.

1. Students extend their understanding of ratios and develop understanding of proportionality to solve single- and multi-step problems. Students use their understanding of ratios and proportionality to solve a wide variety of percent problems, including those involving discounts, interest, taxes, tips, and percent increase or decrease. Students solve problems about scale drawings by relating corresponding lengths between the objects or by using the fact that relationships of lengths within an object are preserved in similar objects. Students graph proportional relationships and understand the unit rate informally as a measure of the steepness of the related line, called the slope. They distinguish proportional relationships from other relationships.
2. Students develop a unified understanding of numbers, recognizing fractions, decimals (that have a finite or a repeating decimal representation), and percents as different representations of rational numbers. Students extend addition, subtraction, multiplication, and division to all rational numbers, maintaining the properties of operations and the relationships between addition and subtraction, and multiplication and division. By applying these properties, and by viewing negative numbers in terms of everyday contexts (e.g., amounts owed or temperatures below zero), students explain and interpret the rules for adding, subtracting, multiplying, and dividing with negative numbers. They use the arithmetic of rational numbers as they formulate expressions and equations in one variable and use these equations to solve problems.
3. Students continue their work with area from Grade 6, solving problems involving the area and circumference of a circle and surface area of three-dimensional objects. In preparation for work on congruence and similarity in Grade 7 they reason about relationships among two-dimensional figures using scale drawings and informal geometric constructions, and they gain familiarity with the relationships between angles formed by intersecting lines. Students work with three-dimensional figures, relating them to two-dimensional figures by examining cross-sections. They solve real-world and mathematical problems involving area, surface area, and volume of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

4. Students build on their previous work with single data distributions to compare two data distributions and address questions about differences between populations. They begin informal work with random sampling to generate data sets and learn about the importance of representative samples for drawing inferences.

Grade 8

In Grade 8, the Learning Standards focus on three critical areas: (1) formulating and reasoning about expressions and equations, including modeling an association in bivariate data with a linear equation, and solving linear equations and systems of linear equations; (2) grasping the concept of a function and using functions to describe quantitative relationships; and (3) analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence, and understanding and applying the Pythagorean Theorem.

1. Students use linear equations and systems of linear equations to represent, analyze, and solve a variety of problems. Students recognize equations for proportions ($y/x = m$ or $y = mx$) as special linear equations ($y = mx + b$), understanding that the constant of proportionality (m) is the slope, and the graphs are lines through the origin. They understand that the slope (m) of a line is a constant rate of change, so that if the input or x-coordinate changes by an amount A, the output or y-coordinate changes by the amount $m \cdot A$. Students also use a linear equation to describe the association between two quantities in bivariate data (such as arm span vs. height for students in a classroom). At this grade, fitting the model and assessing its fit to the data are done informally. Interpreting the model in the context of the data requires students to express a relationship between the two quantities in question and to interpret components of the relationship (such as slope and y-intercept) in terms of the situation.

   Students strategically choose and efficiently implement procedures to solve linear equations in one variable, understanding that when they use the properties of equality and the concept of logical equivalence they maintain the solutions of the original equation. Students solve systems of two linear equations in two variables and relate the systems to pairs of lines in the plane; these intersect, are parallel, or are the same line. Students use linear equations, systems of linear equations, linear functions, and their understanding of slope of a line to analyze situations and solve problems.

2. Students grasp the concept of a function as a rule that assigns to each input exactly one output. They understand that functions describe situations where one quantity determines another. They can translate among representations and partial representations of functions (noting that tabular and graphical representations may be partial representations), and they describe how aspects of the function are reflected in the different representations.

3. Students use ideas about distance and angles, how they behave under translations, rotations, reflections, dilations, and ideas about congruence and similarity to describe and analyze two-dimensional figures and to solve problems. Students show that the sum of the angles in a triangle is the angle formed by a straight line, and that various configurations of lines give rise to similar triangles because of the angles created when a transversal cuts parallel lines. Students understand the statement of the Pythagorean Theorem and its converse, and can explain why the Pythagorean Theorem holds, for example, by decomposing a square in two different ways. They apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons. Students complete their work on volume by solving problems involving cones, cylinders, and spheres.

All the content at each grade level is connected to the Standards for Mathematical Practices. The 2018 Grades 3–8 Mathematics Tests will include questions that require students to connect mathematical content and mathematical practices.

For more information about Learning Standards and Standards for Mathematical Practice, please refer to the EngageNY web site
(http://engageny.org/resource/new-york-state-p-12-common-core-learning-standards-for-mathematics).

Clusters, Standards, and Sequencing in Instruction and Assessment

The 2018 Grades 3–8 Mathematics Tests will focus entirely on the New York State Learning Standards for Mathematics.

The Learning Standards for Mathematics are divided into *standards, clusters, and domains*.

