Florida 2012 EOC Assessments

Algebra 1
End-of-Course Assessment
Test Item Specifications
Version 2

FLORIDA DEPARTMENT OF EDUCATION
www.fldoe.org

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Introduction

In recent years, two realities focused attention on the need to reevaluate Florida's Sunshine State Standards (Standards). First, in 2005, outside consultants reviewed the 1996 Standards and suggested that the benchmark language offer greater specificity to indicate clearly what teachers should teach and what students should be able to do. Second, federal legislation through the *No Child Left Behind Act of 2001* (NCLB) holds schools and school districts accountable for how well each child is learning, which further emphasized the need to hone expectations for all students.

In January 2006, the Department of Education (DOE) committed to a six-year cycle of review and revision of the K–12 content standards. The mathematics standards were rewritten and the Next Generation Sunshine State Standards (NGSSS) for mathematics were adopted by the Florida State Board of Education in September 2007 (available online at http://www.floridastandards.org/Standards/FLStandardSearch.aspx).

The NGSSS are subdivided into benchmarks that identify what a student should know and be able to do. This document, *Algebra 1 End-of-Course Assessment Test Item Specifications* (*Specifications*), provides information about the benchmarks, the stimulus types, and the test items.

The Florida Comprehensive Assessment Test® 2.0 (FCAT 2.0) measures achievement of Florida students in writing, reading, mathematics, and science. End-of-course (EOC) assessments measure achievement of Florida students who have completed coursework in Algebra 1, Biology 1, Civics, Geometry, and U.S. History. The Algebra 1 EOC Assessment measures achievement of Florida students enrolled in Algebra 1, or an equivalent course, by assessing student progress on benchmarks from the NGSSS that are assigned to Algebra 1 course descriptions.

Origin and Purpose of the *Specifications*

The Florida Department of Education and committees of experienced Florida educators developed and approved the *Specifications*. The *Specifications* is a resource document that defines the content and format of the test and test items for item writers and reviewers. Each *Specifications* document indicates the alignment of items with the NGSSS. It also serves to provide all stakeholders with information about the scope and function of the FCAT 2.0 and end-of-course assessments.

Scope of this Document

The *Specifications* for the Algebra 1 EOC Assessment provides general guidelines for the development of all test items used in the Algebra 1 EOC Assessment. Three additional *Specifications* documents provide the same information for FCAT 2.0 Mathematics grades 3–5 and grades 6–8 and for the Geometry EOC Assessment.

The Overall Considerations section in this Introduction provides an explanation of the mathematics elements assessed by the test. The Criteria for Algebra 1 End-of-Course Assessment Items section addresses the quality of the stimuli and test items and selection and development of multiple-choice and fill-in response items. The Item Difficulty and Cognitive Complexity section addresses cognitive-complexity levels as well as item difficulty and universal design. The Individual Benchmark Specifications section contains specific information about each benchmark. This section provides benchmark clarification statements,

content limits, stimulus attributes, response attributes, and a sample item for each benchmark grouping.

Overall Considerations

This section of the *Specifications* describes the guidelines that apply to all test items developed for the Algebra 1 EOC Assessment.

Overall considerations are broad item-development issues that should be addressed during the development of test items. Other sections relate more specifically to one aspect of the development (e.g., item types or content limits).

1. Each test item should be written to measure primarily one benchmark; however, other benchmarks may also be reflected in the item content.
2. When benchmarks are combined for assessment, the individual specification indicates which benchmarks are combined.
3. Test items should be course appropriate for students in terms of difficulty, cognitive development, and reading level.
4. Test items will exhibit a varied range of difficulty.
5. Test items should not disadvantage or exhibit disrespect to anyone in regard to age, gender, race, ethnicity, language, religion, socioeconomic status, disability, or geographic region.
6. For the Algebra 1 End-of-Course Assessment, a four-function calculator will be allowed. For the Geometry End-of-Course Assessment, a scientific calculator will be allowed.
7. Test items may require the student to apply mathematical knowledge described in NGSSS benchmarks from lower grades; however, the benchmarks from lower grades will not be assessed in isolation.
8. Test items should provide clear and complete instructions to students.
9. Each test item should be written clearly and unambiguously to elicit the desired response.
10. A reference sheet containing appropriate formulas and conversions is provided to students taking the Algebra 1 EOC Assessment and the Geometry EOC Assessment during testing. Copies of the reference sheets are included in Appendix G of this document.
11. Test items on the EOC assessments should be written so that students are expected to select or provide the most accurate answer possible. Students should not round decimal equivalents and/or approximations until the final step of the item or task. Whenever possible, the test item stem should specify the decimal place, equivalent fraction, and/or *pi* approximation needed for the answer. In most cases, front-end estimation and truncation are not accurate processes for estimation.

Criteria for Algebra 1 End-of-Course Assessment Items

The Algebra 1 EOC Assessment includes two types of test items: multiple-choice items (MC) and fill-in response items (FR). The general specifications on pages 3 through 14 cover the following criteria:

- Use of Graphics
- Item Style and Format
- Scope of Test Items
- Guidelines for Item Writers
- Item Difficulty and Cognitive Complexity of Algebra 1 End-of-Course Assessment Items
- Universal Design

Use of Graphics

Graphics are used extensively in the Algebra 1 EOC Assessment to provide both necessary and supplemental information. That is, some graphics contain information that is necessary for answering the question, while other graphics illustrate or support the context of the question. All artwork must be high quality.

Most of the individual benchmark specifications in the *Specifications* indicate the extent to which graphics should be used to support test items developed for the benchmark. When no reference is made to the use of graphics, graphics are not required, although they may be used.

Item Style and Format

This section presents stylistic guidelines and formatting directions that should be followed while developing test items. Guidelines are provided separately for each item type to be developed.

General Guidelines

1. Items should be clear and concise, and they should use vocabulary and sentence structure appropriate for the assessed grade level.
2. The final sentence of any MC or FR item stem must be expressed as a question.
3. If an item or task asks a question involving the word *not*, the word *not* should be emphasized by all uppercase letters (e.g., "Which of the following is NOT an example of . . .").
4. For MC and FR items that refer to an estimate (noun), lowercase letters should be used.
5. As appropriate, boldface type should be used to emphasize key words in the test item question (e.g., **least**, **most**, **greatest**, **percent**, **mode**, **median**, **mean**, **range**, etc.).

6. Masculine pronouns should NOT be used to refer to both sexes. Plural forms should be used whenever possible to avoid gender-specific pronouns (e.g., instead of "The student will make changes so that he . . . ," use "The students will make changes so that they . . .").
7. An equal balance of male and female names should be used, including names representing different ethnic groups appropriate for Florida.
8. For clarity, operation symbols, equality signs, and ordinates should be preceded and followed by one space.
9. Decimal numbers between -1 and 1 (including currency) should have a leading zero.
10. Metric numbers should be expressed in a single unit when possible (e.g., 1.4 kilograms instead of 1 kilogram 400 grams).
11. Decimal notation should be used for numbers with metric units (e.g., 1.2 grams instead of $1\frac{1}{5}$ grams).
12. The comma should be used in a number greater than or equal to 1,000 when the number is given in the context of the problem. If a number greater than or equal to 1,000 is presented in an equation or an algebraic expression, no comma should be used. Metric numbers with four digits should be presented without a comma or a space (e.g., 9960 meters). For metric numbers with more than four digits, a thin space should be inserted in place of a comma (e.g., 10 123 kilograms). Dollar amounts of $1,000 or more should include commas.
13. Units of measure should be spelled out, except in graphics where an abbreviation may be used (e.g., *ft* or *yd*). Abbreviations that also spell a word must be punctuated to avoid confusion. For example, to avoid confusion with the preposition *in*, the abbreviation *in*. should include a period and should be used for the unit of measure *inches*. If an abbreviation is used in a graphic, an explanation of the meaning of the abbreviation should be included in the stem.
14. In titles for tables and charts and in labels for axes, the units of measure should be included, preferably in lowercase and in parentheses, e.g., *height (in inches)*.
15. Fractions should be typed with a horizontal fraction bar. The numerator and denominator should be centered with respect to each other. The bar should cover all portions (superscripts, parentheses, etc.) of the numerator and denominator. In a mixed number, a half space should appear between the whole number and the fraction. If a variable appears before or after a fraction bar, the variable should be centered with respect to the fraction bar. If a stimulus, stem, or set of responses contains a fraction in fractional notation, that portion of the item should be 1.5-spaced.
16. In general, numbers zero through nine should be presented as words, and numbers 10 and above should be presented as numerals. In the test item stem, any numbers needed to compute answers should be presented as numerals.

