South Carolina
End-of-Course Examination Program

Teacher's Guide
and
Sample Items

Algebra 1/Mathematics for the Technologies 2 Examination

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South Carolina Department of Education

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Introduction

The South Carolina Education Accountability Act (EAA) of 1998 requires that end-of-course examinations be administered to students in gateway courses. In order to fulfill this EAA mandate, the South Carolina Department of Education (SCDE) has instituted the South Carolina End-of-Course Examination Program (EOCEP).

The purposes and uses of the EOCEP tests are the following:

A. The tests promote instruction in specific academic standards for the particular courses, encourage higher levels of student achievement, and document the level of students' mastery of the course standards.

B. The tests serve as indicators of program, school, and school district effectiveness in the manner prescribed by the Education Oversight Committee in accordance with the provisions of the EAA.

C. The tests are weighted 20 percent in the determination of students' final grades in the gateway courses.

The South Carolina end-of-course examinations are based on specific measurable course standards that are drawn directly from the South Carolina curriculum standards for the particular subject area: algebra, biology, English language arts, and U. S. History. All students (middle school, high school, adult education, alternative school, and district-approved home school) enrolled in the following courses – or any other course that addresses these particular standards – must take the corresponding EOCEP exams: Algebra 1, Math for the Technologies 2, Intermediate Algebra, English 1, Biology 1, Applied Biology 2 and U. S. History and Constitution.

All reading selections and test questions are carefully reviewed by content experts, language and testing experts, and the members of a South Carolina content review committee to ensure that each test question properly measures the intended standard and that test-wise students cannot find unintended clues to the correct answer. In addition, a South Carolina sensitivity review committee scrutinizes the test to ensure that each question is free from bias with respect to race, gender, ethnicity, socioeconomic status, culture, and geographic region as well as content that would be offensive to any cultural, religious, or ethnic group. The items are then field-tested to further ensure validity.

The test questions are not meant to be tricky; rather, they are designed to distinguish between those students who understand the concept or skill being tested and can apply their understanding and those students who have an incomplete understanding of the concept. Students who understand the concept will likely choose the correct option, while those with an incomplete understanding will more likely choose an incorrect option because it is based on a common misconception.

This teacher's guide has been developed to provide educators with important information about the EOCEP and to explain how the examination can be used effectively to strengthen the teaching and learning in South Carolina. The guide provides a description of the test, its role in the EOCEP, and the course standards that guided its development. In addition, the guide provides sample questions and practical suggestions about how to prepare students for the examination and for using the examination.

The standards for the end-of-course examinations as well as the State Board of Education regulation about the EOCEP (R 43-262.4, "End-of-Course Tests") are accessible through the links on the EOCEP Web page at this address:

http://ed.sc.gov/tests/high/eocep/

Additional information on the EAA is provided on the SCDE Web site:

http://ed.sc.gov/scdoe/assets/File/stateboard/documents/262.pdf

PART 1

Overview of the Examination

The test questions on the Algebra 1/Mathematics for the Technologies 2 Examination are aligned with South Carolina College- and Career-Ready Standards for Mathematics (SCCCR-M) and are designed to assess students' mastery of the standards specified as Algebra 1 in the SCCCR-M High School Standards Alignment and Progression Document. http://ed.sc.gov/scdoe/assets/File/tests/high/eocep/SCCCR-MathCourseStandardsCompilation-2015.pdf.
The Algebra 1 course standards—and therefore the examination questions—are divided into four conceptual categories: Algebra, Functions, Number and Quantity, and Statistics and Probability.

The Algebra 1/Mathematics for the Technologies 2 End-of-Course Examination is composed of fifty test items. Students are given enough time in the testing session to attempt every question on the test. Questions on the Algebra 1 EOCEP may be multiple-choice or technology-enhanced.

The sample test questions in part 2 of this document contain only multiple choice items. For samples of technology-enhanced items, please see the On-line Training Tool, available prior to the testing window.

Basic Questions Teachers Have about the Examination and the EOCEP

Who decided what the examination will cover?

A committee of South Carolina educators and leaders developed course progressions that specify which of the SCCCR-Mathematics Standards for High School will be assessed on the Algebra 1 EOCEP. Questions to measure students' mastery of these standards were developed specifically for this examination.

Who will take this examination?

All students scheduled to complete Algebra 1, Mathematics for the Technologies 2 or Intermediate Algebra for credit toward a high school diploma will take this examination. The majority of the students taking this particular test will be in grades eight through ten. The test will be administered only to students who are scheduled to complete either Algebra 1, Mathematics for the Technologies 2 or Intermediate Algebra for high school credit.

How will home-schooled students be tested?

Home-schoolers approved by their local district are required to participate. The districts monitor the administration of EOCEP for home-schooled students.

Why do students have to take this examination?

The EOCEP was developed in response to the EAA, which requires the development of end-of-course examinations in the gateway courses for grades nine through twelve. These examinations serve as indicators of program, school, and school district effectiveness, promote instruction in specific academic course standards, and encourage higher levels of student achievement. They may be used as final examinations for these courses. The test scores must comprise 20 percent of the students' final grades in these courses.

What accommodations will be offered for students with disabilities?

The IEP or 504 Accommodations Plan team determines how a student with disabilities participates in the EOCEP assessments. Accommodations are changes to the content, format, or conditions (instructional, assessment) for particular students that do not reduce the learning expectations or change the construct but do remove construct-irrelevant factors so that students are able to access the content and fully demonstrate what they can do. IEP and 504 teams should refer to Appendix C of the current Test Administration Manual for allowable accommodations.

The following are examples of permissible testing accommodations:

setting- preferential seating, separate location, small-group or individual administration
timing- extended breaks, frequent breaks
scheduling- afternoon administration, multiple testing sessions per day, multiple testing days
presentation- reading aloud to self, repeating directions
response options- responding in test booklet or separate pages, non-verbal indication of answer choices, dictation of responses
customized materials- loose-leaf, large print, braille materials, sign language materials and oral administration scripts and CDs

Will a calculator be allowed during testing?

The EOCEP calculator policy appears on the Office of Assessment's Web page at http://ed.sc.gov/scdoe/assets/File/tests/high/eocep/EOCEP-CalculatorUsePolicyRev.pdf. Students using the on-line version of the EOCEP for Algebra 1 will have an on-line basic calculator, an on-line scientific calculator and an on-line graphing tool available for use on the test. These students may also use an approved hand-held calculator.

Is the test timed?

The test is not timed. It will be administered in a test session of approximately ninety minutes, which should be sufficient time for all students to have the opportunity to attempt every question on the test. Test administrators are instructed to make every effort to give all students sufficient time to complete the test.

How will the scores from the EOCEP be factored into students' grades?

The results of the Algebra 1/Mathematics for the Technologies 2 examination will be counted, beginning in the 2003–04 school year, as 20 percent of a student's final grade in the course. Individual EOCEP scores will be reported using the scale from the South Carolina uniform grading policy. The score reported is a scale score and not the percent correct.

As a teacher, what are my responsibilities with regard to the EOCEP?

On the first day of class, all students taking a course assessed by the EOCEP must receive a copy of the academic standards for Algebra 1. Some students may be taking a course that requires EOCEP assessment but which is different from Algebra 1 in some respects (e.g., Intermediate Algebra). These students should be given the standards for the course they are taking in addition to the standards for Algebra 1. Teachers should incorporate these assessment standards <u>and</u> the appropriate course content into their classroom curriculum. Part 2 of this guide contains sample examination questions for certain of these standards. These samples are intended to help you and your students become familiar with the style of the questions on the test.

The primary responsibility of teachers with regard to the EOCEP is preparing their students for the test by ensuring that they understand the major concepts of algebra and are able to express that understanding. Ongoing daily teaching strategies such as asking probing questions and requiring written explanations, along with student-teacher and student-student dialogue, contribute to this understanding more than multiple-choice practice items do. Having students collect and analyze data, illustrate graphically (both by hand and with graphing technology), and explain their thinking orally and in writing are excellent tools to prepare students to perform well on the end-of-course examination.

PART 2

Sample Test Questions

This section contains sample multiple choice test items that are representative of the questions used on the Algebra 1/Mathematics for the Technologies 2 End-of-Course Examination. These questions are only a sample of what students should expect to encounter on the actual examination. The items illustrate the format, type, and approximate level of difficulty of the examination questions. For each sample question, the relevant conceptual category and standard are identified. The text describes what content the item is testing, what the student should know to be able to answer the item, and what errors students most commonly make.

