TEST SPECIFICATIONS: SAT MATH TEST

A Transparent Blueprint

This section describes the content, format, and distinctive new features of the Math Test in the redesigned SAT, as well as the skills it measures. This section also includes annotated sample questions that help illustrate central aspects of the test.

OVERALL CLAIM FOR THE TEST

The redesigned SAT's Math Test is intended to collect evidence in support of the following claim about student performance:

Students have fluency with, understanding of, and the ability to apply the mathematical concepts, skills, and practices that are most strongly prerequisite and central to their ability to progress through a range of college courses, career training, and career opportunities.

TEST DESCRIPTION

In keeping with the evidence about essential requirements for college and career readiness described in Section II, the redesigned SAT will require a stronger command of fewer, more important topics. To succeed on the redesigned SAT, students will need to exhibit mathematical practices, such as problem solving and using appropriate tools strategically. The SAT will also provide opportunities for richer applied problems.

The redesigned SAT's Math Test has four content areas:

- Heart of Algebra
- Problem Solving and Data Analysis
- Passport to Advanced Math

» Additional Topics in Math

Questions in each content area span the full range of difficulty and address relevant practices, fluency, and conceptual understanding.

Test Summary

The following table summarizes the key content dimensions of the redesigned SAT's Math Test.

SAT MATH TEST CONTENT SPECIFICATIONS		
Time Allotted	80 minutes	
Calculator Portion (38 questions)	55 minutes	
No-Calculator Portion (20 questions)	25 minutes	
	NUMBER	**PERCENTAGE OF TEST**
Total Items	58 questions	100%
Multiple Choice (MC, 4 options)	45 questions	78%
Student-Produced Response (SPR — grid-in)	13 questions	22%
Contribution of Items to Subscores		
Heart of Algebra	19 questions	33%
Analyzing and fluently solving equations and systems of equations		
Creating expressions, equations, and inequalities to represent relationships between quantities and to solve problems		
Rearranging and interpreting formulas		
Problem Solving and Data Analysis	17 questions	29%
Creating and analyzing relationships using ratios, proportions, percentages, and units		
Describing relationships shown graphically		
Summarizing qualitative and quantitative data		
Passport to Advanced Math	16 questions	28%
Rewriting expressions using their structure		
Creating, analyzing, and fluently solving quadratic and higher-order equations		

SAT MATH TEST CONTENT SPECIFICATIONS		
Manipulating polynomials purposefully to solve problems		
Additional Topics in Math*	6 questions	10%
Making area and volume calculations in context		
Investigating lines, angles, triangles, and circles using theorems		
Working with trigonometric functions		
Contribution of Items to Cross-Test Scores		
Analysis in Science	8 questions	14%
Analysis in History/Social Studies	8 questions	14%

*Questions under Additional Topics in Math contribute to the total Math Test score but do not contribute to a subscore within the Math Test.

The test covers all mathematical practices, with an emphasis on problem solving, modeling, using appropriate tools strategically, and looking for and making use of structure to do algebra. The practices emphasized in the redesigned SAT are central to the demands of postsecondary work. Problem solving requires students to make sense of problems and persevere to solve them, a skill highly rated by postsecondary instructors (Conley et al., *Reaching the Goal*, 2011). Modeling stresses applications characteristic of the entire postsecondary curriculum. Students will be asked throughout high school, college, and careers to make choices about which tools to use in solving problems. Finally, structure is fundamental to algebra and to other more advanced mathematics.

As indicated in the test specifications above, the Math Test has two portions. One is a 55-minute portion comprising 38 questions for which students are allowed to use calculators to solve the problems. The other is a 25-minute portion comprising 20 questions for which students are not allowed to use calculators to solve the problems. The blueprint for each of these portions is shown below.

CALCULATOR PORTION

	Number of Questions	% of Test
Total Questions	**38**	**100%**
Multiple Choice (MC)	30	79%
Student-Produced Response (SPR — grid-in)	8	21%
Content Categories	**38**	**100%**
Heart of Algebra	11	29%
Problem Solving and Data Analysis	17	45%
Passport to Advanced Math	7	18%
Additional Topics in Math	3	8%
Time Allocated	55 minutes	

NO-CALCULATOR PORTION

	Number of Questions	% of Test
Total Questions	**20**	**100%**
Multiple Choice (MC)	15	75%
Student-Produced Response (SPR — grid-in)	5	25%
Content Categories	**20**	**100%**
Heart of Algebra	8	40%
Passport to Advanced Math	9	45%
Additional Topics in Math	3	15%
Time Allocated	25 minutes	