17. In MC items where π is used in the stem, the question or answer options should address which form of π should be used or if the answer will be kept in π form. In FR items, the question should address which form of π should be used or the key answer should account for using 22/7 or 3.14.
18. All angle measurements will be in degrees.

Multiple-Choice (MC) Items

1. MC items should take an average of two minutes per item to solve.
2. MC items are worth one point each.
3. MC items should have four answer choices (A, B, C, and D).
4. The correct response should be indicated.
5. During item development and review, the rationale for distractors (incorrect answer options) should be indicated and set off in brackets.
6. In most cases, answer options should be arranged vertically beneath the item stem.
7. If four graphics are labeled horizontally or vertically and horizontally, the labeling should be as follows:

A. B. C. D.	or	A. C. B. D.	
Figure 1 Figure 2 Figure 3 Figure 4	or	Figure 1 Figure 2	Figure 3 Figure 4

8. If the answer options for an item are strictly numerical, they should be arranged in ascending or descending order, with the place values of digits aligned. When the item requires the identification of relative size or magnitude, options should be arranged as they are presented in the item stem.
9. If the answer options for an item are neither strictly numerical nor denominate numbers, the options should be arranged by the logic presented in the question, by alphabetical order, or by length.
10. Distractors should represent computational or procedural errors commonly made by students who have not mastered the assessed concepts. Each distractor should be a believable answer for someone who does not really know the correct answer.
11. Outliers (i.e., answer choices that are longer phrases or sentences than the other choices, or choices with significantly more/fewer digits than the other choices) should NOT be used.
12. Responses such as "None of the Above," "All of the Above," and "Not Here" should not be used.
13. Responses such as "Not Enough Information" or "Cannot Be Determined" should not be used unless they are a part of the benchmark being assessed. They should not be used as distractors for the sake of convenience.
14. If a response is a phrase, the phrase should start with a lowercase letter. No period should be used at the end of a phrase.
15. If a response is a sentence, the sentence should be conventionally capitalized and punctuated.

Fill-In Response (FR) Items

1. The Algebra 1 EOC and Geometry EOC Assessments use FR items.
2. FR items should take an average of 2.5 minutes per item to complete.
3. FR items are worth one point each.
4. Multiple formats (e.g., equivalent fractions and decimals) are acceptable for items as long as each form of the correct response can be recorded in the grid.
5. FR items may have a negative answer.
6. FR items should include instructions that specify the unit in which the answer is to be provided (e.g., inches). If several units of measure are in the item (e.g., in an item involving a conversion), the final unit needed for the answer should be written in boldface.
7. FR items are written with consideration for the number of columns in the response box.
8. The Algebra 1 EOC and Geometry EOC Assessments are computer based and will use a seven-column fill-in response box for items not assessed by multiple choice.

Scope of Test Items

The scope of Algebra 1 EOC Assessment test items is presented in Appendix B, which gives the benchmarks for Algebra 1 EOC. The benchmarks serve as the objectives to which the test items are written. There may be additional specifications or restrictions by grade level or course; these are given in the General Content Limits section of the *Specifications*.

Some of the benchmarks are assessed across grades 3–8, Algebra 1, and Geometry. These benchmarks are introduced at one grade with the understanding that they will be assessed at higher levels of difficulty in each succeeding grade. Florida's NGSSS are available at http://www.floridastandards.org/Standards/FLStandardSearch.aspx.

Guidelines for Item Writers

Item writers must have a comprehensive knowledge of the assessed mathematics curriculum and a strong understanding of the cognitive abilities of the students taking the test. Item writers should know and consistently apply the guidelines established in these *Specifications* as well as contribute to the goal of developing test content that allows students to perform at their best. Item writers are also expected to use their best judgment in writing items that measure the mathematics benchmarks of the NGSSS without introducing extraneous elements that reflect bias for or against a group of students.

Item writers for Algebra 1 EOC must submit items in a particular format and must include the following information about each item. Because items are rated by committees of Florida educators following submission to the DOE, familiarity with the directions for rating items (found in Appendix E) would prove useful to all item writers.

Format

Item writers must submit test items in the agreed-upon template. All appropriate sections of the template should be completed before the items are submitted.

Sources

Item writers are expected to provide sources of all verifiable information included in the test item. Acceptable sources include up-to-date textbooks, magazines and journals respected by the mathematics community, and Internet sites maintained by reputable organizations such as universities. It may be necessary to provide sources verifying why a correct answer is correct, as well as why other responses are incorrect.

Correct Response

Item writers must supply the correct response.

- For multiple-choice items, this includes an explanation of why each distractor is incorrect.
- For fill-in response items, this includes explanations of why the correct answer is correct and an explanation of additional possible correct answers.

Submission of Items

When submitting items, item writers must balance several factors. Item submissions should

- include test items of varying difficulty;
- include test items of varying cognitive complexity;
- have an approximate balance, for multiple-choice items, of the correct response among the four answer options;
- have an equal balance of male and female names; and
- include names representing different ethnic groups in Florida.

Item Difficulty and Cognitive Complexity of Algebra 1 End-of-Course Assessment Items

Educational standards and assessments can be aligned based on the category of content covered and also on the complexity of knowledge required. The Algebra 1 EOC Assessment items, while assessing Florida's NGSSS, must also reflect this goal and standard. It is important to develop items that elicit student responses that demonstrate the complexity of knowledge and skills required to meet these objectives. The degree of challenge of FCAT 2.0 and EOC items is currently categorized in two ways: **item difficulty** and **cognitive complexity**.

Item Difficulty

The difficulty of FCAT 2.0 and EOC items is initially estimated by committees of educators participating in Item Content Review meetings each year. As each test item is reviewed, committee members make a prediction of difficulty based upon their knowledge of student performance at the given grade level. The classification scheme used for this prediction of item difficulty is based on the following:

Easy	More than 70 percent of the students are likely to respond correctly.
Average	Between 40 percent and 70 percent of the students are likely to respond correctly.
Challenging	Fewer than 40 percent of the students are likely to respond correctly.

After an item appears on a test, item difficulty refers to the actual percentage of students who chose the correct answer.

Cognitive Complexity

Cognitive complexity refers to the cognitive demand associated with a test item. In the early years of the FCAT program, the DOE used Bloom's Taxonomy[1] to classify test items; however, Bloom's Taxonomy is difficult to use because it requires an inference about the skill, knowledge, and background of the students responding to the item. Beginning in 2004, the DOE implemented a new cognitive classification system based upon Dr. Norman L. Webb's Depth of Knowledge (DOK) levels.[2] The rationale for classifying an item by its DOK level of complexity focuses on the *expectations made of the item,* not on the *ability of the student*. When classifying an item's demands on thinking (i.e., what the item requires the student to recall, understand, analyze, and do), it is assumed that the student is familiar with the basic concepts of the task. Test items are chosen for the FCAT 2.0 and EOC assessments based on the NGSSS and their grade-level or course appropriateness, but the complexity of the items remains independent of the particular curriculum a student has experienced. On any given assessment, the cognitive complexity of a multiple-choice item may be affected by the distractors (answer options). The cognitive complexity of an item depends on the grade level of the assessment; an item that has a high level of cognitive complexity at one grade may not be as complex at a higher grade.