It is important to remember that the different forms of the examination will contain different items that assess the same standard. In addition, the different forms will contain items within each conceptual category that assess different standards. The complete listing of the Algebra 1 course standards appears in the appendix to this document..

SAMPLE QUESTION 1

SCCCR-M Standard:

A1.FIF.1* Extend previous knowledge of a function to apply to general behavior and features of a function.

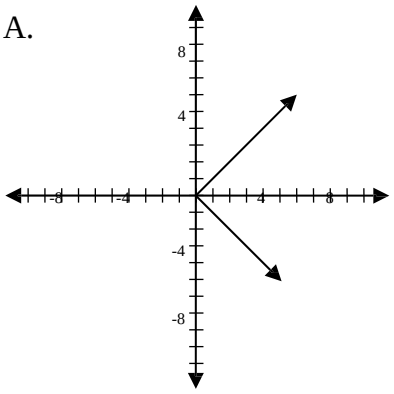
a. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range.

b. Represent a function using function notation and explain that $f(x)$ denotes the output of function f that corresponds to the input x.

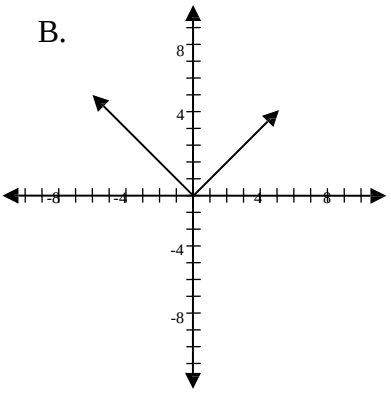
c. Understand that the graph of a function labeled as f is the set of all ordered pairs (x,y) that satisfy the equation $y=f(x)$.

1. Which graph represents a function?

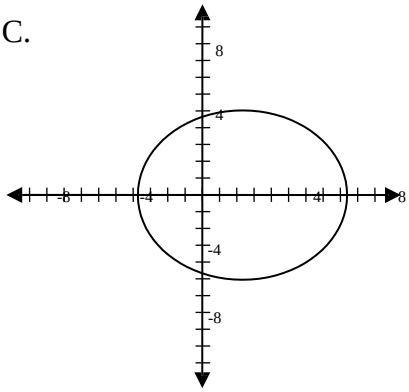
A.



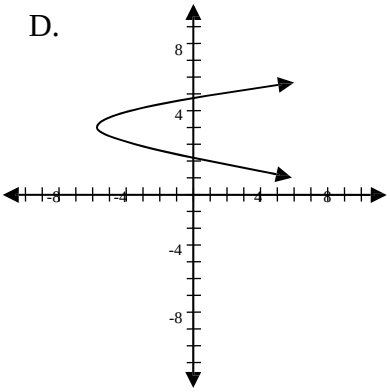
B.



C.



D.



Key: B

This item requires the student to analyze each graph in order to classify the relationship as a function or not a function. The student must either be able to use a vertical line test or to determine how many values for y correspond to each value for x.

Common errors include confusing vertical and horizontal and confusing the definition of a relation with the definition of a function.
Other items for this standard may give the data as a table or as a set of ordered pairs.

SAMPLE QUESTION 2

SCCCR-M Standard:

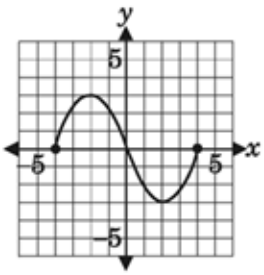
A1.FIF.1* Extend previous knowledge of a function to apply to general behavior and features of a function.

a. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range.

b. Represent a function using function notation and explain that $f(x)$ denotes the output of function f that corresponds to the input x.

c. Understand that the graph of a function labeled as f is the set of all ordered pairs (x,y) that satisfy the equation $y=f(x)$.

2. A function is graphed below.



What is the domain of this function?

A. $3 < y < 3$

B. $4 < y < 4$

C. $3 \leq y \leq 3$

D. $4 \leq y \leq 4$

Key: D

This item requires the student to determine the domain of a function from a graph. The domain includes all possible values for x for which the function is defined and makes sense. The student must recognize that the endpoints of the continuous function are at $x = -4$ and $x = 4$, so that the domain is $-4 \leq x \leq 4$.

Common errors include finding the range instead of the domain. A student failing to recognize that the domain represents possible x values for the function may incorrectly choose option A or option C. Other items for this standard may ask the student to find the range or determine reasonable values of domain or range based on an applied situation.

SAMPLE QUESTION 3

SCCCR-M Standard:

A1.NQ.2* Label and define appropriate quantities in descriptive modeling contexts.

3. Let x be any real number. Then the statement $x^3 > 0$ is true for

A. $x > 0$ only.

B. $x < 0$ only.

C. no values of x.

D. all real values of x.

Key: A

This item focuses on what happens when numbers are cubed. The student must recognize that x^3 is positive when x is positive and is negative when x is negative.

Common errors include thinking that cubing a number results in a positive number, as squaring a number does, or thinking that raising a number to the third power is the same as multiplying the number by 3.

SAMPLE QUESTION 4

SCCCR-M Standard:

A1.AAPR.1* Add, subtract, and multiply polynomials and understand that polynomials are closed under these operations. (Limit to linear; quadratic.)

4. Which expression is equivalent to $(2x - 5) - (3x - 8)$?

A. $-x - 13$

B. $-x + 3$

C. $2x - 16$

D. $5x - 3$

Key: B

This item focuses on using the distributive and associative properties to simplify an expression. For this standard, a problem-solving situation includes this type of item. The student must understand that subtraction of a quantity in parentheses is the same as distributing –1 over the terms in the parentheses, grouping like terms together, and combining like terms.

Common errors include not distributing the negative to both terms in the parentheses or incorrectly combining like terms. Other items for this standard may ask students to simplify or identify equivalent representations of other algebraic expressions by applying the commutative, associative, and distributive properties.

SAMPLE QUESTION 5

SCCCR-M Standard:

A1.FLQE.1* Distinguish between situations that can be modeled with linear functions or exponential functions by recognizing situations in which one quantity changes at a constant rate per unit interval as opposed to those in which a quantity changes by a constant percent rate per unit interval. *(Note: A1.FLQE.1a is not a Graduation Standard.)*

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5. Which of the following situations is best represented by a linear function?
   A. The amount Jeremy tips at a restaurant is a function of the total bill. He tips 15% of the total bill.
   B. The area of a square is a function of the length of the side of the square.
   C. The distance a ball travels after being dropped is a function of acceleration and time. The distance is one-half of the acceleration multiplied by the square of the time.
   D. The length of the side of a rectangle with an area of 48 is a function of the width of the rectangle.

Key: A

This item requires the student to recognize the difference between linear and nonlinear functions in applied situations. The student must understand that a linear function is one that changes by a constant amount for each equivalent interval. For example, since the tip is a constant 15 percent of the total bill, the tip changes the same amount (15 cents) for each additional dollar of the bill. In each of the other options, the rate of change is not constant over time, and therefore does not describe a linear function.

Common errors include thinking that an increase relating to a figure that is made up of lines should be linear.

Other items for this standard may ask students to write a linear function that models a given situation or to recognize a situation that requires an exponential model.

SAMPLE QUESTION 6

SCCCR-M Standard:

A1.ACE.2* Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales. (Limit to linear; quadratic; exponential with integer exponents; direct and indirect variation.)

6. Which equation represents the line passing through the points (–2, 4) and (2, 8)?

A. $y = -x + 2$

B. $y = -x + 6$

C. $y = x + 4$

D. $y = x + 6$

Key: D

This item requires students to identify an equation for a line based on two points. The student may correctly determine the slope by computing

change in y = 8 – 4
and
change in x = 2 – (–2)

or by graphing the points. The student should then find the y-intercept. Finally, the student should use the slope and the y-intercept to identify the equation $y = x + 6$ as the correct answer.

Common errors include miscalculating the slope as run over rise, making errors with signs, substituting the coordinates of a point incorrectly into the equation $y = mx + b$ or $y - y_1 = m(x - x_1)$ or ignoring the intercept altogether. Other items for this standard may ask students to identify the graph or equation of a line given a context, a point and a slope, or a slope and a y-intercept.

