

## **Essential Mathematics Skills Needed for Entry-Level College Courses**

**State education needs your help.** We would like your opinion about the essential mathematics skills our high school graduates need in order to enter into credit-bearing, general education college coursework without need for remediation. Data from this survey are being used to help align K-12 expectations with those of postsecondary to ensure that the State's high school graduates are prepared.

This survey contains a list of skills that have been identified nationally as potentially important to prepare our high school graduates to enter college. We would appreciate your help in identifying entry-level skills that are essential for specific college classes taken by most entering freshmen.

### **To complete the survey:**

1. Please identify the specific entry-level college course for which you are providing essential skills in Mathematics. Please include course number. e.g. *College Algebra III*. (We are looking for courses in which most first-time freshmen enroll to complete their general education core requirements.)
2. Complete the survey by rating each skill along the range of "not essential" (1) to "very essential" (10) for the entry-level course. Please complete all items, but pay special attention to those marked with an asterisk. These have been identified as potential gaps or areas that may be strengthened in our current standards, and we need your input regarding how important they are for college-readiness. We also need to know if there are some skills that are not critical for your courses, so that we can consider de-emphasizing these in favor of other, more critical ones.
3. Please provide comments or add other essential skills that should be considered.
4. Provide your contact information so that we might follow up should we have questions about any of the information submitted. *Please note that the information you submit will be strictly confidential and survey data will only be presented in summary form.*

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My ratings indicate the essential mathematics skills needed for success in the following:  
Entry-level math course for regular general education program – course title/number:

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### **Please submit survey with this coversheet by March 20 to:**

Special Assistant  
Office of the Secretary of Education  
P.O. Box 1475, Richmond, VA 23218  
Telephone: (804) 692-2550 / Fax: (804) 371-0154

Contact (name, email): \_\_\_\_\_

**Postsecondary Institution:** \_\_\_\_\_

*Thank-you for completing this survey!*

# Essential Entry-Level Skills - Mathematics

1 = not essential    10 = most essential

	Ranking
<b>Number Sense and Numerical Operations</b>	
1. Compute with rational numbers fluently and accurately without a calculator	1 2 3 4 5 6 7 8 9 10
2. Recognize and apply magnitude (absolute value) and ordering of real numbers*	1 2 3 4 5 6 7 8 9 10
3. Understand that to solve certain problems and equations, number systems need to be extended from whole numbers to the set of all integers (positive, negative and zero), from integers to rational numbers, from rational numbers to real numbers (rational and irrational numbers) and from real numbers to complex numbers; define and give examples of each of these types of numbers.	1 2 3 4 5 6 7 8 9 10
4. Understand the capabilities and the limitations of calculators and computers in solving problems.	1 2 3 4 5 6 7 8 9 10
<b>Algebra</b>	
1. Perform basic operations on algebraic expressions fluently and accurately.	1 2 3 4 5 6 7 8 9 10
2. Add, subtract and multiply polynomials; divide a polynomial by a low-degree polynomial.	1 2 3 4 5 6 7 8 9 10
3. Factor polynomials by removing the greatest common factor; factor quadratic polynomials.	1 2 3 4 5 6 7 8 9 10
4. Add, subtract, multiply, divide and simplify rational expressions.	1 2 3 4 5 6 7 8 9 10
5. Evaluate polynomial and rational expressions and expressions containing radicals and absolute values at specified values of their variables.	1 2 3 4 5 6 7 8 9 10
6. Understand functions, their representations and their properties.	1 2 3 4 5 6 7 8 9 10
7. Understand functional notation and evaluate a function at a specified point in its domain.	1 2 3 4 5 6 7 8 9 10
8. Apply basic algebraic operations to solve equations and inequalities.	1 2 3 4 5 6 7 8 9 10
9. Solve quadratic equations in one variable.	1 2 3 4 5 6 7 8 9 10
10. Graph a variety of equations and inequalities in two variables, demonstrate understanding of the relationships between the algebraic properties of an equation and the geometric properties of its graph, and interpret a graph.	1 2 3 4 5 6 7 8 9 10
11. Graph exponential functions and identify their key characteristics.	1 2 3 4 5 6 7 8 9 10
12. Solve problems by converting the verbal information given into an appropriate mathematical model involving equations or systems of equations; apply appropriate mathematical techniques to analyze these mathematical models; and interpret the solution obtained in written form using appropriate units of measurement.*	1 2 3 4 5 6 7 8 9 10
13. Recognize and solve problems that can be modeled using a system of two equations in two variables, such as mixture problems.*	1 2 3 4 5 6 7 8 9 10
14. Recognize and solve problems that can be modeled using a finite geometric series, such as home mortgage problems and other compound interest problems.*	1 2 3 4 5 6 7 8 9 10
15. Understand the binomial theorem and its connections to combinatorics, Pascal's triangle and probability.	1 2 3 4 5 6 7 8 9 10