- *Standards* define what students should understand and be able to do. In some cases, standards are further articulated into lettered *components*.
- *Clusters* are groups of related *standards*. Note that standards from different *clusters* may sometimes be closely related, because mathematics is a connected subject.
- *Domains* are larger groups of related *clusters* and *standards*. Standards from different domains may be closely related.

Content Emphases

The Learning Standards for Mathematics were designed with the understanding that not all clusters should be emphasized equally in instruction or assessment. Some clusters require greater emphasis than others based on the time that they take to master and/or their importance to future mathematics or the demands of college and career readiness. The Grades 3–8 Learning Standards are divided into *Major Clusters, Supporting Clusters,* and *Additional Clusters*. The *Major Clusters* are the intended instructional focus for Grades 3–8 and will account for the majority of math test questions. The *Supporting Clusters* and *Additional Clusters* are Mathematics Standards that serve to both introduce and reinforce Major Clusters. The chart below details the recommended instructional focus and the percentage of test questions that assess the Major, Supporting, and Additional Clusters.

Cluster Emphases for Instruction and the 2018 Grades 3–8 Mathematics Tests

Cluster Emphasis	Recommended Instructional Time	Approximate Number of Test Points
Major	**65–75%**	**70–80%**
Supporting	**15–25%**	**10–20%**
Additional	**5–15%**	**5–10%**

Emphasized Standards

The Learning Standards for Mathematics were also designed with the understanding that teachers would emphasize standards that best facilitate mastery of the most important grade-level mathematics and best position students for mastery of future mathematics. Similar to the cluster emphases, not all standards should receive similar emphasis. Within each of the clusters and domains, certain standards require more instructional and assessment emphasis.

One example of a standard needing greater emphasis is 3.NF.3, "Explain equivalence of fractions in special cases, and compare fractions by reasoning about their size." In the Number and Operations – Fractions domain, 3.NF.1, students begin to understand conceptually what a fraction is ("Understand a fraction 1/b as the quantity formed by 1 part when a whole is partitioned…"), and then in 3.NF.2 begin to apply their knowledge in a number line context ("Understand a fraction as a number on the number line…"). Both 3.NF.1 and 3.NF.2 help build students' conceptual understanding in order to apply their knowledge to understand and explain equivalent fractions by "comparing fractions by reasoning about their size," as 3.NF.3 requires.

An emphasis on the most critical clusters and standards allows depth and focus in learning, which is carried out through the Standards for Mathematical Practice. Without such depth and focus, attention to the Standards for Mathematical Practice would be unrealistic.

For more information about Content Emphases, please refer to the EngageNY web site
(http://engageny.org/resource/math-content-emphases).

Sequencing

The August 2012 memorandum *Grades 3–8 Mathematics Testing Program Guidance: September-to-April/May-to-June Common Core Learning Standards* provides guidance on aligning standards to each time period. Standards designated as September-to-April will be assessed on the 2018 Grades 3–8 Mathematics Tests. Several standards designated as Major Clusters are included in the May-to-June instructional period. Placing these standards in the May-to-June instructional period provides more coherent September-to-April content blocks and allows for more logical sequencing for standards that closely relate to the Major Clusters of the following year.

One of the ways the Learning Standards are changing instructional practices and our assessment design is through the spiraling of mathematic concepts within and across grade levels. This means that when a student has mastered a particular standard, that student has also inherently mastered the related standards that came before. It is our recommendation, therefore, that all teachers pay close attention to student mastery of May-to-June standards so that student learning can begin promptly and efficiently the following year.

For more information about the *Grades 3–8 Mathematics Testing Program Guidance: September-to-April/May-to-June Common Core Learning Standards*, please refer to the EngageNY web site
(http://www.p12.nysed.gov/assessment/ei/2013/math-sept-april-may-june.pdf).

Emphases and Sequencing

The charts on pages 11–16 illustrate the different *clusters* and *standards* recommended for instructional emphasis. *Standards* that are recommended for greater emphasis are indicated with a check mark while those that are recommended for instruction after the administration of the 2018 Grades 3–8 Mathematics Tests are indicated by the word "Post." ***The instructional emphasis recommended in this chart is mirrored in the Grades 3–8 test designs, whereby clusters and standards that are recommended for greater emphasis will be assessed in greater number. Standards recommended for greater emphasis that are designated for instruction after the administration of the 2018 Grades 3–8 Mathematics Tests will be fundamental in ensuring that students are prepared for the instruction of each subsequent grade and may be tested on the subsequent grade level's test.***