SAMPLE QUESTION 7

SCCCR-M Standard:

A1.ACE.2* Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales. (Limit to linear; quadratic; exponential with integer exponents; direct and indirect variation.)

7. The cost of renting a table at a flea market is based on a fixed price per day plus an initial registration fee. If it costs \$45 to rent a table for one day and a total of \$90 to rent a table for four days, which of the following equations represents the total cost (c) to rent a table at the flea market for d days?

A. $c = 15(d + 30)$

B. $c = 15d + 30$

C. $c = 15d + 45$

D. $c = 15(d + 45)$

Key: B

This item requires the student to recognize that the two values needed in the equation are the initial registration fee and the fixed price per day. Here are two approaches to this problem. The fixed price per day can be determined by finding the slope of the line segment between two points—(1, 45) and (4, 90)—which is 15. Similarly, the student may reason that the difference in total cost (c) between four days and one day is \$45 and therefore that the fixed price per day is \$15. Once the fixed price per day is found, the initial registration fee can be calculated using the total cost for one day, \$45, and subtracting the fixed price per day. In either case, students are expected to understand the relationship between the equation and the situation represented by the equation.

Common errors include not recognizing which quantities are variable and which are constant. Students often miscalculate the initial fee or use an incorrect format for their equation.

SAMPLE QUESTION 8

SCCCR-M Standard:

A1.AREI.6* Solve systems of linear equations algebraically and graphically focusing on pairs of linear equations in two variables. *(Note: A1.AREI.6a and 6b are not Graduation Standards.)*

a. Solve systems of linear equations using the substitution method.

b. Solve systems of linear equations using linear combination.

8. A tour boat leaves the dock and travels to the wildlife park at 7 miles per hour (mph) for x hours. The return trip to the dock takes y hours at 15 mph. The boat ride takes a total of 3 hours.

Which system of equations best represents this situation?

A. $x + y = 3$
$7x = 15y$

B. $x = y$
$7x = 15y$

C. $x + y = 3$
$7x + 15y = 3$

D. $x = y$
$7x + 15y = 3$

Key: A

This item requires the student to write a system of linear equations. This skill is pre-requisite to solving a system of equations. The student must recognize that the distance from the dock to the wildlife park is the same, whether the tour boat is coming or going. The student must realize that the distance can be determined by multiplying the rate (miles per hour) by the number of hours, an operation that produces one equation ($7x = 15y$) that represents the equal distances. Since the total time is 3 hours, the second equation is $x + y = 3$.

Common errors are misunderstanding the given information, such as not understanding that x and y can represent different times or not recognizing that distance = rate × time.

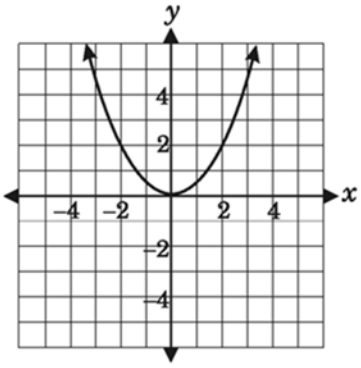
SAMPLE QUESTION 9

SCCCR-M Standard:

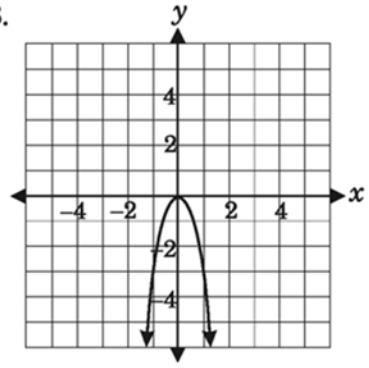
A1.FBF.3* Describe the effect of the transformations $kf(x)$, $f(x)+k$, $f(x+k)$, and combinations of such transformations on the graph of $y=f(x)$ for any real number k. Find the value of k given the graphs and write the equation of a transformed parent function given its graph. (Limit to linear; quadratic; exponential with integer exponents; vertical shift and vertical stretch.)

9. **Each graph below represents an equation of the form $y = ax^2$. Which graph represents the equation with the greatest value for a?**

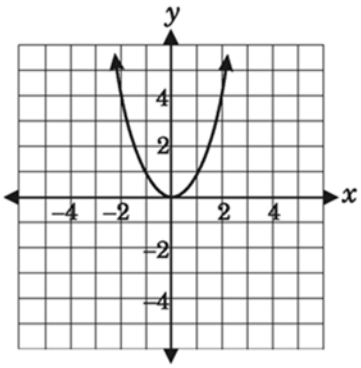
A.



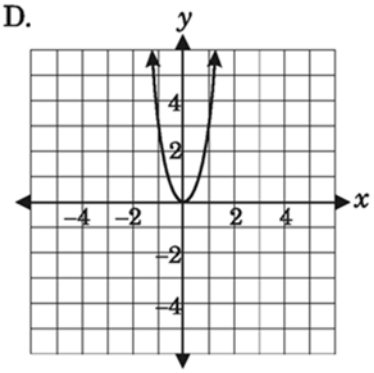
B.



C.



D.



Key: D

This item focuses on the impact of changes in the coefficient a on the graph of $y = ax^2$. The student must recognize that the larger the value of a, the steeper or narrower the graph, and that the smaller the value of a, the flatter and more open the graph.

Common errors include believing that the wider the graph, the larger the value of a, or mistaking a narrow graph that opens downward as having a large coefficient for the x^2 term. Other items for this standard may ask the student to identify a new graph based on changes to the coefficient a.

SAMPLE QUESTIONS 10 - 12

SCCCR-M Standard:

A1.FLQE.1* Distinguish between situations that can be modeled with linear functions or exponential functions by recognizing situations in which one quantity changes at a constant rate per unit interval as opposed to those in which a quantity changes by a constant percent rate per unit interval. *(Note: A1.FLQE.1a is not a Graduation Standard.)*

10. Population A is 800. It grows by 5% each month. Population B is 500. It grows by 20 each month. Which set of statements correctly describes the growth of both populations?

A. Population A is linear.
Population B is exponential.

B. Population A is exponential.
Population B is linear.

C. Population A is exponential.
Population B is exponential.

D. Population A is linear.
Population B is linear.

Key: B

These examples require the student to recognize linear and/or exponential growth.

Other items for this standard may ask students to write a linear function that models a given situation or to recognize a situation that requires an exponential model.

11. Which situation must have a linear relationship?

A. The number of bacteria in a sample doubles each hour.
B. The amount of money earned daily on a school fundraiser increased the first week and decreased the second week.
C. The total cost of stamps given that each stamp costs 48¢.
D. The amount of radiation coming from a sample, given that the amount of radiation decreases by half each hour.

Key: C

12. Which situation must have an exponential relationship ?

A. The number of bacteria in a sample doubles each hour.
B. The amount of money earned daily on a school fundraiser increased the first week and decreased the second week.
C. The total cost of pieces of bubble gum is based on the fact that each piece costs 2¢.
D. The total mass of a box of baseballs depends on the number of baseballs in the box plus the mass of the box.

Key is A

SAMPLE QUESTION 13

SCCCR-M Standard:

A1.AREI.10* Explain that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.

Larry's Dairy sells butter to a local grocery. The equation $y = 2.4x$ can be used to model the relationship between the value of butter and the weight of the butter they sell. They can sell any amount of butter, up to 30 pounds. Which statement is true?

A. The equation has 30 solutions.

B. The equation has no solutions.

C. The equation has 2.4 solutions.

D. The equation has infinite solutions.

Key is D

Students should recognize that solutions to equations may include more than just whole numbers.

Common errors are limiting solutions to whole numbers or choosing a number form the prompt (2.4) as a possible answer.

Other items for this standard may include choosing the graph of the solution, recognizing that the graph is continuous in many cases. Options may also include tables of solutions.

SAMPLE QUESTION 14

SCCCR-M Standard

A1.ASE.1* Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions. (Limit to linear; quadratic; exponential.)

The height (h), in meters, of an item in d days can be modeled using the equation $h = 3\left(\frac{5}{4}\right)^d$. What does the fraction $\frac{5}{4}$ represent in this equation?