HEART OF ALGEBRA: LINEAR EQUATIONS AND FUNCTIONS

SAT HEART OF ALGEBRA DOMAIN	
Content Dimension	**Description**
Application	
1. Create, solve, or interpret linear equations in one variable.	The student will create, solve, or interpret a linear expression or equation in one variable that represents a context. The expression or equation will have rational coefficients, and multiple steps may be required to simplify the expression, simplify the equation, or solve for the variable in the equation.
2. Create, solve, or interpret linear inequalities in one variable.	The student will create, solve, or interpret a linear inequality in one variable that represents a context. The inequality will have rational coefficients, and multiple steps may be required to simplify or solve for the variable.
3. Build a linear function that models a linear relationship between two quantities.	The student will describe a linear relationship that models a context using either an equation in two variables or function notation. The equation or function will have rational coefficients, and multiple steps may be required to build and simplify the equation or function.
4. Create, solve, and interpret systems of linear inequalities in two variables.	The student will analyze one or more constraints that exist between two variables by creating, solving, or interpreting an inequality in two variables or a system of inequalities in two variables to represent a context. Multiple steps may be required to create the inequality or system of inequalities or to determine whether a given point is in the solution set.
5. Create, solve, and interpret systems of two linear equations in two variables.	The student will analyze one or more constraints that exist between two variables by creating, solving, or analyzing a system of linear equations to represent a context. The equations will have rational coefficients, and multiple steps may be required to simplify or solve the system.
Fluency	
6. Solve linear equations in one variable.	The student will algebraically solve an equation (or inequality) in one variable. The equation (or inequality) will have rational coefficients and may require multiple steps to solve for the variable; the equation may yield no solution, one solution, or infinitely many solutions. The student may also be asked to determine the value of a constant or coefficient for an equation with no solution or infinitely many solutions.
7. Solve systems of two linear equations in two variables.	The student will algebraically solve a system of two linear equations in two variables. The equations will have rational coefficients, and the system may yield no solution, one solution, or infinitely many solutions. The student may also be asked to determine the value of a constant or coefficient of an equation in which the system has no solution, one solution, or infinitely many solutions.
Conceptual Understanding	
8. Interpret the variables and constants in expressions for linear functions within the context presented.	The student will make connections between a context and the linear equation that models the context and will identify or describe the real-life meaning of a constant term, a variable, or a feature of the given equation.

SAT HEART OF ALGEBRA DOMAIN	
Content Dimension	**Description**
9. Understand connections between algebraic and graphical representations.	The student will select a graph described by a given linear equation, select a linear equation that describes a given graph, determine the equation of a line given a verbal description of its graph, determine key features of the graph of a linear function from its equation, or determine how a graph may be impacted by a change in its equation.

Algebra is the language of much of high school mathematics, and it is also an important prerequisite for advanced mathematics and postsecondary education in many subjects. The redesigned SAT focuses strongly on algebra and recognizes in particular the essentials of the subject that are most essential for success in college and careers. Heart of Algebra will assess students' ability to analyze, fluently solve, and create linear equations and inequalities. Students will also be expected to analyze and fluently solve equations and systems of equations using multiple techniques.

To assess full command of the material, these problems will vary significantly in form and appearance. Problems may be straightforward fluency exercises or may pose challenges of strategy or understanding, such as interpreting the interplay between graphical and algebraic representations or solving as a process of reasoning. Students will be required to demonstrate both procedural skill and a deeper understanding of the concepts that undergird linear equations and functions to successfully exhibit a command of the Heart of Algebra.

Mastering linear equations and functions has clear benefits to students. The ability to use linear equations to model scenarios and to represent unknown quantities is powerful across the curriculum in the postsecondary classroom as well as in the workplace. Further, linear equations and functions remain the bedrock upon which much of advanced mathematics is built. Consider, for example, that derivatives in calculus are used to approximate curves by straight lines and to approximate nonlinear functions by linear ones. Without a strong foundation in the core of algebra, much of this advanced work remains inaccessible.

PROBLEM SOLVING AND DATA ANALYSIS: PROPORTIONAL RELATIONSHIPS, PERCENTAGES, COMPLEX MEASUREMENTS, AND DATA INTERPRETATION AND SYNTHESIS