Grade 3

Cluster Emphasis	Domain	Cluster	Standard	
Major Clusters	Operations and Algebraic Thinking	*Represent and solve problems involving multiplication and division.*	3.OA.1	
			3.OA.2	
			3.OA.3	✓
			3.OA.4	
		Understand the properties of multiplication and the relationship between multiplication and division.	3.OA.5	
			3.OA.6	
		Multiply and divide within 100.	3.OA.7	
		Solve problems involving the four operations, and identify and explain patterns in arithmetic.	3.OA.8	✓
			3.OA.9	
	Number and Operations—Fractions	*Develop understanding of fractions as numbers.*	3.NF.1	
			3.NF.2	
			3.NF.3	✓
	Measurement and Data	*Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects.*	3.MD.1	
			3.MD.2	
		Geometric measurement: understand concepts of area and relate area to multiplication and to addition.	3.MD.5	
			3.MD.6	
			3.MD.7	✓
Supporting Clusters	Measurement and Data	*Represent and interpret data.*	3.MD.3	
			3.MD.4	*Post*
	Geometry	*Reason with shapes and their attributes.*	3.G.1	*Post*
			3.G.2	
Additional Clusters	Number and Operations in Base Ten	*Use place value understanding and properties of operations to perform multi-digit arithmetic.*	3.NBT.1	
			3.NBT.2	
			3.NBT.3	
	Measurement and Data	*Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.*	3.MD.8	*Post*

✓ = Standards recommended for greater emphasis

Post = Standards recommended for instruction in May-June

Grade 4

Cluster Emphasis	Domain	Cluster	Standard		
Major Clusters	Operations and Algebraic Thinking	*Represent and solve problems involving multiplication and division.*	4.OA.1		
			4.OA.2	✓	
			4.OA.3		
	Number and Operations in Base Ten	*Generalize place value understanding for multi-digit whole numbers.*	4.NBT.1		
			4.NBT.2		
			4.NBT.3		
		Use place value understanding and properties of operations to perform multi-digit arithmetic.	4.NBT.4		
			4.NBT.5	✓	
			4.NBT.6		
	Number and Operations—Fractions	*Extend understanding of fraction equivalence and ordering.*	4.NF.1		
			4.NF.2		
		Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.	4.NF.3	✓	
			4.NF.4	✓	
		Understand decimal notation for fractions, and compare decimal fractions.	4.NF.5		*Post*
			4.NF.6	✓	*Post*
			4.NF.7	✓	*Post*
Supporting Clusters	Operations and Algebraic Thinking	*Gain familiarity with factors and multiples.*	4.OA.4		
	Measurement and Data	*Solve problems involving measurements and conversion of measurements from a larger unit to a smaller unit.*	4.MD.1		*Post*
			4.MD.2		*Post*
			4.MD.3		
		Represent and interpret data.	4.MD.4		
Additional Clusters	Operations and Algebraic Thinking	*Generate and analyze patterns.*	4.OA.5		
	Measurement and Data	*Geometric measurement: understand concepts of angles and measure angles.*	4.MD.5		
			4.MD.6		
			4.MD.7		
	Geometry	*Draw and identify lines and angles, and classify shapes by properties of their lines and angles.*	4.G.1		
			4.G.2		
			4.G.3		

✓ = Standards recommended for greater emphasis

Post = Standards recommended for instruction in May-June

Grade 5

Cluster Emphasis	Domain	Cluster	Standard	
Major Clusters	Number and Operations in Base Ten	*Understand the place value system.*	5.NBT.1	
			5.NBT.2	
			5.NBT.3	
		Perform operations with multi-digit whole numbers and with decimals to hundredths.	5.NBT.4	
			5.NBT.5	✓
			5.NBT.6	✓
			5.NBT.7	✓
	Number and Operations—Fractions	*Use equivalent fractions as a strategy to add and subtract fractions.*	5.NF.1	
			5.NF.2	✓
		Apply and extend previous understandings of multiplication and division to multiply and divide fractions.	5.NF.3	
			5.NF.4	
			5.NF.5	
			5.NF.6	✓
			5.NF.7	✓
	Measurement and Data	*Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.*	5.MD.3	
			5.MD.4	
			5.MD.5	
Supporting Clusters	Measurement and Data	*Convert like measurement units within a given measurement system.*	5.MD.1	
		Represent and interpret data.	5.MD.2	
Additional Clusters	Operations and Algebraic Thinking	*Write and interpret numerical expressions.*	5.OA.1	
			5.OA.2	
		Analyze patterns and relationships.	5.OA.3	*Post*
	Geometry	*Graph points on the coordinate plane to solve.*	5.G.1	*Post*
			5.G.2	*Post*
		Classify two-dimensional figures into categories based on their properties.	5.G.3	
			5.G.4	