The categories—low complexity, moderate complexity, and high complexity—form an ordered description of the demands an item may make on a student. For example, low-complexity items may require a student to solve a one-step problem. Moderate-complexity items may require multiple steps. High-complexity items may require a student to analyze and synthesize information. The distinctions made in item complexity ensure that items will assess the depth of student knowledge at each benchmark. The intent of the item writer weighs heavily in determining the complexity of an item.

The pages that follow illustrate some of the varying demands that items might make at each complexity level for Algebra 1. Note that items may fit one or more descriptions. In most instances, these items are classified at the highest level of complexity demanded by the item. Caution must be used in referring to the chart of descriptors that is provided for each cognitive complexity level. This chart is provided for ease of reference, but the ultimate determination of item complexity should be made considering the overall cognitive demand placed on a student. A table also provides the breakdown of the percentage of points by cognitive-complexity level.

Item writers are expected to evaluate their items in terms of cognitive complexity and include this on the item template. Test items should be written to the highest level of complexity as appropriate to the assessed benchmark.

[1] Bloom, B.S. et al. *Taxonomy of Educational Objectives, Handbook I: Cognitive Domain.* New York: McKay, 1956.
[2] Webb, Norman L. and others. "Web Alignment Tool" 24 July 2005. Wisconsin Center for Education Research. University of Wisconsin-Madison. 2 Feb. 2006. http://www.wcer.wisc.edu/WAT/index.aspx.

Low Complexity

Algebra 1 low-complexity items rely heavily on the recall and recognition of previously learned concepts and principles. Items typically specify what the student is to do, which is often to carry out some procedure that can be performed mechanically. It is not left to the student to come up with an original method or solution.

Below is an example of a low-complexity test item that is based on Benchmark MA.912.A.3.5. For more information about this benchmark, see page 42.

The owner of a clothing store buys leather jackets at wholesale cost, then sells them to the public at a higher retail price. She determines the retail price of one jacket by tripling the wholesale cost and adding 10% of the wholesale cost. Which equation could be used to calculate r, the retail price of a jacket, based on w, the wholesale price of the jacket?

A. $r = 3w + 10w$
★ **B.** $r = 3w + 0.1w$
C. $r = w + 10(3w)$
D. $r = w + 0.1(3w)$

Moderate Complexity

Algebra 1 moderate-complexity items involve more flexible thinking than low-complexity items. Items require a response that goes beyond the habitual, is not explicitly specified in the text, and ordinarily has more than a single step. The student is expected to decide what to do—using informal methods of reasoning and problem-solving strategies—and to bring together skill and knowledge from various domains.

Below is an example of a moderate-complexity item that is based on Benchmark MA.912.A.3.14. For more information about this benchmark, see page 55.

Monique owns a catering business. Last weekend, she catered two events in which all attendees were served either a chicken or a steak dinner. The table below shows some pricing information about these two events.

BEFORE-TAX PRICES FOR MONIQUE'S CATERED EVENTS

Day of Event	Number of Chicken Dinners Served	Number of Steak Dinners Served	Total Before-Tax Price of Dinners
Saturday	27	17	$ 809.50
Sunday	46	34	$1,495.00

The following system of equations can be used to determine the before-tax price of c dollars for each chicken dinner and s dollars for each steak dinner Monique served.

$$27c + 17s = 809.50$$
$$46c + 34s = 1495.00$$

What is the before-tax price of a chicken dinner?

			1	5	.	5

Correct Answer: 15.5

High Complexity

Algebra 1 high-complexity items make heavy demands on student thinking. Items often have multiple decision points requiring the student to think in a sophisticated way. Both the algebraic thinking and the algebraic process required go beyond the routine.

Below is an example of a high-complexity item that is based on Benchmark MA.912.A.3.10. For more information about this benchmark, see page 49.

What is the x-intercept of the line parallel to $2x - 4y = 8$ and passing through (7, 1)?

						5

Correct Answer: 5

The following chart is provided for ease of reference; however, caution must be used in referring to this chart of descriptors for each cognitive-complexity level. The ultimate determination of an item's cognitive complexity should be made considering the intent of the overall cognitive demand placed on a student.

Examples of FCAT 2.0 and EOC Mathematics Activities across Cognitive-Complexity Levels		
Low Complexity	**Moderate Complexity**	**High Complexity**
• Recall or recognize a fact, term, or property. • Identify appropriate units or tools for common measurements. • Compute a sum, difference, product, or quotient. • Recognize or determine an equivalent representation. • Calculate the value of an expression, given specific values for the variables. • Solve a one-step problem. • Retrieve information from a graph, table, or figure. • Perform a single-unit conversion (e.g., feet to inches).	• Solve a problem requiring multiple operations. • Solve a problem involving multiple transformations of a figure or spatial visualization or reasoning. • Retrieve information from a graph, table, or figure and use it to solve a problem. • Compare figures or statements. • Determine a reasonable estimate. • Extend an algebraic or geometric pattern. • Explain steps of a solution process. • Translate and solve a routine problem, given data and conditions. • Represent a situation mathematically in more than one way.	• Solve real-world problems using multiple steps and multiple decision points. • Describe how different representations can be used for different purposes. • Solve a nonroutine problem (as determined by grade-level appropriateness). • Analyze similarities and differences between procedures and concepts. • Generalize an algebraic or geometric pattern. • Formulate an original problem, given a situation. • Solve a problem in more than one way. • Provide a mathematical explanation and/or justification to a problem. • Describe, compare, and contrast solution methods. • Formulate a mathematical model for a complex situation. • Analyze or produce a deductive argument.

Items are classified on the cognitive demand inherent in the test items, not on assumptions about the student's approach to the items. Low-complexity items rely heavily on recall and recognition. Moderate-complexity items require more flexible thinking and may require informal reasoning or problem solving. High-complexity items are written to elicit analysis and abstract reasoning.

The table below presents the range for the percentage of raw-score points by cognitive-complexity level on each mathematics assessment.

Percentage of Points by Cognitive-Complexity Level for FCAT 2.0 and EOC Mathematics

Grades/Courses	Low	Moderate	High
3–4	25–35	50–70	5–15
5	10–20	55–75	10–20
6–8	10–20	60–80	10–20
Algebra 1	10–20	60–80	10–20
Geometry	10–20	60–80	10–20

Universal Design

The application of universal design principles helps develop assessments that are usable by the greatest number of test takers, including those with disabilities and nonnative speakers of English. To support the goal of providing access to all students, the test maximizes readability, legibility, and compatibility with accommodations, and test development includes a review for potential bias and sensitivity issues.

The DOE trains both internal and external reviewers to revise items, allowing for the widest possible range of student participation. Item writers must attend to the best practices suggested by universal design including, but not limited to

- reduction of wordiness;
- avoidance of ambiguity;
- selection of reader-friendly construction and terminology; and
- consistently applied concept names and graphic conventions.

Universal design principles also inform decisions about test layout and design including, but not limited to, type size, line length, spacing, and graphics.

Review Procedures for Algebra 1 End-of-Course Assessment Test Items

Prior to appearing on any assessment, all Algebra 1 items must pass several levels of review as part of the development process. Florida educators and citizens, in conjunction with the DOE and assessment contractors, scrutinize all material prior to accepting it for placement on the tests.

Review for Potential Bias

Mathematics items are reviewed by groups of Florida educators generally representative of Florida's geographic regions and culturally diverse population. Items are reviewed for the following kinds of bias: gender, racial, ethnic, linguistic, religious, geographic, and socioeconomic. Item reviews also include consideration of issues related to individuals with disabilities.