SAT PROBLEM SOLVING AND DATA ANALYSIS DOMAIN	
Content Dimension	**Description**
Application	
1. Use ratios, rates, proportional relationships, and scale drawings to solve single- and multistep problems.	The student will use a proportional relationship between two variables to solve a multistep problem to determine a ratio or rate; calculate a ratio or rate and then solve a multistep problem; take a given ratio or rate and solve a multistep problem.
2. Solve single- and multistep problems involving percentages.	The student will solve a multistep problem to determine a percentage; calculate a percentage and then solve a multistep problem; take a given percentage and solve a multistep problem.
3. Solve single- and multistep problems involving measurement quantities, units, and unit conversion.	The student will solve a multistep problem to determine a unit rate; calculate a unit rate and then solve a multistep problem; solve a multistep problem to complete a unit conversion; solve a multistep problem to calculate density; use the concept of density to solve a multistep problem.
4. Given a scatterplot, use linear, quadratic, or exponential models to describe how the variables are related.	The student will, given a scatterplot, select the equation of a line or curve of best fit; interpret the line in the context of the situation; use the line or curve of best fit to make a prediction.
5. Use the relationship between two variables to investigate key features of the graph.	The student will make connections between the graphical representation of a relationship and properties of the graph by selecting the graph that represents the properties described; using the graph to identify a value or set of values.
6. Compare linear growth with exponential growth.	The student will infer the connection between two variables given a context in order to determine what type of model fits best.
7. Use two-way tables to summarize categorical data and relative frequencies, and calculate conditional probability.	The student will summarize categorical data or use categorical data to calculate conditional frequencies; conditional probabilities; association of variables; independence of events.
8. Make inferences about population parameters based on sample data.	The student will estimate a population parameter given the results from a random sample of the population. The sample statistics may mention confidence intervals and measurement error that the student should understand and make use of, but need not calculate.
9. Use statistics to investigate measures of center of data and analyze shape, center, and spread.	The student will calculate measures of center and/or spread for a given set of data or use given statistics to compare two separate sets of data. The measures of center that may be calculated include mean, median, and mode, and the measures of spread that may be calculated include range. When comparing two data sets, the student may investigate mean, median, mode, range, and/or standard deviation.
10. Evaluate reports to make inferences, justify conclusions, and determine appropriateness of data collection methods.	The student will evaluate reports to make inferences, justify conclusions, and determine appropriateness of data collection methods. The reports may consist of tables, graphs, and text summaries.

The redesigned SAT's Math Test has responded to the research evidence identifying what is essential for college readiness and success by focusing significantly on problem solving and data analysis: the ability to create a representation of a problem, consider the units involved, attend to the meaning of quantities, and know and use different properties of operations and objects. Problems in this category will require significant quantitative reasoning about ratios, rates, and proportional relationships and will place a premium on understanding and applying unit rate.

Interpreting and synthesizing data are widely applicable skills in postsecondary education and careers. In the redesigned SAT's Math Test, students will be expected to identify quantitative measures of center, the overall pattern, and any striking deviations from the overall pattern and spread in one or two different data sets. This includes recognizing the effects of outliers on the measures of center of a data set. In keeping with the need to stress widely applicable prerequisites, the redesigned SAT emphasizes applying core concepts and methods of statistics, rather than covering broadly a vast range of statistical techniques.

Finally, the redesigned SAT's Math Test emphasizes students' ability to apply math to solve problems in rich and varied contexts and features problems that require the application of problem solving and data analysis to solve problems in science, social studies, and career-related contexts.

PASSPORT TO ADVANCED MATH: ANALYZING ADVANCED EXPRESSIONS

SAT PASSPORT TO ADVANCED MATH DOMAIN	
Content Dimension	**Description**
Application	
1. Create quadratic or exponential functions.	The student will create a quadratic or exponential function or equation that models a context. The equation will have rational coefficients and may require multiple steps to simplify or solve the equation.
2. Choose and produce equivalent forms of expressions to reveal and explain properties of a quantity.	The student will, given a context, determine the most suitable form of an expression or equation to reveal a particular trait.
Procedural Skill and Fluency	
3. Create equivalent expressions involving radicals and rational exponents.	The student will create equivalent expressions involving rational exponents and radicals, including simplifying or rewriting in other forms.
4. Create equivalent forms of expressions by using structure.	The student will create an equivalent form of an algebraic expression by using structure and fluency with operations.
5. Solve quadratic equations.	The student will solve a quadratic equation having rational coefficients. The equation can be presented in a wide range of forms to reward attending to algebraic structure and can require manipulation in order to solve.
6. Perform arithmetic operations on polynomials.	The student will add, subtract, and multiply polynomial expressions and simplify the result. The expressions will have rational coefficients.
7. Solve radical and rational equations in one variable, including examples where there are extraneous solutions.	The student will solve an equation in one variable that contains radicals or contains the variable in the denominator of a fraction. The equation will have rational coefficients, and the student may be required to identify when a resulting solution is extraneous.
8. Solve a system of equations consisting of one linear and one quadratic equation in two variables.	The student will solve a system of one linear equation and one quadratic equation. The equations will have rational coefficients.
9. Rewrite simple rational expressions.	The student will add, subtract, multiply, or divide two rational expressions or divide two polynomial expressions and simplify the result. The expressions will have rational coefficients.
Conceptual Understanding	
10. Interpret parts of nonlinear expressions in terms of their context.	The student will make connections between a context and the nonlinear equation that models the context to identify or describe the real-life meaning of a constant term, a variable, or a feature of the given equation.
11. Understand the relationship between zeros and factors of polynomials; use it to sketch graphs.	The student will use properties of factorable polynomials to solve conceptual problems relating to zeros, such as determining whether an expression is a factor of a polynomial based on other information provided.