✓ = Standards recommended for greater emphasis

Post = Standards recommended for instruction in May-June

Grade 6

Cluster Emphasis	Domain	Cluster	Standard	
Major Clusters	Ratios and Proportional Relationships	*Understand ratio concepts and use ratio reasoning to solve problems.*	6.RP.1	
			6.RP.2	
			6.RP.3	✓
	The Number System	*Apply and extend previous understandings of multiplication and division to divide fractions by fractions.*	6.NS.1	
		Apply and extend previous understandings of numbers to the system of rational numbers.	6.NS.5	
			6.NS.6	
			6.NS.7	
			6.NS.8	
	Expressions and Equations	*Apply and extend previous understandings of arithmetic to algebraic expressions.*	6.EE.1	
			6.EE.2	
			6.EE.3	
			6.EE.4	
		Reason about and solve one-variable equations and inequalities.	6.EE.5	
			6.EE.6	
			6.EE.7	✓
			6.EE.8	
		Represent and analyze quantitative relationships between dependent and independent variables.	6.EE.9	
Supporting Clusters	Measurement and Data	*Solve real-world and mathematical problems involving area, surface area, and volume.*	6.G.1	
			6.G.2	
			6.G.3	
			6.G.4	
Additional Clusters	The Number System	*Compute fluently with multi-digit numbers and find common factors and multiples.*	6.NS.2	
			6.NS.3	
			6.NS.4	
	Statistics and Probability	*Develop understanding of statistical variability.*	6.SP.1	✓ *Post*
			6.SP.2	*Post*
			6.SP.3	✓ *Post*
		Summarize and describe distributions.	6.SP.4	*Post*
			6.SP.5	*Post*

✓ = Standards recommended for greater emphasis

Post = Standards recommended for instruction in May-June

Grade 7

Cluster Emphasis	Domain	Cluster	Standard	
Major Clusters	Ratios and Proportional Relationships	*Analyze proportional relationships and use them to solve real-world and mathematical problems.*	7.RP.1	
			7.RP.2	✓
			7.RP.3	✓
	The Number System	*Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.*	7.NS.1	
			7.NS.2	
			7.NS.3	✓
	Expressions and Equations	*Use properties of operations to generate equivalent expressions.*	7.EE.1	✓
			7.EE.2	
		Solve real-life and mathematical problems using numerical and algebraic expressions and equations.	7.EE.3	✓
			7.EE.4a	✓
			7.EE.4b	
Supporting Clusters	Statistics and Probability	*Use random sampling to draw inferences about a population.*	7.SP.1	
			7.SP.2	
		Investigate chance processes and develop, use, and evaluate probability models.	7.SP.5	
			7.SP.6	
			7.SP.7	
			7.SP.8	
Additional Clusters	Geometry	*Draw, construct, and describe geometrical figures and describe the relationships between them.*	7.G.1	
			7.G.2	*Post*
			7.G.3	*Post*
		Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.	7.G.4	
			7.G.5	*Post*
			7.G.6	*Post*
	Statistics and Probability	*Draw informal comparative inferences about two populations.*	7.SP.3	
			7.SP.4	

✓ = Standards recommended for greater emphasis

Post = Standards recommended for instruction in May-June

Grade 8

Cluster Emphasis	Domain	Cluster	Standard		
Major Clusters	Expressions and Equations	*Work with radicals and integer exponents.*	8.EE.1		
			8.EE.2		*Post*
			8.EE.3		
			8.EE.4		
		Understand the connections between proportional relationships, lines, and linear equations.	8.EE.5	✓	
			8.EE.6		
		Analyze and solve linear equations and pairs of simultaneous linear equations.	8.EE.7		
			8.EE.8	✓	
	Functions	*Define, evaluate, and compare functions.*	8.F.1		
			8.F.2		
			8.F.3	✓	
		Use functions to model relationships between quantities.	8.F.4	✓	
			8.F.5		
	Geometry	*Understand and apply the Pythagorean Theorem.*	8.G.6	✓	*Post*
			8.G.7	✓	*Post*
			8.G.8	✓	*Post*
		Understand congruence and similarity using physical models, transparencies, or geometry software.	8.G.1		
			8.G.2		
			8.G.3		
			8.G.4		
			8.G.5		
Supporting Clusters	Number System	*Know that there are numbers that are not rational, and approximate them by rational numbers.*	8.NS.1		*Post*
			8.NS.2		*Post*
	Statistics and Probability	*Investigate patterns of association in bivariate data.*	8.SP.1		
			8.SP.2		
			8.SP.3		
			8.SP.4		
Additional Clusters	Geometry	*Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.*	8.G.9		

✓ = Standards recommended for greater emphasis

Post = Standards recommended for instruction in May-June

The 2018 Grades 3–8 Mathematics Tests

Testing Sessions

The 2018 Grades 3–8 Mathematics Tests consist of two sessions that are administered over two days. Students will be provided as much time as necessary to complete each test session. On average, students in Grade 3 will likely need approximately 55–65 minutes to complete Session 1 and 60–70 minutes to complete Session 2. Students in Grade 4 will likely need approximately 65–75 minutes to complete each of the two test sessions. Students in Grade 5 will likely need approximately 80–90 minutes to complete Session 1 and 70–80 minutes to complete Session 2. Students in Grades 6–8 will likely need approximately 80–90 minutes to complete Session 1 and 75–85 minutes to complete Session 2. For more information regarding what students may do once they have completed their work, please refer to the section "When Students Have Completed Their Tests."