Review for Community Sensitivity

Florida citizens associated with a variety of organizations and institutions review all items for issues of potential concern to members of the community at large. The purpose for this review is to ensure that the primary purpose of assessing mathematics achievement is not undermined by inadvertently including in the test any materials that parents and other stakeholders alike may deem inappropriate. Reviewers are asked to consider the variety of cultural, regional, philosophical, political, and religious backgrounds throughout Florida, and then to determine whether the subject matter will be acceptable to Florida students, their parents, and other members of Florida communities. Test items are written to meet Algebra 1 EOC criteria.

Review of Test Items

The DOE and the assessment contractors review all test items during the item-development process.

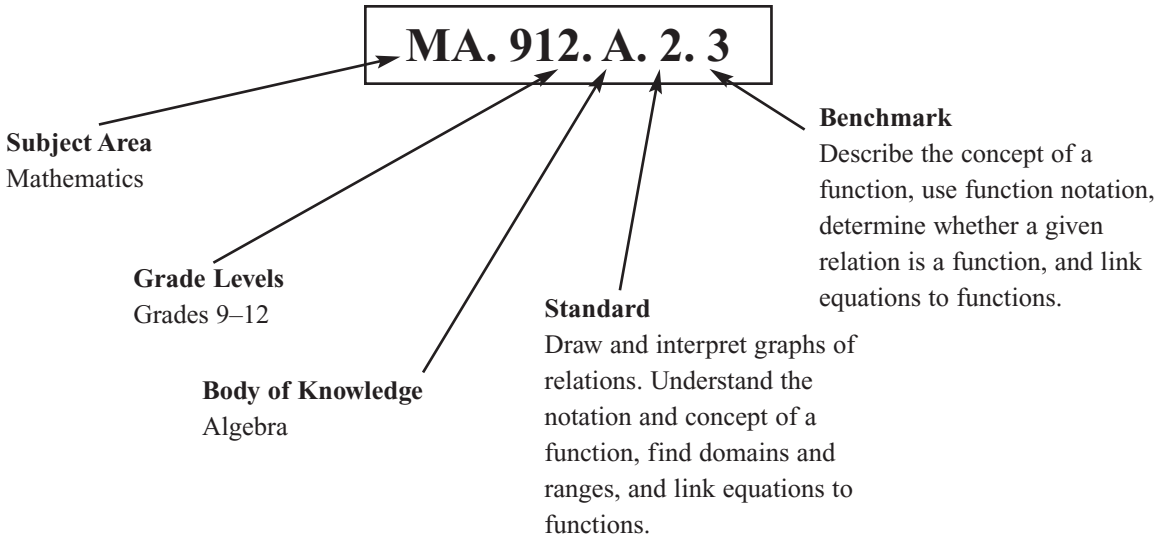
Groups of Florida educators and citizens are subsequently convened to review the test items for content characteristics and item specifications. The content review focuses on validity, determining whether each item is a valid measure of the designated NGSSS benchmark, as defined by the course specifications for test items. Separate reviews for bias and sensitivity issues are also conducted as noted above.

Algebra 1 items are field tested with a large group of students in Florida to ensure clarity of items before they count toward a student's score. In the event an item does not test well, it is either deleted or revised. Revised items will again require field testing prior to being scored.

Benchmark Classification System

Each benchmark in the NGSSS is labeled with a system of numbers and letters.

- The letters in the *first two positions* of the code identify the **Subject Area** (e.g., MA for mathematics).
- The numbers in the *third, fourth, and fifth positions* represent the **Grade Levels** to which the benchmark belongs.
- The letter in the *sixth position* of the code represents the **Body of Knowledge** to which the benchmark belongs.
- The number in the *seventh position* represents the **Standard** to which the benchmark belongs.
- The number in the *last position* of the code states the specific **Benchmark** under the grade-level Standard.



Grades 9–12 Body of Knowledge Algebra
Standard 2: Relations and Functions Draw and interpret graphs of relations. Understand the notation and concept of a function, find domains and ranges, and link equations to functions.
MA.912.A.2.3 Describe the concept of a function, use function notation, determine whether a given relation is a function, and link equations to functions.

Definitions of Benchmark Specifications

The *Specifications* identifies how Florida's NGSSS benchmarks are assessed by FCAT 2.0 Mathematics grades 3–8, Algebra 1 EOC, and Geometry EOC. For each benchmark assessed in mathematics, the following information is provided in each grade-level *Specifications* section.

Body of Knowledge refers to eight general categories of mathematics standards at the high school level: Algebra, Calculus, Discrete Mathematics, Financial Literacy, Geometry, Probability, Statistics, and Trigonometry. These Bodies of Knowledge do not comprise courses. Standards and benchmarks were pulled from the various Bodies of Knowledge to write specific high-school level courses (such as Algebra 1) in mathematics.

Reporting Category is a grouping of related benchmarks from the NGSSS that is used to summarize and report achievement for FCAT 2.0 Mathematics, the Algebra 1 EOC Assessment, and the Geometry EOC Assessment.

Standard refers to the standard statement presented in the NGSSS.

Benchmark refers to the benchmark statement presented in the NGSSS. The benchmarks are specific statements of expected student achievement. The benchmarks are different for the different grade levels or courses assessed (as described at the beginning of this section). In some cases, two or more related benchmarks are grouped together because the assessment of one benchmark addresses another benchmark. Such groupings are indicated in the benchmark statement.

Item Types are used to assess the benchmark or group of benchmarks. The types of items used on the assessment are described in the Item Style and Format section of the *Specifications*. In the Sample Items section that follows, the item types are abbreviated as MC for multiple choice and FR for fill-in response.

Benchmark Clarification explains how the achievement of the benchmark will be demonstrated by students for each specific item type. The clarification statements explain what students are expected to do when responding to the question.

Content Limits define the range of content knowledge and degree of difficulty that should be assessed in the test items for the benchmark.

Benchmark content limits are to be used in conjunction with the General Content Limits identified in the *Specifications*. The content limits defined in the Individual Benchmark Specifications section may be an expansion or further restriction of the General Content Limits specified earlier in the *Specifications*.

Stimulus Attributes define the types of stimulus materials that should be used in the test items, including the appropriate use of graphic materials and item context or content.

Response Attributes define the characteristics of the answers that a student must choose from or provide.

Sample Items are provided for each type of question assessed. The sample items are presented in a format like that used in the test. The correct answer for each sample item is identified in the following manner:

- For MC items, the correct answer is indicated with a five-point star.
- For FR items, the acceptable answers are given.

Item Context gives a topical frame of reference to real-world applications of the test items.

General Content Limits for EOC Assessments

Algebra 1 and Geometry End-of-Course General Content Limits

The content limits described below are applicable to all test items developed for the Algebra 1 and Geometry End-of-Course Assessments; however, the content limits defined in the Individual Benchmark Specifications can supersede these general content limits.

Whole numbers

Addition
- Items should not require the use of more than six addends.
- Addends should not exceed six digits.

Subtraction
- Subtrahends, minuends, and differences should not exceed six digits.

Multiplication
- Products should not exceed eight digits.

Division
- Divisors should not exceed three digits.
- Dividends should not exceed five digits.

Decimals

Addition
- Items should not require the use of more than six addends.
- Addends should not exceed six digits.

Subtraction
- Subtrahends, minuends, and differences should not exceed six digits.

Multiplication
- Products should not exceed eight digits.

Division
- Divisors should not exceed three digits, unless dealing with currency.
- Dividends should not exceed five digits, unless dealing with currency.
- Quotients should not exceed seven digits.

Fractions

- Items should not require the use of more than three addends or factors.

Percent

- See benchmark for specific content limits.

Measurement

- See benchmark for specific content limits.