A. The final height of the object is $\frac{5}{4}$ meters.
B. The starting height of the object is $\frac{5}{4}$ meters.
C. The height of the object is multiplied by $\frac{5}{4}$ each day.
D. The height of the object increases by $\frac{5}{4}$ meters each day.

Key is C

PART 3

Preparing Your Students for the Examination

Here are some classroom strategies you can employ to help prepare your students for the Algebra 1/Mathematics for the Technologies 2 End-of-Course Examination:

A. Ensure that your instructional practices are sufficient to prepare your students for the examination by

- incorporating ongoing cumulative review on a regular basis.
- using realistic problems, real-world contexts, and current issues to launch instruction and apply the mathematics skills and concepts you are teaching.
- asking frequently in all classes such questions as these: “Why?” “How do you know?” “Can you explain your reasoning?”

B. Rather than practicing for the test, incorporate classroom assessments that probe students’ understanding by

- focusing on standards-based instruction as the key to doing well on this assessment.
- using meaningful classroom assessments that reflect the standards you teach in your classroom.

C. Ensure that your students are sufficiently familiar with the format of the examination by

- incorporating into your ongoing instruction various questions, exercises, and problems that are similar in format and content to the samples in this manual.
- giving your students opportunities to practice with the On-line Training Tool (OTT) before the testing window opens.

D. Ensure that your students are sufficiently motivated to take the examination by

- sharing information about the purpose and importance of the examination.
- sending notes home to enlist parental support for student preparation.

E. Ensure that your course outline is aligned with the examination by

- placing appropriate emphasis on the content and process standards that are assessed and on any standards in your course outline that support the assessed standards.
- supplementing the standard textbook with other instructional materials, particularly if specific standards are not adequately covered in the textbook.

PART 4

Raising Student Achievement Levels

You can use these teaching strategies to help raise your students' achievement levels on the Algebra 1/Mathematics for the Technologies 2 End-of-Course-Examination.

A. Correlate your course syllabus with the standards. Become thoroughly familiar with the standards and their relationship to your course syllabus for Algebra 1, Mathematics for the Technologies 1 and 2, or Intermediate Algebra:. If certain standards are not included in your course outline but are assessed on the examination, you should incorporate those standards into your outline. Course emphasis should be placed on the algebra course standards and the algebra topics that directly tie to the standards.

B. Collaborate with other teachers in your school. Discussions with math colleagues that systematically review any inconsistencies between what is being taught and which standards are being assessed are critical for aligning curriculum and assessment. After having such discussions, teachers are able to make adjustments in what they emphasize and de-emphasize, what terms they use, and how and when they present specific aspects of the curriculum.

C. Incorporate multiple-choice questions into your unit tests and quizzes. Since students are already tested and quizzed on an ongoing basis, one of the more straightforward strategies for raising achievement is to ensure that ongoing tests and quizzes include questions that are similar to those that students will face on the end-of-course examination. Generally, well-written multiple-choice items contain as the alternative options the most common mistakes that students make. Instead of just giving your students the correct answer, take time after any test or quiz to explain why they may have selected the incorrect options.

D. Develop action plans for your department. Every school and every department is different. Strategies that are needed in one place may not be needed in another. Some schools may have already implemented and institutionalized some strategies and therefore need to focus on others. For these reasons, departments are encouraged to develop their own action plans that reflect existing conditions and needs. Written action plans with objectives, activities, timelines, and assigned responsibilities are effective ways to move forward.

Appendix A

South Carolina College- and Career-Ready (SCCCR-M) Algebra 1 Standards

Arithmetic with Polynomials and Rational Expressions

A1.AAPR.1* Add, subtract, and multiply polynomials and understand that polynomials are closed under these operations. (Limit to linear; quadratic.)

Creating Equations

A1.ACE.1* Create and solve equations and inequalities in one variable that model real-world problems involving linear, quadratic, simple rational, and exponential relationships. Interpret the solutions and determine whether they are reasonable. (Limit to linear; quadratic; exponential with integer exponents.)

A1.ACE.2* Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales. (Limit to linear; quadratic; exponential with integer exponents; direct and indirect variation.)

A1.ACE.4* Solve literal equations and formulas for a specified variable including equations and formulas that arise in a variety of disciplines.

Reasoning with Equations and Inequalities

A1.AREI.1* Understand and justify that the steps taken when solving simple equations in one variable create new equations that have the same solution as the original.

A1.AREI.3* Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

A1.AREI.4* Solve mathematical and real-world problems involving quadratic equations in one variable. *(Note: A1.AREI.4a and 4b are not Graduation Standards.)*

> a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x-h)^2=k$ that has the same solutions. Derive the quadratic formula from this form.
>
> b. Solve quadratic equations by inspection, taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a+bi$ for real numbers a and b. (Limit to non-complex roots.)

A1.AREI.5 Justify that the solution to a system of linear equations is not changed when one of the equations is replaced by a linear combination of the other equation.

A1.AREI.6* Solve systems of linear equations algebraically and graphically focusing on pairs of linear equations in two variables. *(Note: A1.AREI.6a and 6b are not Graduation Standards.)*

a. Solve systems of linear equations using the substitution method.

b. Solve systems of linear equations using linear combination.

A1.AREI.10* Explain that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.

A1.AREI.11* Solve an equation of the form $f(x) = g(x)$ graphically by identifying the x-coordinate(s) of the point(s) of intersection of the graphs of $y=f(x)$ and $y=g(x)$. (Limit to linear; quadratic; exponential.)

A1.AREI.12* Graph the solutions to a linear inequality in two variables.

Structure and Expressions

A1.ASE.1* Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions. (Limit to linear; quadratic; exponential.)

A1.ASE.2* Analyze the structure of binomials, trinomials, and other polynomials in order to rewrite equivalent expressions.

A1.ASE.3* Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

a. Find the zeros of a quadratic function by rewriting it in equivalent factored form and explain the connection between the zeros of the function, its linear factors, the x-intercepts of its graph, and the solutions to the corresponding quadratic equation.

Building Functions

A1.FBF.3* Describe the effect of the transformations $kf(x)$, $f(x)+k$, $f(x+k)$, and combinations of such transformations on the graph of $y=f(x)$ for any real number k. Find the value of k given the graphs and write the equation of a transformed parent function given its graph. (Limit to linear; quadratic; exponential with integer exponents; vertical shift and vertical stretch.)

Interpreting Functions

A1.FIF.1* Extend previous knowledge of a function to apply to general behavior and features of a function.

a. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range.

b. Represent a function using function notation and explain that $f(x)$ denotes the output of function f that corresponds to the input x.

c. Understand that the graph of a function labeled as f is the set of all ordered pairs (x,y) that satisfy the equation $y=f(x)$.

A1.FIF.2* Evaluate functions and interpret the meaning of expressions involving function notation from a mathematical perspective and in terms of the context when the function describes a real-world situation.

A1.FIF.4* Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. (Limit to linear; quadratic; exponential.)

A1.FIF.5* Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes. (Limit to linear; quadratic; exponential.)

A1.FIF.6* Given a function in graphical, symbolic, or tabular form, determine the average rate of change of the function over a specified interval. Interpret the meaning of the average rate of change in a given context. (Limit to linear; quadratic; exponential.)

A1.FIF.7* Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases. (Limit to linear; quadratic; exponential only in the form $y=a^x+k$.)

A1.FIF.8* Translate between different but equivalent forms of a function equation to reveal and explain different properties of the function. (Limit to linear; quadratic; exponential.) *(Note: A1.FIF.8a is not a Graduation Standard.)*

a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

A1.FIF.9* Compare properties of two functions given in different representations such as algebraic, graphical, tabular, or verbal. (Limit to linear; quadratic; exponential.)

Linear, Quadratic, and Exponential

A1.FLQE.1* Distinguish between situations that can be modeled with linear functions or exponential functions by recognizing situations in which one quantity changes at a constant rate per unit interval as opposed to those in which a quantity changes by a constant percent rate per unit interval. *(Note: A1.FLQE.1a is not a Graduation Standard.)*

> a. Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals.

A1.FLQE.2* Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables. (Limit to linear; exponential.)

A1.FLQE.3* Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or more generally as a polynomial function.

A1.FLQE.5* Interpret the parameters in a linear or exponential function in terms of the context. (Limit to linear.)

Quantities

A1.NQ.1* Use units of measurement to guide the solution of multi-step tasks. Choose and interpret appropriate labels, units, and scales when constructing graphs and other data displays.