The tests must be administered under standard conditions and the directions must be followed carefully. The same test administration procedures must be used with all students so that valid inferences can be drawn from the test results.

NYSED devotes great attention to the security and integrity of the NYSTP. School administrators and teachers involved in the administration of State assessments are responsible for understanding and adhering to the instructions set forth in the *School Administrator's Manual* and the *Teacher's Directions*. These resources will be found at the Office of State Assessment web site (http://www.p12.nysed.gov/assessment/ei/eigen.html).

When Students Have Completed Their Tests

Students who finish their assessment should be encouraged to go back and check their work. Once the student checks his or her work, or chooses not to, examination materials should be collected by the proctor. After a student's assessment materials are collected, or the student has submitted the test if testing on computer, that student may be permitted to read silently.* This privilege is granted at the discretion of each school. No talking is permitted and no other schoolwork is permitted.

Given that the spring 2018 tests have no time limits, schools and districts have the discretion to create their own approach to ensure that all students who are productively working are given the time they need within the confines of the regular school day to continue to take the tests. If the test is administered in a large-group setting, school administrators may prefer to allow students to hand in their test materials, or submit the test if testing on computer, as they finish and then leave the room. If so, take care that students leave the room as quietly as possible so as not to disturb the students who are still working on the test.

* For more detailed information about test administration, including proper procedures for talking to students during testing and handling reading materials, please refer to the *School Administrator's Manual* and the *Teacher's Directions.*

Test Design

In Grades 3–8, students are required to apply mathematical understandings and mathematical practices gained in the classroom in order to answer three types of questions: multiple-choice, short-response, and extended-response. Session 1 consists of multiple-choice questions. Session 2 consists of multiple choice, short-response, and extended-response questions. Students will NOT be permitted to use calculators in Grades 3–5. In Session 2 of Grade 6 students **must have the exclusive use of a four-function calculator with a square root key or a scientific calculator**. In Grades 7–8, students **must have the exclusive use of a scientific calculator**. For more information about calculator use, please refer to page 27.

The charts below provide a description of the 2018 Grades 3–8 Test Designs. **Note that the test designs have changed from 2017.** Embedded field test questions are included in the number of multiple-choice questions in Session 1 listed below. It will not be apparent to students whether a question is an embedded field test question that does not count toward their score or an operational test question that does count toward their score.

2018 Grade 3 Test Design

Session	Number of Multiple-Choice Questions	Number of Short-Response Questions	Number of Extended-Response Questions	Total Number of Questions
1	25	0	0	25
2	8	6	1	15
Total	33	6	1	40

2018 Grade 4 Test Design

Session	Number of Multiple-Choice Questions	Number of Short-Response Questions	Number of Extended-Response Questions	Total Number of Questions
1	30	0	0	30
2	8	6	1	15
Total	38	6	1	45

2018 Grade 5 Test Design

Session	Number of Multiple-Choice Questions	Number of Short-Response Questions	Number of Extended-Response Questions	Total Number of Questions
1	30	0	0	30
2	8	6	1	15
Total	38	6	1	45

2018 Grade 6 Test Design

Session	Number of Multiple-Choice Questions	Number of Short-Response Questions	Number of Extended-Response Questions	Total Number of Questions
1	31	0	0	31
2	7	7	1	15
Total	38	7	1	46

2018 Grade 7 Test Design

Session	Number of Multiple-Choice Questions	Number of Short-Response Questions	Number of Extended-Response Questions	Total Number of Questions
1	33	0	0	33
2	7	7	1	15
Total	40	7	1	48

2018 Grade 8 Test Design

Session	Number of Multiple-Choice Questions	Number of Short-Response Questions	Number of Extended-Response Questions	Total Number of Questions
1	33	0	0	33
2	7	7	1	15
Total	40	7	1	48

2018 Grades 3–8 Mathematics Tests Blueprint

All questions on the 2018 Grades 3–8 Mathematics Tests measure the Learning Standards for Mathematics. The tests were designed around the Content Emphases (page 9). As such, questions that assess the Major Clusters make up the majority of the test. Additionally, standards recommended for more emphasis within clusters (pages 11–16) are assessed with greater frequency.

While all questions are linked to a primary standard, some questions measure more than one standard and one or more of the Standards for Mathematical Practices. Similarly, some questions measure cluster-level understandings. As a result of the alignment to standards, clusters, and Standards for Mathematical Practice, the tests assess students' conceptual understanding, procedural fluency, and problem-solving abilities, rather than assessing their knowledge of isolated skills and facts.

The tables below illustrate the domain-level and cluster-level test blueprint for each grade. For more information on which clusters and standards to emphasize in instruction, please refer to pages 11–16.