# Essential Entry-Level Skills - Mathematics

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	Ranking
<b>Geometry</b>	
1. Understand the different roles played by axioms, definitions and theorems in the logical structure of mathematics, especially in geometry.*	1 2 3 4 5 6 7 8 9 10
2. Identify, explain the necessity of and give examples of definitions, axioms and theorems.*	1 2 3 4 5 6 7 8 9 10
3. State and prove key basic theorems in geometry such as the Pythagorean theorem, the sum of the angles of a triangle is 180 degrees, and the line joining the midpoints of two sides of a triangle is parallel to the third side and half its length.*	1 2 3 4 5 6 7 8 9 10
4. Recognize that there are geometries, other than Euclidean geometry, in which the parallel postulate is not true.*	1 2 3 4 5 6 7 8 9 10
5. Identify and apply the definitions related to lines and angles and use them to prove theorems in (Euclidean) geometry, solve problems, and perform basic geometric constructions using a straight edge and compass.	1 2 3 4 5 6 7 8 9 10
6. Know the basic theorems about congruent and similar triangles and use them to prove additional theorems and solve problems.	1 2 3 4 5 6 7 8 9 10
7. Know the definitions and basic properties of a circle and use them to prove basic theorems and solve problems.*	1 2 3 4 5 6 7 8 9 10
8. Apply the Pythagorean theorem, its converse and properties of special right triangles to solve problems.	1 2 3 4 5 6 7 8 9 10
9. Use rigid motions (compositions of reflections, translations and rotations) to determine whether two geometric figures are congruent and to create and analyze geometric designs.*	1 2 3 4 5 6 7 8 9 10
10. Know about the similarity of figures and use the scale factor to solve problems.	1 2 3 4 5 6 7 8 9 10
11. Know that geometric measurements (length, area, perimeter, volume) depend on the choice of a unit and that measurements made on physical objects are approximations; calculate the measurements of common plane and solid geometric figures.	1 2 3 4 5 6 7 8 9 10
12. Visualize solids and surfaces in three-dimensional space when given two-dimensional representations (e.g., nets, multiple views) and create two-dimensional representations for the surfaces of three-dimensional objects.	1 2 3 4 5 6 7 8 9 10
13. Represent geometric objects and figures algebraically using coordinates; use algebra to solve geometric problems.	1 2 3 4 5 6 7 8 9 10
14. Describe a line by a linear equation.	1 2 3 4 5 6 7 8 9 10
15. Find the distance between two points using their coordinates and the Pythagorean theorem.	1 2 3 4 5 6 7 8 9 10
16. Understand basic right-triangle trigonometry and apply it to solve problems.	1 2 3 4 5 6 7 8 9 10
17. Use the standard formula for the area of a triangle, $A = 1/2 bh$ , to explain the area formula, $A = 1/2 ab \sin C$ where $a$ and $b$ are the lengths of two sides of a triangle and $C$ is the measure of the included angle formed by these two sides, and use it to find the area of a triangle when given the lengths of two of its sides and the included angle.*	1 2 3 4 5 6 7 8 9 10
18. Derive basic formulas involving these functions, and use these functions and formulas to solve problems.	1 2 3 4 5 6 7 8 9 10

# Essential Entry-Level Skills - Mathematics

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	Rating
<b>Data Interpretation, Statistics and Probability</b>	
1. Explain and apply quantitative information.*	1 2 3 4 5 6 7 8 9 10
2. Explain and critique alternative ways of presenting and using information.	1 2 3 4 5 6 7 8 9 10
3. Evaluate reports based on data published in the media by considering the source of the data, the design of the study, and the way the data are analyzed and displayed.*	1 2 3 4 5 6 7 8 9 10
4. Recognize when arguments based on data confuse correlation with causation.*	1 2 3 4 5 6 7 8 9 10
5. Explain the use of data and statistical thinking to draw inferences, make predictions and justify conclusions.*	1 2 3 4 5 6 7 8 9 10
6. Explain the differences between randomized experiments and observational studies.*	1 2 3 4 5 6 7 8 9 10
7. Explain and apply probability concepts and calculate simple probabilities.*	1 2 3 4 5 6 7 8 9 10
8. Explain how the law of large numbers can be applied in simple examples.*	1 2 3 4 5 6 7 8 9 10

<b>Mathematical Reasoning</b>	
1. Use inductive and deductive reasoning to arrive at valid conclusions.*	1 2 3 4 5 6 7 8 9 10
2. Use multiple representations (literal, symbolic, graphic) to represent problems and solutions.	1 2 3 4 5 6 7 8 9 10
3. Understand the role of definitions, proofs and counter-examples in mathematical reasoning; constructing simple proofs.*	1 2 3 4 5 6 7 8 9 10
4. Use the special symbols of mathematics correctly and precisely.	1 2 3 4 5 6 7 8 9 10
5. Recognize when an estimate or approximation is more appropriate than an exact answer and understand the limits on precision of approximations.	1 2 3 4 5 6 7 8 9 10
6. Distinguish relevant from irrelevant information, identify missing information, and either find what is needed or make appropriate estimates.*	1 2 3 4 5 6 7 8 9 10
7. Recognize and use the process of mathematical modeling and recognize and clarify mathematical structures that are embedded in other contexts, formulate a problem in mathematical terms, use mathematical strategies to reach a solution, and interpret the solution in the context of the original problem.*	1 2 3 4 5 6 7 8 9 10
8. When solving problems, think ahead about strategy, test ideas with special cases, try different approaches, check for errors and reasonableness of solution as a regular part of routine work, and devise independent ways to verify results.*	1 2 3 4 5 6 7 8 9 10
9. Shift regularly between the specific and the general, use examples to understand general ideas, and extend specific results to more general cases to gain insight.*	1 2 3 4 5 6 7 8 9 10

# Essential Entry-Level Skills - Mathematics

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Mathematics subject strands	
Number Sense and Numerical Operations	1 2 3 4 5 6 7 8 9 10
Algebra	1 2 3 4 5 6 7 8 9 10
Geometry	1 2 3 4 5 6 7 8 9 10
Data Interpretation, Statistics and Probability*	1 2 3 4 5 6 7 8 9 10
Mathematical Reasoning	1 2 3 4 5 6 7 8 9 10

Please identify any other essential skills needed for success in your entry-level credit bearing mathematics course.

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