A1.NQ.2* Label and define appropriate quantities in descriptive modeling contexts.

A1.NQ.3* Choose a level of accuracy appropriate to limitations on measurement when reporting quantities in context.

Real Number System

A1.NRNS.1* Rewrite expressions involving simple radicals and rational exponents in different forms.

A1.NRNS.2* Use the definition of the meaning of rational exponents to translate between rational exponent and radical forms.

A1.NRNS.3 Explain why the sum or product of rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

Interpreting Data

A1.SPID.6* Using technology, create scatterplots and analyze those plots to compare the fit of linear, quadratic, or exponential models to a given data set. Select the appropriate model, fit a function to the data set, and use the function to solve problems in the context of the data.

A1.SPID.7* Create a linear function to graphically model data from a real-world problem and interpret the meaning of the slope and intercept(s) in the context of the given problem.

A1.SPID.8* Using technology, compute and interpret the correlation coefficient of a linear fit.

					South Carolina College- and Career-Ready Standards for Mathematics							
Conceptual Category	CCSS Alignment	SCCCR-M Key Concept	SCCCR-M Course Standard	Middle School#	Algebra 1	Foundations In Algebra	Intermediate Algebra	Algebra 2	Geometry	Probability & Statistics	Pre-Calculus	Calculus
Alg	APR. 1	Arithmetic with Polynomials and Rational Expressions	AAPR.1* Add, subtract, and multiply polynomials and understand that polynomials are closed under these operations.		(Limit to linear; quadratic.)							
Alg	APR. 2		AAPR.2 Know and apply the Division Theorem and the Remainder Theorem for polynomials.									
Alg	APR.3		AAPR.3 Graph polynomials identifying zeros when suitable factorizations are available and indicating end behavior. Write a polynomial function of least degree corresponding to a given graph.					(Limit to polynomials with degrees 3 or less.)				
Alg	APR. 4		AAPR.4 Prove polynomial identities and use them to describe numerical relationships.									
Alg	APR. 5		AAPR.5 Apply the Binomial Theorem to expand powers of binomials, including those with one and with two variables. Use the Binomial Theorem to factor squares, cubes, and fourth powers of binomials.									
Alg	APR. 6		AAPR.6 Apply algebraic techniques to rewrite simple rational expressions in different forms; using inspection, long division, or, for the more complicated examples, a computer algebra system.									
Alg	APR.7		AAPR.7 Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.									
Alg	CED.1	Creating Equations	ACE.1* Create and solve equations and inequalities in one variable that model real-world problems involving linear, quadratic, simple rational, and exponential relationships. Interpret the solutions and determine whether they are reasonable.		(Limit to linear; quadratic; exponential with integer exponents.)	(Limit to linear; quadratic; exponential with integer exponents.)						
Alg	CED.2		ACE.2* Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales.		(Limit to linear; quadratic; exponential with integer exponents; direct and indirect variation.)	(Limit to linear; quadratic; exponential with integer exponents; direct and indirect variation.)						
Alg	CED.3		ACE.3 Use systems of equations and inequalities to represent constraints arising in real-world situations. Solve such systems using graphical and analytical methods, including linear programing. Interpret the solution within the context of the situation.					(Limit to linear programming.)				
Alg	CED. 4		ACE.4* Solve literal equations and formulas for a specified variable including equations and formulas that arise in a variety of disciplines.									

Conceptual Category	CCSS Alignment	SCCCR-M Key Concept	SCCCR-M Course Standard	Middle School#	Algebra 1	Foundations In Algebra	Intermediate Algebra	Algebra 2	Geometry	Probability & Statistics	Pre-Calculus	Calculus
Alg	REI.1	Reasoning with Equations and Inequalities	AREI.1* Understand and justify that the steps taken when solving simple equations in one variable create new equations that have the same solution as the original.									
Alg	REI.2		AREI.2* Solve simple rational and radical equations in one variable and understand how extraneous solutions may arise.									
Alg	REI.3		AREI.3* Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.									
Alg	REI.4		AREI.4* Solve mathematical and real-world problems involving quadratic equations in one variable. (Note: AREI.4a and 4b are not Graduation Standards.) a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form 〖(x-h)〗^2=k that has the same solutions. Derive the quadratic formula from this form. b. Solve quadratic equations by inspection, taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a+bi for real numbers a and b.		a. and b.; b. (Limit to non-complex roots.)			b. only				
Alg	REI.5		AREI.5 Justify that the solution to a system of linear equations is not changed when one of the equations is replaced by a linear combination of the other equation.									
Alg	REI.6		AREI.6* Solve systems of linear equations algebraically and graphically focusing on pairs of linear equations in two variables. (Note: AREI.6a and 6b are not Graduation Standards.) a. Solve systems of linear equations using the substitution method. b. Solve systems of linear equations using linear combination.									
Alg	REI.7		AREI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. Understand that such systems may have zero, one, two, or infinitely many solutions.					(Limit to linear equations and quadratic functions.)				
Alg	REI. 8		AREI.8 Represent a system of linear equations as a single matrix equation in a vector variable.									
Alg	REI.9		AREI.9 Using technology for matrices of dimension 3 × 3 or greater, find the inverse of a matrix if it exists and use it to solve systems of linear equations.									
Alg	REI.10		AREI.10* Explain that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.									
Alg	REI.11		AREI.11* Solve an equation of the form f(x)=g(x) graphically by identifying the x-coordinate(s) of the point(s) of intersection of the graphs of y=f(x) and y=g(x).		(Limit to linear; quadratic; exponential.)	(Limit to linear; quadratic; exponential.)						
Alg	REI. 12		AREI.12* Graph the solutions to a linear inequality in two variables.									
Alg	SSE.1	Structure and Expressions	ASE.1* Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions.		(Limit to linear; quadratic; exponential.)	(Limit to linear; quadratic; exponential.)						
Alg	SSE. 2		ASE.2* Analyze the structure of binomials, trinomials, and other polynomials in order to rewrite equivalent expressions.									
Alg	SSE.3		ASE.3* Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. (Note: ASE.3b and 3c are not Graduation Standards.) a. Find the zeros of a quadratic function by rewriting it in equivalent factored form and explain the connection between the zeros of the function, its linear factors, the x-intercepts of its graph, and the solutions to the corresponding quadratic equation. b. Determine the maximum or minimum value of a quadratic function by completing the square. c. Use the properties of exponents to transform expressions for exponential functions.		a. only		a. and b. only	b. and c. only				
Alg	SSE. 4		ASE.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems including applications to finance.									

Conceptual Category	CCSS Alignment	SCCCR-M Key Concept	SCCCR-M Course Standard	Middle School#	Algebra 1	Foundations In Algebra	Intermediate Algebra	Algebra 2	Geometry	Probability & Statistics	Pre-Calculus	Calculus
Func	BF.1	Building Functions	FBF.1* Write a function that describes a relationship between two quantities. (Note: FBF.1a is not a Graduation Standard.) a. Write a function that models a relationship between two quantities using both explicit expressions and a recursive process and by combining standard forms using addition, subtraction, multiplication and division to build new functions. b. Combine functions using the operations addition, subtraction, multiplication, and division to build new functions that describe the relationship between two quantities in mathematical and real-world situations.								b. only	
Func	BF.2		FBF.2* Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.									
Func	BF.3		FBF.3* Describe the effect of the transformations kf(x), f(x)+k, f(x+k), and combinations of such transformations on the graph of y=f(x) for any real number k. Find the value of k given the graphs and write the equation of a transformed parent function given its graph.		(Limit to linear; quadratic; exponential with integer exponents; vertical shift and vertical stretch.)	(Limit to linear; quadratic; exponential with integer exponents; vertical shift and vertical stretch.)						
Func	BF.4		FBF.4 Understand that an inverse function can be obtained by expressing the dependent variable of one function as the independent variable of another, as f and g are inverse functions if and only if f(x)=y and g(y)=x, for all values of x in the domain of f and all values of y in the domain of g, and find inverse functions for one-to-one function or by restricting the domain. a. Use composition to verify one function is an inverse of another. b. If a function has an inverse, find values of the inverse function from a graph or table.									
Func	BF.5		FBF.5 Understand and verify through function composition that exponential and logarithmic functions are inverses of each other and use this relationship to solve problems involving logarithms and exponents.									