Domain-Level Test Blueprint—Percent of Test Points on Grade 3 Test				
Number and Operations in Base Tens	Number and Operations—Fractions	Operations and Algebraic Thinking	Measurement and Data	Geometry
5–15%	15–25%	40–50%	15–25%	5–15%

Cluster-Emphasis Test Blueprint—Percent of Test Points on Grade 3 Test		
Major Clusters	Supporting Clusters	Additional Clusters
70–80%	10–20%	5–10%

Domain-Level Test Blueprint—Percent of Test Points on Grade 4 Test				
Number and Operations in Base Tens	Number and Operations—Fractions	Operations and Algebraic Thinking	Measurement and Data	Geometry
20–30%	20–30%	15–25%	15–25%	5–15%

Cluster-Emphasis Test Blueprint—Percent of Test Points on Grade 4 Test		
Major Clusters	Supporting Clusters	Additional Clusters
70–80%	10–20%	5–10%

Domain-Level Test Blueprint—Percent of Test Points on Grade 5 Test				
Number and Operations in Base Tens	Number and Operations—Fractions	Operations and Algebraic Thinking	Measurement and Data	Geometry
20–30%	30–40%	5–15%	20–30%	5–15%

Cluster-Emphasis Test Blueprint—Percent of Test Points on Grade 5 Test		
Major Clusters	Supporting Clusters	Additional Clusters
70–80%	10–20%	5–10%

Domain-Level Test Blueprint—Percent of Test Points on Grade 6 Test				
The Number Systems	Expressions and Equations	Ratios and Proportional Relationships	Geometry	Statistics and Probability
15–25%	35–45%	20–30%	10–20%	0%

Cluster-Emphasis Test Blueprint—Percent of Test Points on Grade 6 Test		
Major Clusters	Supporting Clusters	Additional Clusters
70–80%	10–20%	5–10%

Domain-Level Test Blueprint—Percent of Test Points on Grade 7 Test				
Ratios and Proportional Relationships	The Number System	Expressions and Equations	Geometry	Statistics and Probability
20–30%	15–25%	30–40%	5–15%	10–20%

Cluster-Emphasis Test Blueprint—Percent of Test Points on Grade 7 Test		
Major Clusters	Supporting Clusters	Additional Clusters
70–80%	10–20%	5–10%

Domain-Level Test Blueprint—Percent of Test Points on Grade 8 Test				
The Number Systems	Expressions and Equations	Functions	Geometry	Statistics and Probability
0%	40–45%	25–30%	20–25%	10–15%

Cluster-Emphasis Test Blueprint—Percent of Test Points on Grade 8 Test		
Major Clusters	Supporting Clusters	Additional Clusters
70–80%	10–20%	5–10%

Question Formats

The 2018 Grades 3–8 Mathematics Tests contain multiple-choice (1-point), short-response (2-point), and extended-response (3-point) questions. For multiple-choice questions, students select the correct response from four answer choices. For short- and extended-response questions, students write an answer to an open-ended question and may be required to show their work. In some cases, they may be required to explain, in words, how they arrived at their answers. Some test questions target more than one standard or assess an entire cluster. As such, many individual test questions assess September-to-April standards in conjunction with May–June standards from past grades.

Multiple-Choice Questions

Multiple-choice questions are designed to assess Learning Standards for Mathematics. Mathematics multiple-choice questions will mainly be used to assess standard algorithms and conceptual standards. Multiple-choice questions incorporate both Standards and Standards for Mathematical Practices, some in real-world applications. Many multiple-choice questions require students to complete multiple steps. Likewise, some of these questions are linked to more than one standard, drawing on the simultaneous application of multiple skills and concepts. Within answer choices, distractors[1] will all be based on plausible missteps.

Short-Response Questions

Short-response questions are similar to past 2-point questions, requiring students to complete a task and show their work. Like multiple-choice questions, short-response questions will often require multiple steps, the application of multiple mathematics skills, and real-world applications. Many of the short-response questions will cover conceptual and application standards.

Extended-Response Questions

Extended-response questions are similar to past 3-point questions, asking students to show their work in completing two or more tasks or a more extensive problem. Extended-response questions allow students to show their understanding of mathematical procedures, conceptual understanding, and application. Extended-response questions may also assess student reasoning and the ability to critique the arguments of others.

Released Assessment Resources

Released Questions for the Grades 3–8 Mathematics Tests are available on the EngageNY web site (https://www.engageny.org/ccss-library).

Math Item Review Criteria and Multiple Representations are available on the EngageNY web site (http://www.engageny.org/resource/common-core-assessment-design).

[1] A distractor is an incorrect response that may appear to be a plausible correct response to a student who has not mastered the skill or concept being assessed.