SAT PASSPORT TO ADVANCED MATH DOMAIN	
Content Dimension	**Description**
12. Understand a nonlinear relationship between two variables by making connections between their algebraic and graphical representations.	The student will select a graph corresponding to a given nonlinear equation, interpret graphs in the context of solving systems of equations, select a nonlinear equation corresponding to a given graph, determine the equation of a curve given a verbal description of a graph, determine key features of the graph of a linear function from its equation, or determine the impact to a graph of a change in the defining equ tion.
13. Use function notation, and interpret statements using function notation.	The student will use function notation to solve conceptual problems related to transformations and compositions of functions.
14. Use structure to isolate or identify a quantity of interest in an expression or isolate a quantity of interest in an equation.	The student will rearrange an equation or formula to isolate a single variable or a quantity of interest.

As a test that provides an entry point to postsecondary education and careers, the redesigned SAT's Math Test will include topics that are central to the ability of students to progress to later, more advanced mathematics. Problems in Passport to Advanced Math will cover topics that have great relevance and utility for college and career work.

Chief among these topics is the understanding of the structure of expressions and the ability to analyze, manipulate, and rewrite these expressions. This includes an understanding of the key parts of expressions, such as terms, factors, and coefficients, and the ability to interpret complicated expressions made up of these components. Students will be able to show their skill in rewriting expressions, identifying equivalent forms of expressions, and understanding the purpose of different forms.

This category also includes reasoning with more complex equations, including solving quadratic and higher-order equations in one variable and understanding the graphs of quadratic and higher-order functions. Finally, this category includes the ability to interpret and build functions, another skill crucial for success in later mathematics and scientific fields.

ADDITIONAL TOPICS IN MATH

SAT ADDITIONAL TOPICS IN MATH DOMAIN	
Content Dimension	**Description**
Application	
1. Solve problems using volume formulas.	The student will use given information about figures, such as length of a side, area of a face, or volume of a solid, to calculate missing information. Any required volume formulas will be provided to students either on the formula sheet or within the question.
2. Use trigonometric ratios and the Pythagorean Theorem to solve applied problems involving right triangles.	The student will use information about triangle side lengths or angles presented in a context to calculate missing information using the Pythagorean theorem and/or trigonometric ratios.
Procedural Skill and Fluency	
3. Perform arithmetic operations on complex numbers.	The student will add, subtract, multiply, divide, and simplify complex numbers.
4. Convert between degrees and radians and use radians to determine arc lengths; use trigonometric functions of radian measure.	The student will convert between angle measures in degrees and radians in order to calculate arc lengths by recognizing the relationship between an angle measured in radians and an arc length, evaluating trigonometric functions of angles in radians.
5. Apply theorems about circles to find arc lengths, angle measures, chord lengths, and areas of sectors.	The student will use given information about circles and lines to calculate missing values for radius, diameter, chord length, angle, arc, and sector area.
Conceptual Understanding	
6. Use concepts and theorems about congruence and similarity to solve problems about lines, angles, and triangles.	The student will use theorems about triangles and intersecting lines to determine missing lengths and angle measures of triangles. The student may also be asked to provide a missing length or angle to satisfy a given theorem.
7. Use the relationship between similarity, right triangles, and trigonometric ratios; use the relationship between sine and cosine of complementary angles.	The student will use trigonometry and theorems about triangles and intersecting lines to determine missing lengths and angle measures of right triangles. The student may also be asked to provide a missing length or angle that would satisfy a given theorem.
8. Create or use an equation in two variables to solve a problem about a circle in the coordinate plane.	The student will create an equation or use properties of an equation of a circle to demonstrate or determine a property of the circle's graph.

While the overwhelming majority of problems on the redesigned SAT's Math Test fall into the first three domains, the test also addresses additional topics in high school math. In keeping with the approach described in Section II, patterns of selection for these are governed by evidence about their relevance to postsecondary education and work. The additional topics include essential geometric and trigonometric concepts and the Pythagorean Theorem, which become powerful methods of analysis and problem solving when connected to other math domains.