Conceptual Category	CCSS Alignment	SCCCR-M Key Concept	SCCCR-M Course Standard	Middle School#	Algebra 1	Foundations In Algebra	Intermediate Algebra	Algebra 2	Geometry	Probability & Statistics	Pre-Calculus	Calculus
Func	IF.1	Interpreting Functions	FIF.1* Extend previous knowledge of a function to apply to general behavior and features of a function. a. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. b. Represent a function using function notation and explain that f(x) denotes the output of function f that corresponds to the input x. c. Understand that the graph of a function labeled as f is the set of all ordered pairs (x,y) that satisfy the equation y=f(x).									
Func	IF.2		FIF.2* Evaluate functions and interpret the meaning of expressions involving function notation from a mathematical perspective and in terms of the context when the function describes a real-world situation.									
Func	IF.3		FIF.3* Define functions recursively and recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.									
Func	IF.4		FIF.4* Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.		(Limit to linear; quadratic; exponential.)	(Limit to linear; quadratic; exponential.)						
Func	IF.5		FIF.5* Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes.		(Limit to linear; quadratic; exponential.)	(Limit to linear; quadratic; exponential.)						
Func	IF.6		FIF.6* Given a function in graphical, symbolic, or tabular form, determine the average rate of change of the function over a specified interval. Interpret the meaning of the average rate of change in a given context.		(Limit to linear; quadratic; exponential.)							
Func	IF.7		FIF.7* Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases. (Note: FIF.7a – d are not Graduation Standards.) a. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available and showing end behavior. b. Graph radical functions over their domain, showing end behavior. c. Graph exponential and logarithmic functions, showing intercepts and end behavior. d. Graph trigonometric functions, showing period, midline, and amplitude.		overarching standard only; (Limit to linear; quadratic; exponential only in the form y=a^x+k.)	overarching standard only; (Limit to linear; quadratic; exponential only in the form y=a^x+k.)	overarching standard only	overarching standard only				
Func	IF.8		FIF.8* Translate between different but equivalent forms of a function equation to reveal and explain different properties of the function. (Note: FIF.8a and 8b are not Graduation Standards.) a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. b. Interpret expressions for exponential functions by using the properties of exponents.		a. only; (Limit to linear; quadratic; exponential.)	a. only; (Limit to linear; quadratic; exponential.)	b. only	b. only				
Func	IF.9		FIF.9* Compare properties of two functions given in different representations such as algebraic, graphical, tabular, or verbal.		(Limit to linear; quadratic; exponential.)	(Limit to linear; quadratic; exponential.)						

Conceptual Category	CCSS Alignment	SCCCR-M Key Concept	SCCCR-M Course Standard	Middle School#	Algebra 1	Foundations In Algebra	Intermediate Algebra	Algebra 2	Geometry	Probability & Statistics	Pre-Calculus	Calculus
Func	LE.1	Linear, Quadratic, and Exponential	FLQE.1* Distinguish between situations that can be modeled with linear functions or exponential functions by recognizing situations in which one quantity changes at a constant rate per unit interval as opposed to those in which a quantity changes by a constant percent rate per unit interval. (Note: FLQE.1a and 1b are not Graduation Standards.) a. Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals. b. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.		a. only	a. only		b. only				
Func	LE.2		FLQE.2* Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.		(Limit to linear; exponential.)							
Func	LE.3		FLQE.3* Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or more generally as a polynomial function.									
Func	LE.4		FLQE.4 Express a logarithm as the solution to the exponential equation, 〖ab〗^ct=d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.									
Func	LE.5		FLQE.5* Interpret the parameters in a linear or exponential function in terms of the context.		(Limit to linear.)	(Limit to linear.)						
Func	TF.1	Trigonometry	FT.1 Understand that the radian measure of an angle is the length of the arc on the unit circle subtended by the angle.									
Func	TF.2		FT.2 Define sine and cosine as functions of the radian measure of an angle in terms of the x- and y-coordinates of the point on the unit circle corresponding to that angle and explain how these definitions are extensions of the right triangle definitions. a. Define the tangent, cotangent, secant, and cosecant functions as ratios involving sine and cosine. b. Write cotangent, secant, and cosecant functions as the reciprocals of tangent, cosine, and sine, respectively.									
Func	TF.3		FT.3 Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4, and π/6, and use the unit circle to express the values of sine, cosine, and tangent for π-x, π+x, and 2π-x in terms of their values for x, where x is any real number.									
Func	TF.4		FT.4 Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.									
Func	TF.5		FT.5 Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.									
Func	TF.6		FT.6 Define the six inverse trigonometric functions using domain restrictions for regions where the function is always increasing or always decreasing.									
Func	TF.7		FT.7 Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.									
Func	TF.8		FT.8 Justify the Pythagorean, even/odd, and cofunction identities for sine and cosine using their unit circle definitions and symmetries of the unit circle and use the Pythagorean identity to find sin Â, cos Â, or tan Â, given sin Â, cos Â, or tan Â, and the quadrant of the angle.									
Func	TF.9		FT.9 Justify the sum and difference formulas for sine, cosine, and tangent and use them to solve problems.									

Conceptual Category	CCSS Alignment	SCCCR-M Key Concept	SCCCR-M Course Standard	Middle School#	Algebra 1	Foundations In Algebra	Intermediate Algebra	Algebra 2	Geometry	Probability & Statistics	Pre-Calculus	Calculus
Geom	C.1	Circles	GCI.1 Prove that all circles are similar.									
Geom	C.2		GCI.2* Identify and describe relationships among inscribed angles, radii, and chords; among inscribed angles, central angles, and circumscribed angles; and between radii and tangents to circles. Use those relationships to solve mathematical and real-world problems.									
Geom	C.3		GCI.3 Construct the inscribed and circumscribed circles of a triangle using a variety of tools, including a compass, a straightedge, and dynamic geometry software, and prove properties of angles for a quadrilateral inscribed in a circle.									
Geom	C.4		GCI.4 Construct a tangent line to a circle through a point on the circle, and construct a tangent line from a point outside a given circle to the circle; justify the process used for each construction.									
Geom	C.5		GCI.5* Derive the formulas for the length of an arc and the area of a sector in a circle and apply these formulas to solve mathematical and real-world problems.									

Conceptual Category	CCSS Alignment	SCCCR-M Key Concept	SCCCR-M Course Standard	Middle School#	Algebra 1	Foundations In Algebra	Intermediate Algebra	Algebra 2	Geometry	Probability & Statistics	Pre-Calculus	Calculus
Geom	CO.1	Congruence	GCO.1* Define angle, perpendicular line, parallel line, line segment, ray, circle, and skew in terms of the undefined notions of point, line, and plane. Use geometric figures to represent and describe real-world objects.									
Geom	CO.2		GCO.2* Represent translations, reflections, rotations, and dilations of objects in the plane by using paper folding, sketches, coordinates, function notation, and dynamic geometry software, and use various representations to help understand the effects of simple transformations and their compositions.									
Geom	CO.3		GCO.3* Describe rotations and reflections that carry a regular polygon onto itself and identify types of symmetry of polygons, including line, point, rotational, and self-congruence, and use symmetry to analyze mathematical situations.									
Geom	CO.4		GCO.4* Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.									
Geom	CO.5		GCO.5* Predict and describe the results of transformations on a given figure using geometric terminology from the definitions of the transformations, and describe a sequence of transformations that maps a figure onto its image.									
Geom	CO.6		GCO.6* Demonstrate that triangles and quadrilaterals are congruent by identifying a combination of translations, rotations, and reflections in various representations that move one figure onto the other.									
Geom	CO.8		GCO.7* Prove two triangles are congruent by applying the Side-Angle-Side, Angle-Side-Angle, Angle-Angle-Side, and Hypotenuse-Leg congruence conditions.									
Geom	CO.9		GCO.8* Prove, and apply in mathematical and real-world contexts, theorems about lines and angles, including the following: a. vertical angles are congruent; b. when a transversal crosses parallel lines, alternate interior angles are congruent, alternate exterior angles are congruent, and consecutive interior angles are supplementary; c. any point on a perpendicular bisector of a line segment is equidistant from the endpoints of the segment; d. perpendicular lines form four right angles.									
Geom	CO.10		GCO.9* Prove, and apply in mathematical and real-world contexts, theorems about the relationships within and among triangles, including the following: a. measures of interior angles of a triangle sum to 180°; b. base angles of isosceles triangles are congruent; c. the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; d. the medians of a triangle meet at a point.									
Geom	CO.11		GCO.10* Prove, and apply in mathematical and real-world contexts, theorems about parallelograms, including the following: a. opposite sides of a parallelogram are congruent; b. opposite angles of a parallelogram are congruent; c. diagonals of a parallelogram bisect each other; d. rectangles are parallelograms with congruent diagonals; e. a parallelograms is a rhombus if and only if the diagonals are perpendicular.									
Geom	CO.12		GCO.11* Construct geometric figures using a variety of tools, including a compass, a straightedge, dynamic geometry software, and paper folding, and use these constructions to make conjectures about geometric relationships.									