Mathematics Rubrics and Scoring Policies

The 2018 Grades 3–8 Mathematics Tests will use rubrics and scoring policies similar to those used in 2017. The Mathematics Rubrics are as follows:

2-Point Holistic Rubric

2 Points	A two-point response includes the correct solution to the question and demonstrates a thorough understanding of the mathematical concepts and/or procedures in the task. This response • indicates that the student has completed the task correctly, using mathematically sound procedures • contains sufficient work to demonstrate a thorough understanding of the mathematical concepts and/or procedures • may contain inconsequential errors that do not detract from the correct solution and the demonstration of a thorough understanding
1 Point	A one-point response demonstrates only a partial understanding of the mathematical concepts and/or procedures in the task. This response • correctly addresses only some elements of the task • may contain an incorrect solution but applies a mathematically appropriate process • may contain the correct solution but required work is incomplete
0 Points*	A zero-point response is incorrect, irrelevant, incoherent, or contains a correct solution obtained using an obviously incorrect procedure. Although some elements may contain correct mathematical procedures, holistically they are not sufficient to demonstrate even a limited understanding of the mathematical concepts embodied in the task.

* Condition Code A is applied whenever a student who is present for a test session leaves an entire constructed-response question in that session completely blank (no response attempted).

3-Point Holistic Rubric

3 Points	A three-point response includes the correct solution(s) to the question and demonstrates a thorough understanding of the mathematical concepts and/or procedures in the task. This response • indicates that the student has completed the task correctly, using mathematically sound procedures • contains sufficient work to demonstrate a thorough understanding of the mathematical concepts and/or procedures • may contain inconsequential errors that do not detract from the correct solution(s) and the demonstration of a thorough understanding
2 Points	A two-point response demonstrates a partial understanding of the mathematical concepts and/or procedures in the task. This response • appropriately addresses most but not all aspects of the task using mathematically sound procedures • may contain an incorrect solution but provides sound procedures, reasoning, and/or explanations • may reflect some minor misunderstanding of the underlying mathematical concepts and/or procedures
1 Point	A one-point response demonstrates only a limited understanding of the mathematical concepts and/or procedures in the task. This response • may address some elements of the task correctly but reaches an inadequate solution and/or provides reasoning that is faulty or incomplete • exhibits multiple flaws related to misunderstanding of important aspects of the task, misuse of mathematical procedures, or faulty mathematical reasoning • reflects a lack of essential understanding of the underlying mathematical concepts • may contain the correct solution(s) but required work is limited
0 Points*	A zero-point response is incorrect, irrelevant, incoherent, or contains a correct solution obtained using an obviously incorrect procedure. Although some elements may contain correct mathematical procedures, holistically they are not sufficient to demonstrate even a limited understanding of the mathematical concepts embodied in the task.

* Condition Code A is applied whenever a student who is present for a test session leaves an entire constructed-response question in that session completely blank (no response attempted).

2018 2- and 3-Point Mathematics Scoring Policies

Below are the policies to be followed while scoring the mathematics tests for all grades:

1. If a student shows the work in other than a designated "Show your work" or "Explain" area, that work should still be scored.
2. If the question requires students to show their work, and the student shows appropriate work and clearly identifies a correct answer but fails to write that answer in the answer space, the student should still receive full credit.
3. If students are directed to show work, a correct answer with **no** work shown receives **no** credit.
4. If students are **not** directed to show work, any work shown will **not** be scored. This applies to items that do **not** ask for any work and items that ask for work for one part and do **not** ask for work in another part.
5. If the student provides one legible response (and one response only), the rater should score the response, even if it has been crossed out.
6. If the student has written more than one response but has crossed some out, the rater should score only the response that has **not** been crossed out.
7. If the student provides more than one response, but does not indicate which response is to be considered the correct response and none has been crossed out, the student shall not receive full credit.
8. If the student makes a conceptual error (that is an error in understanding rather than an arithmetic or computational error), that student shall not receive more than 50% credit.
9. Trial-and-error responses are **not** subject to Scoring Policy #6 above, since crossing out is part of the trial-and-error process.
10. If a response shows repeated occurrences of the same conceptual error within a question, the conceptual error should **not** be considered more than once in gauging the demonstrated level of understanding.
11. In questions requiring number sentences, the number sentences must be written horizontally.
12. When measuring angles with a protractor, there is a +/- 5 degrees deviation allowed of the true measure.
13. Condition Code A is applied whenever a student who is present for a test session leaves an entire constructed-response question in that session completely blank (no response attempted). This is not to be confused with a score of zero wherein the student does respond to part or all of the question but that work results in a score of zero.

Mathematics Tools

Why Mathematics Tools?

These provisions are necessary for students to meet Standard for Mathematical Practice Five found throughout the New York State P–12 Learning Standards for Mathematics:

> **Use appropriate tools strategically**
>
> *Mathematically proficient students consider the available tools when solving a mathematical problem. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a web site, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.*

It is up to the student to decide when it will be helpful to use the mathematics tools to answer a question.