Item Contexts

The situation in which a test item is presented is called the item context. Algebra 1 EOC items may be presented in either real-world or mathematical contexts; however, other variables must also be considered. Several of these considerations are listed below, and others are described in the Individual Benchmark Specifications. For more information about item contexts, refer to the DOE website at http://fcat.fldoe.org/fcat2/pdf/MathematicsAppendixA.pdf.

1. The item content should be designed to interest students at the tested levels.
2. The item context should be designed to incorporate subject areas other than mathematics. Specifically, topics from the NGSSS should be used where appropriate. For example, items may require students to work with topics related to The Arts, Language Arts, Literature, Social Studies/Consumerism, Science, Foreign Language, or Health/Physical Education.
3. As often as possible, items should be presented in real-world contexts or should be related to real-world situations.
4. Items including specific information or data should be accurate and documented against reliable sources. It may be necessary to obtain copyright permissions.
5. The item content should be timely but not likely to become dated too quickly.
6. Information should be presented through written text and/or through visual material, such as graphs, tables, diagrams, maps, models, and/or other illustrations.
7. All graphs provided to the students should be complete with title, scale, and labeled axes, except when these components are to be completed by the student.
8. All graphics in items should be uncluttered and should clearly depict the necessary information. Graphics should contain relevant details that contribute to the student's understanding of the item or support the context of the item. Graphics should not introduce bias to the item.
9. Extraneous information may be included in items.

Benchmarks Assessed on Algebra 1 End-of-Course Assessment and Geometry End-of-Course Assessment

Algebra 1 EOC	Geometry EOC
Body of Knowledge: Algebra	
MA.912.A.1.8 Use the zero product property of real numbers in a variety of contexts to identify solutions to equations. (Assessed with MA.912.A.7.2.)	
MA.912.A.2.3 Describe the concept of a function, use function notation, determine whether a given relation is a function, and link equations to functions. (Also assesses MA.912.A.2.13.)	
MA.912.A.2.4 Determine the domain and range of a relation. (Also assesses MA.912.A.2.13.)	
MA.912.A.2.13 Solve real-world problems involving relations and functions. (Assessed with MA.912.A.2.3 and MA.912.A.2.4.)	
MA.912.A.3.1 Solve linear equations in one variable that include simplifying algebraic expressions. (Also assesses MA.912.A.3.2.)	
MA.912.A.3.2 Identify and apply the distributive, associative, and commutative properties of real numbers and the properties of equality. (Assessed with MA.912.A.3.1.)	
MA.912.A.3.3 Solve literal equations for a specified variable.	
MA.912.A.3.4 Solve and graph simple and compound inequalities in one variable, and be able to justify each step in a solution.	

Prior Knowledge: Items may require the student to apply mathematical knowledge described in NGSSS benchmarks from lower grades; however, the benchmarks from lower grades will not be assessed in isolation.

Benchmarks Assessed on Algebra 1 End-of-Course Assessment and Geometry End-of-Course Assessment

Algebra 1 EOC	Geometry EOC
Body of Knowledge: Algebra (Continued)	
MA.912.A.3.5 Symbolically represent and solve multi-step and real-world applications that involve linear equations and inequalities.	
MA.912.A.3.7 Rewrite equations of a line into slope-intercept form and standard form. (Assessed with MA.912.A.3.10.)	
MA.912.A.3.8 Graph a line given any of the following information: a table of values, the *x*- and *y*-intercepts, two points, the slope and a point, the equation of the line in slope-intercept form, standard form, or point-slope form. (Also assesses MA.912.A.3.12.)	
MA.912.A.3.9 Determine the slope, *x*-intercept, and *y*-intercept of a line given its graph, its equation, or two points on the line.	
MA.912.A.3.10 Write an equation of a line given any of the following information: two points on the line, its slope and one point on the line, or its graph. Also, find an equation of a new line parallel to a given line, or perpendicular to a given line, through a given point on the new line. (Also assesses MA.912.A.3.7, MA.912.A.3.12, and MA.912.G.1.4.)	
MA.912.A.3.11 Write an equation of a line that models a data set, and use the equation or the graph to make predictions. Describe the slope of the line in terms of the data, recognizing that the slope is the rate of change.	

Prior Knowledge: Items may require the student to apply mathematical knowledge described in NGSSS benchmarks from lower grades; however, the benchmarks from lower grades will not be assessed in isolation.

Benchmarks Assessed on Algebra 1 End-of-Course Assessment and Geometry End-of-Course Assessment

Algebra 1 EOC	Geometry EOC
Body of Knowledge: Algebra (Continued)	
MA.912.A.3.12 Graph a linear equation or inequality in two variables with and without graphing technology. Write an equation or inequality represented by a given graph. (Assessed with MA.912.A.3.8 and MA.912.A.3.10.)	
MA.912.A.3.13 Use a graph to approximate the solution of a system of linear equations or inequalities in two variables with and without technology. (Assessed with MA.912.A.3.14.)	
MA.912.A.3.14 Solve systems of linear equations and inequalities in two and three variables using graphical, substitution, and elimination methods. (Also assesses MA.912.A.3.13 and MA.912.A.3.15.)	
MA.912.A.3.15 Solve real-world problems involving systems of linear equations and inequalities in two and three variables. (Assessed with MA.912.A.3.14.)	
MA.912.A.4.1 Simplify monomials and monomial expressions using the laws of integral exponents.	
MA.912.A.4.2 Add, subtract, and multiply polynomials.	
MA.912.A.4.3 Factor polynomial expressions. (Also assesses MA.912.A.5.1.)	
MA.912.A.4.4 Divide polynomials by monomials and polynomials with various techniques, including synthetic division.	
MA.912.A.5.1 Simplify algebraic ratios. (Assessed with MA.912.A.4.3.)	

Prior Knowledge: Items may require the student to apply mathematical knowledge described in NGSSS benchmarks from lower grades; however, the benchmarks from lower grades will not be assessed in isolation.

Benchmarks Assessed on Algebra 1 End-of-Course Assessment and Geometry End-of-Course Assessment

Algebra 1 EOC	Geometry EOC
Body of Knowledge: Algebra (Continued)	
MA.912.A.5.4 Solve algebraic proportions.	
MA.912.A.6.1 Simplify radical expressions. (Assessed with MA.912.A.6.2.)	
MA.912.A.6.2 Add, subtract, multiply, and divide radical expressions (square roots and higher). (Also assesses MA.912.A.6.1.)	
MA.912.A.7.1 Graph quadratic equations with and without graphing technology. (Also assesses MA.912.A.7.8.)	
MA.912.A.7.2 Solve quadratic equations over the real numbers by factoring and by using the quadratic formula. (Also assesses MA.912.A.1.8 and MA.912.A.7.8.)	
MA.912.A.7.8 Use quadratic equations to solve real-world problems. (Assessed with MA.912.A.7.1 and MA.912.A.7.2.)	
MA.912.A.10.1 Use a variety of problem-solving strategies, such as drawing a diagram, making a chart, guessing-and-checking, solving a simpler problem, writing an equation, working backwards, and creating a table. (Assessed throughout.)	
MA.912.A.10.2 Decide whether a solution is reasonable in the context of the original situation. (Assessed throughout.)	

Prior Knowledge: Items may require the student to apply mathematical knowledge described in NGSSS benchmarks from lower grades; however, the benchmarks from lower grades will not be assessed in isolation.