Conceptual Category	CCSS Alignment	SCCCR-M Key Concept	SCCCR-M Course Standard	Middle School#	Algebra 1	Foundations In Algebra	Intermediate Algebra	Algebra 2	Geometry	Probability & Statistics	Pre-Calculus	Calculus
Geom	GMD.1	Geometric Measurement and Dimension	GGMD.1* Explain the derivations of the formulas for the circumference of a circle, area of a circle, and volume of a cylinder, pyramid, and cone. Apply these formulas to solve mathematical and real-world problems.									
Geom	GMD. 2		GGMD.2 Explain the derivation of the formulas for the volume of a sphere and other solid figures using Cavalieri's principle.									
Geom	GMD.3		GGMD.3* Apply surface area and volume formulas for prisms, cylinders, pyramids, cones, and spheres to solve problems and justify results. Include problems that involve algebraic expressions, composite figures, geometric probability, and real-world applications.									
Geom	GMD. 4		GGMD.4 * Describe the shapes of two-dimensional cross-sections of three-dimensional objects and use those cross-sections to solve mathematical and real-world problems.									
Geom	GPE.1	Expressing Geometric Properties with Equations	GGPE.1* Understand that the standard equation of a circle is derived from the definition of a circle and the distance formula.									
Geom	GPE.2		GGPE.2 Use the geometric definition of a parabola to derive its equation given the focus and directrix.									
Geom	GPE.3		GGPE.3 Use the geometric definition of an ellipse and of a hyperbola to derive the equation of each given the foci and points whose sum or difference of distance from the foci are constant.									
Geom	GPE.4		GGPE.4* Use coordinates to prove simple geometric theorems algebraically.									
Geom	GPE.5		GGPE.5* Analyze slopes of lines to determine whether lines are parallel, perpendicular, or neither. Write the equation of a line passing through a given point that is parallel or perpendicular to a given line. Solve geometric and real-world problems involving lines and slope.									
Geom	GPE.6		GGPE.6 Given two points, find the point on the line segment between the two points that divides the segment into a given ratio.									
Geom	GPE.7		GGPE.7* Use the distance and midpoint formulas to determine distance and midpoint in a coordinate plane, as well as areas of triangles and rectangles, when given coordinates.									
Geom	MG.1	Modeling	GM.1* Use geometric shapes, their measures, and their properties to describe real-world objects.									
Geom	MG.3		GM.2 Use geometry concepts and methods to model real-world situations and solve problems using a model.									

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Geom	SRT.1	Similarity, Right Triangles, and Trigonometry	GSRT.1 Understand a dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. Verify experimentally the properties of dilations given by a center and a scale factor. Understand the dilation of a line segment is longer or shorter in the ratio given by the scale factor.									
Geom	SRT.2		GSRT.2* Use the definition of similarity to decide if figures are similar and justify decision. Demonstrate that two figures are similar by identifying a combination of translations, rotations, reflections, and dilations in various representations that move one figure onto the other.									
Geom	SRT.3		GSRT.3* Prove that two triangles are similar using the Angle-Angle criterion and apply the proportionality of corresponding sides to solve problems and justify results.									
Geom	SRT.4		GSRT.4* Prove, and apply in mathematical and real-world contexts, theorems involving similarity about triangles, including the following: a. A line drawn parallel to one side of a triangle divides the other two sides into parts of equal proportion. b. If a line divides two sides of a triangle proportionally, then it is parallel to the third side. c. The square of the hypotenuse of a right triangle is equal to the sum of squares of the other two sides.									
Geom	SRT.5		GSRT.5* Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.									
Geom	SRT.6		GSRT.6* Understand how the properties of similar right triangles allow the trigonometric ratios to be defined and determine the sine, cosine, and tangent of an acute angle in a right triangle.									
Geom	SRT.7		GSRT.7 Explain and use the relationship between the sine and cosine of complementary angles.									
Geom	SRT.8		GSRT.8* Solve right triangles in applied problems using trigonometric ratios and the Pythagorean Theorem.									
Geom	SRT.9		GSRT.9 Derive the formula A=1/2 ab sin C for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.									
Geom	SRT.10		GSRT.10 Prove the Laws of Sines and Cosines and use them to solve problems.									
Geom	SRT.11		GSRT.11 Use the Law of Sines and the Law of Cosines to solve for unknown measures of sides and angles of triangles that arise in mathematical and real-world problems.									
N&Q	Q.1	Quantities	NQ.1* Use units of measurement to guide the solution of multi-step tasks. Choose and interpret appropriate labels, units, and scales when constructing graphs and other data displays.									
N&Q	Q.2		NQ.2* Label and define appropriate quantities in descriptive modeling contexts.									
N&Q	Q.3		NQ.3* Choose a level of accuracy appropriate to limitations on measurement when reporting quantities in context.									
N&Q	RN.2	Real Number System	NRNS.1* Rewrite expressions involving simple radicals and rational exponents in different forms.									
N&Q	RN.1		NRNS.2* Use the definition of the meaning of rational exponents to translate between rational exponent and radical forms.									
N&Q	RN.3		NRNS.3 Explain why the sum or product of rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.									

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N&Q	CN.1	Complex Number System	NCNS.1* Know there is a complex number i such that i^2=-1, and every complex number has the form a+bi with a and b real.									
N&Q	CN.2		NCNS.2 Use the relation i^2=-1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.									
N&Q	CN.3		NCNS.3 Find the conjugate of a complex number in rectangular and polar forms and use conjugates to find moduli and quotients of complex numbers.									
N&Q	CN.4		NCNS.4 Graph complex numbers on the complex plane in rectangular and polar form and explain why the rectangular and polar forms of a given complex number represent the same number.									
N&Q	CN.5		NCNS.5 Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation.									
N&Q	CN.6		NCNS.6 Determine the modulus of a complex number by multiplying by its conjugate and determine the distance between two complex numbers by calculating the modulus of their difference.									
N&Q	CN.7		NCNS.7* Solve quadratic equations in one variable that have complex solutions.									
N&Q	CN.8		NCNS.8 Extend polynomial identities to the complex numbers and use DeMoivre's Theorem to calculate a power of a complex number.									
N&Q	CN.9		NCNS.9 Know the Fundamental Theorem of Algebra and explain why complex roots of polynomials with real coefficients must occur in conjugate pairs.									
N&Q	VM.1	Vector and Matrix Quantities	NVMQ.1 Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes.									
N&Q	VM.2		NVMQ.2 Represent and model with vector quantities. Use the coordinates of an initial point and of a terminal point to find the components of a vector.									
N&Q	VM.3		NVMQ.3 Represent and model with vector quantities. Solve problems involving velocity and other quantities that can be represented by vectors.									
N&Q	VM.4		NVMQ.4 Perform operations on vectors. a. Add and subtract vectors using components of the vectors and graphically. b. Given the magnitude and direction of two vectors, determine the magnitude of their sum and of their difference.									
N&Q	VM.5		NVMQ.5 Multiply a vector by a scalar, representing the multiplication graphically and computing the magnitude of the scalar multiple.									
N&Q	VM.6		NVMQ.6* Use matrices to represent and manipulate data. (Note: This Graduation Standard is covered in Grade 8.)	8.DSP.5								
N&Q	VM.7 & 8		NVMQ.7 Perform operations with matrices of appropriate dimensions including addition, subtraction, and scalar multiplication.									
N&Q	VM.9		NVMQ.8 Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.									
N&Q	VM.10		NVMQ.9 Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.									
N&Q	VM.11		NVMQ.10 Multiply a vector by a matrix of appropriate dimension to produce another vector. Work with matrices as transformations of vectors.									
N&Q	VM.12		NVMQ.11 Apply 2×2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area.									