Rulers and Protractors

Students in Grade 3 must have a ruler for their exclusive use for both sessions of the test. Students in Grades 4–8 must have a ruler and a protractor for their exclusive use for all sessions of the test. Students with disabilities may use adapted rulers and protractors if this is indicated as a testing accommodation on the student's Individualized Education Program or Section 504 Accommodation Plan.

Note: Schools are responsible for supplying the appropriate tools for use with the Grades 3–8 Mathematics Test when testing with printed test booklets. A ruler tool and a protractor tool are provided to the student as part of the computer testing delivery system, Nextera.

Calculators

Students in Grades 3–5 are **NOT** permitted to use calculators on the 2018 Mathematics Tests.

Students in Grade 6 are **NOT** permitted to use a calculator with Session 1. For Session 2, students should have exclusive **use of a four-function calculator with a square root key or a scientific calculator**. Graphing calculators are **NOT** permitted.

Students in Grades 7–8 should have exclusive **use of a scientific calculator** for both Session 1 and Session 2. Graphing calculators are **NOT** permitted.

For students testing on computers in Grades 6–8, a calculator is provided as part of the computer testing delivery system, but schools should continue to supply students with exclusive use of the type of hand-held calculator the students use for everyday mathematics instruction.

Value of Pi

Students should learn that π is an irrational number. For the short-response and extended-response questions in Grades 7–8 (Session 2), the π key and the full display of the calculator should be used in computations. The approximate values of π, such as 3.1416, 3.14, or $\frac{22}{7}$, are unacceptable.

Reference Sheets

Each student testing in Grades 5–8 will be provided with a mathematics reference sheet for his or her exclusive use during both Session 1 and Session 2.

Grade 5 Mathematics Reference Sheet

CONVERSIONS

1 mile = 5,280 feet
1 mile = 1,760 yards

1 pound = 16 ounces
1 ton = 2,000 pounds

1 cup = 8 fluid ounces
1 pint = 2 cups
1 quart = 2 pints
1 gallon = 4 quarts
1 liter = 1,000 cubic centimeters

FORMULAS

Right Rectangular Prism $V = Bh$ or $V = lwh$

Grade 6 Mathematics Reference Sheet

CONVERSIONS

1 inch = 2.54 centimeters
1 meter = 39.37 inches
1 mile = 5,280 feet
1 mile = 1,760 yards
1 mile = 1.609 kilometers

1 kilometer = 0.62 mile
1 pound = 16 ounces
1 pound = 0.454 kilogram
1 kilogram = 2.2 pounds
1 ton = 2,000 pounds

1 cup = 8 fluid ounces
1 pint = 2 cups
1 quart = 2 pints
1 gallon = 4 quarts
1 gallon = 3.785 liters
1 liter = 0.264 gallon
1 liter = 1,000 cubic centimeters

FORMULAS

Triangle	$A = \frac{1}{2}bh$
Right Rectangular Prism	$V = Bh$ or $V = lwh$

Grade 7 Mathematics Reference Sheet

CONVERSIONS

1 inch = 2.54 centimeters
1 meter = 39.37 inches
1 mile = 5,280 feet
1 mile = 1,760 yards
1 mile = 1.609 kilometers

1 kilometer = 0.62 mile
1 pound = 16 ounces
1 pound = 0.454 kilogram
1 kilogram = 2.2 pounds
1 ton = 2,000 pounds

1 cup = 8 fluid ounces
1 pint = 2 cups
1 quart = 2 pints
1 gallon = 4 quarts
1 gallon = 3.785 liters
1 liter = 0.264 gallon
1 liter = 1,000 cubic centimeters

FORMULAS

Triangle	$A = \frac{1}{2}bh$
Parallelogram	$A = bh$
Circle	$A = \pi r^2$
Circle	$C = \pi d$ or $C = 2\pi r$
General Prisms	$V = Bh$

Grade 8 Mathematics Reference Sheet

CONVERSIONS

1 inch = 2.54 centimeters
1 meter = 39.37 inches
1 mile = 5,280 feet
1 mile = 1,760 yards
1 mile = 1.609 kilometers

1 kilometer = 0.62 mile
1 pound = 16 ounces
1 pound = 0.454 kilogram
1 kilogram = 2.2 pounds
1 ton = 2,000 pounds

1 cup = 8 fluid ounces
1 pint = 2 cups
1 quart = 2 pints
1 gallon = 4 quarts
1 gallon = 3.785 liters
1 liter = 0.264 gallon
1 liter = 1,000 cubic centimeters

FORMULAS

Triangle	$A = \frac{1}{2}bh$
Parallelogram	$A = bh$
Circle	$A = \pi r^2$
Circle	$C = \pi d$ or $C = 2\pi r$
General Prisms	$V = Bh$
Cylinder	$V = \pi r^2 h$
Sphere	$V = \frac{4}{3}\pi r^3$
Cone	$V = \frac{1}{3}\pi r^2 h$
Pythagorean Theorem	$a^2 + b^2 = c^2$