Benchmarks Assessed on Algebra 1 End-of-Course Assessment and Geometry End-of-Course Assessment

Algebra 1 EOC	Geometry EOC
Body of Knowledge: Discrete Mathematics	
MA.912.D.7.1 Perform set operations such as union and intersection, complement, and cross product.	**MA.912.D.6.2** Find the converse, inverse, and contrapositive of a statement. (Also assesses MA.912.D.6.3.)
MA.912.D.7.2 Use Venn diagrams to explore relationships and patterns and to make arguments about relationships between sets.	**MA.912.D.6.3** Determine whether two propositions are logically equivalent. (Assessed with MA.912.D.6.2.)
	MA.912.D.6.4 Use methods of direct and indirect proof, and determine whether a short proof is logically valid. (Assessed with MA.912.G.3.4 and MA.912.G.4.6.)
Body of Knowledge: Geometry	
MA.912.G.1.4 Use coordinate geometry to find slopes, parallel lines, perpendicular lines, and equations of lines. (Assessed with MA.912.A.3.10.)	**MA.912.G.1.1** Find the lengths and midpoints of line segments in two-dimensional coordinate systems.
	MA.912.G.1.3 Identify and use the relationships between special pairs of angles formed by parallel lines and transversals. (Also assesses MA.912.G.8.5.)
	MA.912.G.2.1 Identify and describe convex, concave, regular, and irregular polygons. (Assessed with MA.912.G.2.3.)
	MA.912.G.2.2 Determine the measures of interior and exterior angles of polygons, justifying the method used.
	MA.912.G.2.3 Use properties of congruent and similar polygons to solve mathematical or real-world problems. (Also assesses MA.912.G.2.1, MA.912.G.4.1, MA.912.G.4.2, MA.912.G.4.4, and MA.912.G.4.5.)

Prior Knowledge: Items may require the student to apply mathematical knowledge described in NGSSS benchmarks from lower grades; however, the benchmarks from lower grades will not be assessed in isolation.

Benchmarks Assessed on Algebra 1 End-of-Course Assessment and Geometry End-of-Course Assessment

Algebra 1 EOC	Geometry EOC
Body of Knowledge: Geometry (Continued)	
	MA.912.G.2.4 Apply transformations (translations, reflections, rotations, dilations, and scale factors) to polygons to determine congruence, similarity, and symmetry. Know that images formed by translations, reflections, and rotations are congruent to the original shape. Create and verify tessellations of the plane using polygons.
	MA.912.G.2.5 Explain the derivation and apply formulas for perimeter and area of polygons (triangles, quadrilaterals, pentagons, etc.). (Also assesses MA.912.G.2.7.)
	MA.912.G.2.7 Determine how changes in dimensions affect the perimeter and area of common geometric figures. (Assessed with MA.912.G.2.5.)
	MA.912.G.3.1 Describe, classify, and compare relationships among quadrilaterals including the square, rectangle, rhombus, parallelogram, trapezoid, and kite. (Assessed with MA.912.G.3.4.)
	MA.912.G.3.2 Compare and contrast special quadrilaterals on the basis of their properties. (Assessed with MA.912.G.3.4.)
	MA.912.G.3.3 Use coordinate geometry to prove properties of congruent, regular, and similar quadrilaterals. (Also assesses MA.912.G.8.5.)
	MA.912.G.3.4 Prove theorems involving quadrilaterals. (Also assesses MA.912.D.6.4, MA.912.G.3.1, MA.912.G.3.2, and MA.912.G.8.5.)
	MA.912.G.4.1 Classify, construct, and describe triangles that are right, acute, obtuse, scalene, isosceles, equilateral, and equiangular. (Assessed with MA.912.G.2.3.)
	MA.912.G.4.2 Define, identify, and construct altitudes, medians, angle bisectors, perpendicular bisectors, orthocenter, centroid, incenter, and circumcenter. (Assessed with MA.912.G.2.3.)

Prior Knowledge: Items may require the student to apply mathematical knowledge described in NGSSS benchmarks from lower grades; however, the benchmarks from lower grades will not be assessed in isolation.

Benchmarks Assessed on Algebra 1 End-of-Course Assessment and Geometry End-of-Course Assessment

Algebra 1 EOC	Geometry EOC
Body of Knowledge: Geometry (Continued)	
	MA.912.G.4.4 Use properties of congruent and similar triangles to solve problems involving lengths and areas. (Assessed with MA.912.G.2.3.)
	MA.912.G.4.5 Apply theorems involving segments divided proportionally. (Assessed with MA.912.G.2.3.)
	MA.912.G.4.6 Prove that triangles are congruent or similar, and use the concept of corresponding parts of congruent triangles. (Also assesses MA.912.D.6.4 and MA.912.G.8.5.)
	MA.912.G.4.7 Apply the inequality theorems: triangle inequality, inequality in one triangle, and the Hinge Theorem.
	MA.912.G.5.1 Prove and apply the Pythagorean Theorem and its converse. (Assessed with MA.912.G.5.4.)
	MA.912.G.5.2 State and apply the relationships that exist when the altitude is drawn to the hypotenuse of a right triangle. (Assessed with MA.912.G.5.4.)
	MA.912.G.5.3 Use special right triangles ($30°-60°-90°$ and $45°-45°-90°$) to solve problems. (Assessed with MA.912.G.5.4.)
	MA.912.G.5.4 Solve real-world problems involving right triangles. (Also assesses MA.912.G.5.1, MA.912.G.5.2, and MA.912.G.5.3.)
	MA.912.G.6.2 Define and identify: circumference, radius, diameter, arc, arc length, chord, secant, tangent, and concentric circles. (Assessed with MA.912.G.6.5.)
	MA.912.G.6.4 Determine and use measures of arcs and related angles (central, inscribed, and intersections of secants and tangents). (Assessed with MA.912.G.6.5.)
	MA.912.G.6.5 Solve real-world problems using measures of circumference, arc length, and areas of circles and sectors. (Also assesses MA.912.G.6.2, MA.912.G.6.4, and MA.912.G.8.5.)

Prior Knowledge: Items may require the student to apply mathematical knowledge described in NGSSS benchmarks from lower grades; however, the benchmarks from lower grades will not be assessed in isolation.

Benchmarks Assessed on Algebra 1 End-of-Course Assessment and Geometry End-of-Course Assessment

Algebra 1 EOC	Geometry EOC
Body of Knowledge: Geometry (Continued)	
	MA.912.G.6.6 Given the center and the radius, find the equation of a circle in the coordinate plane, or given the equation of a circle in center-radius form, state the center and the radius of the circle. (Also assesses MA.912.G.6.7.)
	MA.912.G.6.7 Given the equation of a circle in center-radius form or given the center and the radius of a circle, sketch the graph of the circle. (Assessed with MA.912.G.6.6.)
	MA.912.G.7.1 Describe and make regular, non-regular, and oblique polyhedra, and sketch the net for a given polyhedron and vice versa. (Also assesses MA.912.G.7.2.)
	MA.912.G.7.2 Describe the relationships between the faces, edges, and vertices of polyhedra. (Assessed with MA.912.G.7.1.)
	MA.912.G.7.4 Identify chords, tangents, radii, and great circles of spheres. (Assessed with MA.912.G.7.5.)
	MA.912.G.7.5 Explain and use formulas for lateral area, surface area, and volume of solids. (Also assesses MA.912.G.7.4 and MA.912.G.7.6.)
	MA.912.G.7.6 Identify and use properties of congruent and similar solids. (Assessed with MA.912.G.7.5.)
	MA.912.G.7.7 Determine how changes in dimensions affect the surface area and volume of common geometric solids.
	MA.912.G.8.1 Analyze the structure of Euclidean geometry as an axiomatic system. Distinguish between undefined terms, definitions, postulates, and theorems. (Assessed throughout.)
	MA.912.G.8.2 Use a variety of problem-solving strategies, such as drawing a diagram, making a chart, guess-and-check, solving a simpler problem, writing an equation, and working backwards. (Assessed throughout.)

Prior Knowledge: Items may require the student to apply mathematical knowledge described in NGSSS benchmarks from lower grades; however, the benchmarks from lower grades will not be assessed in isolation.