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S&P	CP.1	Conditional Probability and Rules of Probability	SPCR.1 Describe events as subsets of a sample space and a. Use Venn diagrams to represent intersections, unions, and complements. b. Relate intersections, unions, and complements to the words and, or, and not. c. Represent sample spaces for compound events using Venn diagrams.									
S&P	CP.2		SPCR.2 Use the multiplication rule to calculate probabilities for independent and dependent events. Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.									
S&P	CP.3		SPCR.3 Understand the conditional probability of A given B as P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.									
S&P	CP.4		SPCR.4 Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities.									
S&P	CP.5		SPCR.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.									
S&P	CP.6		SPCR.6 Calculate the conditional probability of an event A given event B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.									
S&P	CP.7 & 8		SPCR.7 Apply the Addition Rule and the Multiplication Rule to determine probabilities, including conditional probabilities, and interpret the results in terms of the probability model.									
S&P	CP.9		SPCR.8 Use permutations and combinations to solve mathematical and real-world problems, including determining probabilities of compound events. Justify the results.									
S&P	IC.1	Making Inferences and Justifying Conclusions	SPMJ.1* Understand statistics and sampling distributions as a process for making inferences about population parameters based on a random sample from that population.	7.DSP.1, 7.DSP.2, 7.DSP.4								
S&P	IC.2		SPMJ.2* Distinguish between experimental and theoretical probabilities. Collect data on a chance event and use the relative frequency to estimate the theoretical probability of that event. Determine whether a given probability model is consistent with experimental results.	7.DSP.6, 7.DSP.7								
S&P	IC.3		SPMJ.3 Plan and conduct a survey to answer a statistical question. Recognize how the plan addresses sampling technique, randomization, measurement of experimental error and methods to reduce bias.									
S&P	IC.4		SPMJ.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.									
S&P	IC.5		SPMJ.5 Distinguish between experiments and observational studies. Determine which of two or more possible experimental designs will best answer a given research question and justify the choice based on statistical significance.									
S&P	IC.6		SPMJ.6 Evaluate claims and conclusions in published reports or articles based on data by analyzing study design and the collection, analysis, and display of the data.									

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S&P	ID.1	Interpreting Data	SPID.1* Select and create an appropriate display, including dot plots, histograms, and box plots, for data that includes only real numbers.									
S&P	ID.2		SPID.2* Use statistics appropriate to the shape of the data distribution to compare center and spread of two or more different data sets that include all real numbers.									
S&P	ID.3		SPID.3* Summarize and represent data from a single data set. Interpret differences in shape, center, and spread in the context of the data set, accounting for possible effects of extreme data points (outliers).									
S&P	ID.4		SPID.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.									
S&P	ID.5		SPID.5* Analyze bivariate categorical data using two-way tables and identify possible associations between the two categories using marginal, joint, and conditional frequencies.	8.DSP.4								
S&P	ID.6		SPID.6* Using technology, create scatterplots and analyze those plots to compare the fit of linear, quadratic, or exponential models to a given data set. Select the appropriate model, fit a function to the data set, and use the function to solve problems in the context of the data.									
S&P	ID.7		SPID.7* Create a linear function to graphically model data from a real-world problem and interpret the meaning of the slope and intercept(s) in the context of the given problem.									
S&P	ID.8		SPID.8* Using technology, compute and interpret the correlation coefficient of a linear fit.									
S&P	ID.9		SPID.9 Differentiate between correlation and causation when describing the relationship between two variables. Identify potential lurking variables which may explain an association between two variables.									
S&P			SPID.10 Create residual plots and analyze those plots to compare the fit of linear, quadratic, and exponential models to a given data set. Select the appropriate model and use it for interpolation.									
S&P	MD. 1	Using Probability to Make Decisions	SPMD.1 Develop the probability distribution for a random variable defined for a sample space in which a theoretical probability can be calculated and graph the distribution.									
S&P	MD.2		SPMD.2 Calculate the expected value of a random variable as the mean of its probability distribution. Find expected values by assigning probabilities to payoff values. Use expected values to evaluate and compare strategies in real-world scenarios.									
S&P	MD. 3		SPMD.3 Construct and compare theoretical and experimental probability distributions and use those distributions to find expected values.									
S&P	MD.4		SPMD.4* Use probability to evaluate outcomes of decisions by finding expected values and determine if decisions are fair.	7.DSP.6, 7.DSP.7, 7.DSP.8								
S&P	MD.5		SPMD.5* Use probability to evaluate outcomes of decisions. Use probabilities to make fair decisions.	7.DSP.6, 7.DSP.7, 7.DSP.8								
S&P	MD.6		SPMD.6* Analyze decisions and strategies using probability concepts.	7.DSP.6, 7.DSP.7, 7.DSP.8								
C		Limits and Continuity	LC.1 Understand the concept of a limit graphically, numerically, analytically, and contextually. a. Estimate and verify limits using tables, graphs of functions, and technology. b. Calculate limits, including one-sided limits, algebraically using direct substitution, simplification, rationalization, and the limit laws for constant multiples, sums, differences, products, and quotients. c. Calculate infinite limits and limits at infinity. Understand that infinite limits and limits at infinity provide information regarding the asymptotes of certain functions, including rational, exponential and logarithmic functions.									
C			LC.2 Understand the definition and graphical interpretation of continuity of a function. a. Apply the definition of continuity of a function at a point to solve problems. b. Classify discontinuities as removable, jump, or infinite. Justify that classification using the definition of continuity. c. Understand the Intermediate Value Theorem and apply the theorem to prove the existence of solutions of equations arising in mathematical and real-world problems.									

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C		Derivatives	D.1 Understand the concept of the derivative of a function geometrically, numerically, analytically, and verbally. a. Interpret the value of the derivative of a function as the slope of the corresponding tangent line. b. Interpret the value of the derivative as an instantaneous rate of change in a variety of real-world contexts such as velocity and population growth. c. Approximate the derivative graphically by finding the slope of the tangent line drawn to a curve at a given point and numerically by using the difference quotient. d. Understand and explain graphically and analytically the relationship between differentiability and continuity. e. Explain graphically and analytically the relationship between the average rate of change and the instantaneous rate of change. f. Understand the definition of the derivative and use this definition to determine the derivatives of various functions.									
C			D.2 Apply the rules of differentiation to functions. a. Know and apply the derivatives of constant, power, trigonometric, inverse trigonometric, exponential, and logarithmic functions. b. Use the constant multiple, sum, difference, product, quotient, and chain rules to find the derivatives of functions. c. Understand and apply the methods of implicit and logarithmic differentiation.									
C			D.3 Apply theorems and rules of differentiation to solve mathematical and real-world problems. a. Explain geometrically and verbally the mathematical and real-world meanings of the Extreme Value Theorem and the Mean Value Theorem. b. Write an equation of a line tangent to the graph of a function at a point. c. Explain the relationship between the increasing/decreasing behavior of f and the signs of f'. Use the relationship to generate a graph of f given the graph of f', and vice versa, and to identify relative and absolute extrema of f. d. Explain the relationships among the concavity of the graph of f, the increasing/decreasing behavior of f' and the signs of f''. Use those relationships to generate graphs of f, f', and f'' given any one of them and identify the points of inflection of f. e. Solve a variety of real-world problems involving related rates, optimization, linear approximation, and rates of change.									
C		Integrals	C.I.1 Understand the concept of the integral of a function geometrically, numerically, analytically, and contextually. a. Explain how the definite integral is used to solve area problems. b. Approximate definite integrals by calculating Riemann sums using left, right, and mid-point evaluations, and using trapezoidal sums. c. Interpret the definite integral as a limit of Riemann sums. d. Explain the relationship between the integral and derivative as expressed in both parts of the Fundamental Theorem of Calculus. Interpret the relationship in terms of rates of change.									
C			C.I.2 Apply theorems and rules of integration to solve mathematical and real-world problems. a. Apply the Fundamental Theorems of Calculus to solve mathematical and real-world problems. b. Explain graphically and verbally the properties of the definite integral. Apply these properties to evaluate basic definite integrals. c. Evaluate integrals using substitution.									

A cell with no limitation indicates the standard should be fully taught in the specified course.

#Districts may wish to create an extension unit in Geometry to review these Graduation Standards.