Benchmarks Assessed on Algebra 1 End-of-Course Assessment and Geometry End-of-Course Assessment

Algebra 1 EOC	Geometry EOC
Body of Knowledge: Geometry (Continued)	
	MA.912.G.8.3 Determine whether a solution is reasonable in the context of the original situation. (Assessed throughout.)
	MA.912.G.8.4 Make conjectures with justifications about geometric ideas. Distinguish between information that supports a conjecture and the proof of a conjecture.
	MA.912.G.8.5 Write geometric proofs, including proofs by contradiction and proofs involving coordinate geometry. Use and compare a variety of ways to present deductive proofs, such as flow charts, paragraphs, two-column, and indirect proofs. (Assessed with MA.912.G.1.3, MA.912.G.3.3, MA.912.G.3.4, MA.912.G.4.6, and MA.912.G.6.5.)
Body of Knowledge: Trigonometry	
	MA.912.T.2.1 Define and use the trigonometric ratios (sine, cosine, tangent, cotangent, secant, and cosecant) in terms of angles of right triangles.

Prior Knowledge: Items may require the student to apply mathematical knowledge described in NGSSS benchmarks from lower grades; however, the benchmarks from lower grades will not be assessed in isolation.

Individual Benchmark Specifications for Algebra 1 End-of-Course Assessment

This section of the *Specifications* describes how Florida's NGSSS benchmarks are assessed. High school assessments are constructed using the Bodies of Knowledge (BOK). Algebra 1 and Geometry are assessed in end-of-course (EOC) formats.

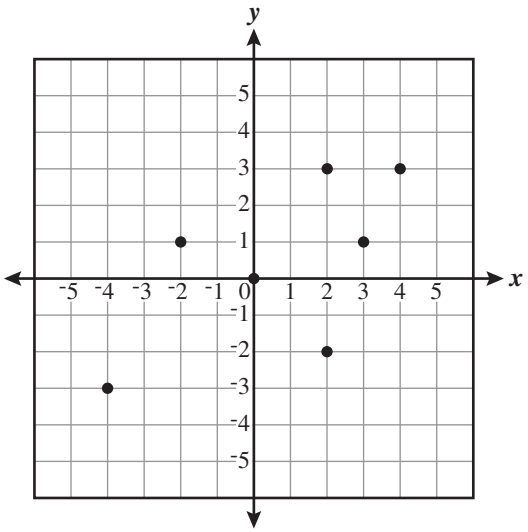
The set of sample test items that is included throughout the *Specifications* document represents a wide range of difficulty and cognitive complexity. Although most of the items are of average difficulty and moderate complexity and can be answered correctly by students who reach Achievement Level 3, some of the items presented will be challenging for some students and are specifically included to prompt item writers to submit items that will measure the abilities of students in higher achievement levels. As the assessment is constructed to measure various achievement levels, this document was constructed to help item writers see the range of difficulties and complexities of items that may appear on a test.

Benchmark MA.912.A.2.3

Body of Knowledge	Algebra
Reporting Category	Functions, Linear Equations, and Inequalities
Standard	**Standard 2** Draw and interpret graphs of relations. Understand the notation and concept of a function, find domains and ranges, and link equations to functions.
Benchmark	**MA.912.A.2.3 Describe the concept of a function, use function notation, determine whether a given relation is a function, and link equations to functions.** Also assesses MA.912.A.2.13 Solve real-world problems involving relations and functions.
Item Types	This benchmark will be assessed using MC and FR items.
Benchmark Clarifications	Students will determine if a given relation is a function. Students will evaluate an equation given in function notation.
Content Limits	In items that require students to write a function, only continuous linear or quadratic functions of the form $y = ax^2$ should be used. In items presenting relations, relations can be given in various forms, including graphs, tables, sets of ordered pairs, and mapping diagrams. Items presenting a relation as a set of ordered pairs may not exceed six ordered pairs in the set. Items presenting a relation in a table should have no more than 8 rows of values. Items presenting a mapping diagram should have no more than 8 arrows. In items presenting relations as graphs for the purpose of determining if the relation is a function, the graph need not be continuous. Graphs that contain only ordered pairs should not exceed 10 ordered pairs. Items should utilize function notation as appropriate.
Response Attribute	Fill-in response items may require that students provide an element of the range (or domain) for a point of interest.

Sample Item 1 **MC**

Andrew plotted a set of points on the coordinate grid shown below. All of the points have integer coefficients.



Which of the following points could be removed so that Andrew's graph represents a function?

A. (-4, -3)
B. (-2, 1)
C. (0, 0)
★ **D.** (2, -2)

Item Context Science, Technology, Engineering, and Mathematics

Sample Item 2 **FR**

The function shown below is used to convert a temperature, x, in degrees Fahrenheit (°F), to a temperature, $f(x)$, in degrees Celsius (°C).

$$f(x) = \frac{5}{9}(x - 32)$$

Micah wanted to convert today's high temperature of 77°F to °C. What is today's high temperature in °C?

					2	5

Sample Response 25

Item Context Science, Technology, Engineering, and Mathematics

Benchmark MA.912.A.2.4

Body of Knowledge	Algebra
Reporting Category	Functions, Linear Equations, and Inequalities
Standard	**Standard 2** Draw and interpret graphs of relations. Understand the notation and concept of a function, find domains and ranges, and link equations to functions.
Benchmark	**MA.912.A.2.4 Determine the domain and range of a relation.** Also assesses MA.912.A.2.13 Solve real-world problems involving relations and functions.
Item Types	This benchmark will be assessed using MC and FR items.
Benchmark Clarification	Students will determine the domain and range of relations.
Content Limits	In items requiring students to determine either the domain or range of a function, functions are limited to linear and quadratic functions of the form $y = ax^2$. The item should restrict the domain or range. In items requiring students to determine the domain and/or range of a graph, the graph can be one of the following: • linear function; • quadratic function; • continuous piecewise function; or • ordered pairs. Items can require students to determine domain and range from a table, set of ordered pairs, or a mapping diagram. Domains and ranges may only be given as inequalities (e.g., $0 < x \leq 60$ for domain) or written as a sentence. Items should utilize function notation, as appropriate.

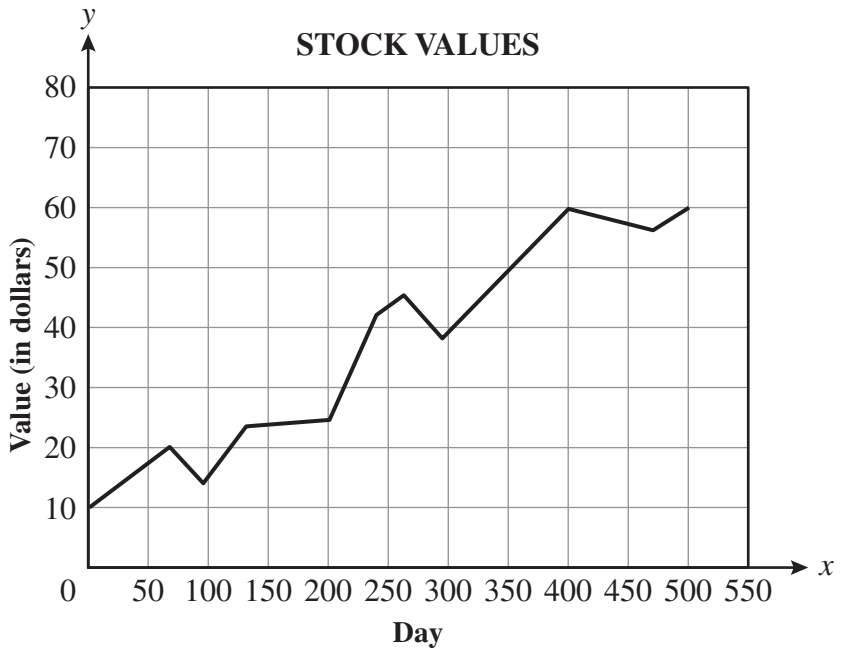
Response Attributes Multiple-choice and fill-in response items may require that students provide the least value (lower bound), greatest value (upper bound), or another specified member of the domain or range.

Domains and ranges used in options should be presented as a list, an inequality (e.g., $0 < x \leq 60$ for domain), or written as a sentence.

Fill-in response items may ask students to complete an inequality that satisfies a domain or a range.

Sample Item 3 **MC**

An economics teacher plotted the value of a stock on 11 different days during a 500-day period and used line segments to connect the values. In the graph below, the horizontal axis is measured in days and the vertical axis is measured in dollars.



Based on the graph, which of the following best describes the range of the value of the stock for this 500-day period?

A. $0 \leq x \leq 500$
B. $1 \leq x \leq 500$
★ **C.** $10 \leq y \leq 60$
D. $0 \leq y \leq 80$

Item Context Business Management and Administration

Sample Item 4 **FR**

The set of ordered pairs shown below defines a relation.

$$\{(0, 0),\ (1, 5),\ (2, 8),\ (3, 9),\ (4, 8),\ (5, 5),\ (6, 0)\}$$

What is the value of the greatest element in the range of this relation?

						9

Sample Response 9

Item Context Science, Technology, Engineering, and Mathematics

Sample Item 5 **FR**

J'Nai has a radio-controlled airplane that weighs 7 kilograms (kg). The equation below shows k, the kinetic energy of a 7 kg object, as a function of v, its velocity in meters per second (m/s).

$$k = \frac{7v^2}{2}$$

J'Nai found that her plane could do a certain trick if the plane was going at least 8 m/s but no more than 12 m/s. What is the greatest value in the range?

				5	0	4

Sample Response 504

Item Context Science, Technology, Engineering, and Mathematics

Benchmark MA.912.A.3.1

Body of Knowledge	Algebra
Reporting Category	Functions, Linear Equations, and Inequalities
Standard	**Standard 3** Solve linear equations and inequalities.
Benchmark	**MA.912.A.3.1 Solve linear equations in one variable that include simplifying algebraic expressions.** Also assesses MA.912.A.3.2 Identify and apply the distributive, associative, and commutative properties of real numbers and the properties of equality.
Item Types	This benchmark will be assessed using MC and FR items.
Benchmark Clarification	Students will solve linear equations in one variable.
Content Limits	Equations must be presented in all items. Items may include equations with the variable on both sides of the equation. Items may include applications of commutative, associative, distributive, and identity properties.

Sample Item 6 **MC**

Mario needs to cut three shelves from a board that is 1.8 meters long. The second shelf is 15 centimeters longer than twice the length of the first shelf. The remaining shelf is 5 centimeters longer than the first shelf. The equation below represents this situation, where x is the length of the first shelf, in meters.

$$x + (2x + 0.15) + (x + 0.05) = 1.8$$

Which of the following is the length, in meters, of the first shelf?

★ **A.** 0.40
B. 0.45
C. 0.53
D. 0.96

Item Context Arts

Sample Item 7 **FR**

Billy is planning to drive from his house to a baseball stadium and arrive in time for the beginning of the championship game. His arrival time depends on the traffic. If traffic is light, he will travel at an average speed of 50 miles per hour and arrive 1 hour early. If traffic is heavy, he will travel at an average speed of 30 miles per hour and arrive on time. The equation below can be used to model this situation, where t represents Billy's driving time, in hours.

$$50(t - 1) = 30t$$

What value of t makes this equation true?

2	.	5				

Sample Response 2.5

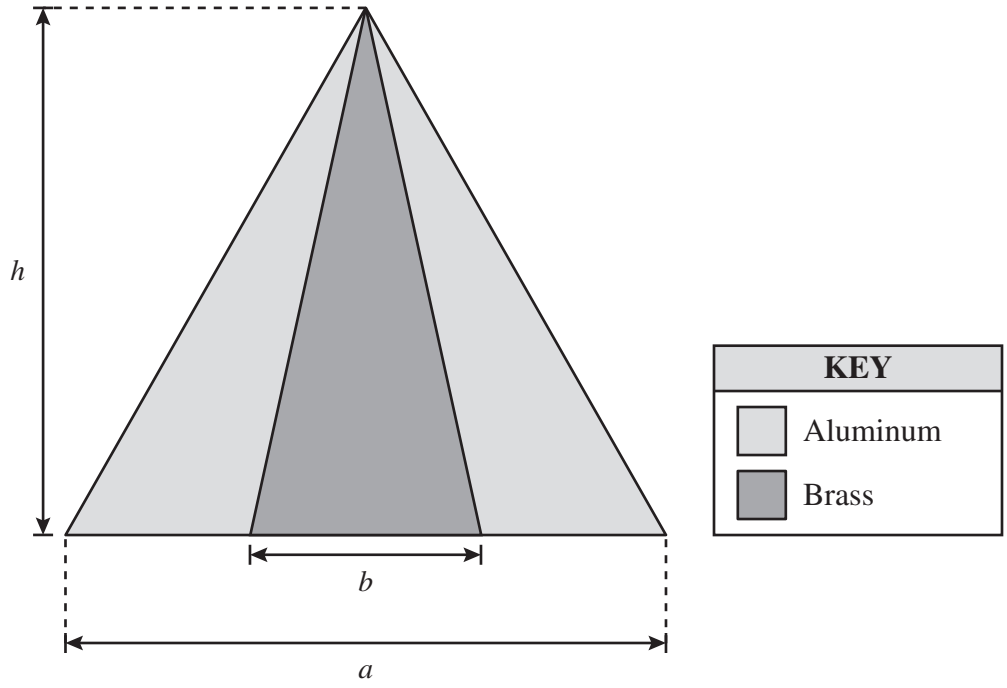
Item Context Science, Technology, Engineering, and Mathematics

Benchmark MA.912.A.3.3

Body of Knowledge	Algebra
Reporting Category	Functions, Linear Equations, and Inequalities
Standard	**Standard 3** Solve linear equations and inequalities.
Benchmark	**MA.912.A.3.3 Solve literal equations for a specified variable.**
Item Type	This benchmark will be assessed using MC items.
Benchmark Clarification	Students will manipulate an equation in order to isolate a specified variable.
Content Limits	Items must contain more than two variables and require two or more procedural steps to complete. In items with variables of varying integral powers, the item can only require the isolation of a variable with a power of one.

Sample Item 8 **MC**

Carol wants to make a sculpture using brass and aluminum, with the dimensions shown below.



The area of the aluminum section can be found using the equation $A = \frac{1}{2}ah - \frac{1}{2}bh$. Which of the following shows the aluminum section's area formula solved for h?

A. $h = 2A(a - b)$

★ **B.** $h = \frac{2A}{a - b}$

C. $h = \frac{A}{2(a - b)}$

D. $h = \frac{A(a - b)}{2}$

Item Context Science, Technology, Engineering, and Mathematics

Benchmark MA.912.A.3.4

Body of Knowledge	Algebra
Reporting Category	Functions, Linear Equations, and Inequalities
Standard	**Standard 3** Solve linear equations and inequalities.
Benchmark	**MA.912.A.3.4 Solve and graph simple and compound inequalities in one variable, and be able to justify each step in a solution.**
Item Type	This benchmark will be assessed using MC items.
Benchmark Clarifications	Students will solve simple and compound inequalities and/or graph solutions on a number line. Students will provide statements and/or reasons for each step in solving a simple or compound inequality.
Content Limit	Items will not include inequalities without a solution.

Sample Item 9 **MC**

Taylor has a total of \$25 to spend on dinner, which includes a 6.5% sales tax and a 20% tip. Taylor used the inequality shown below to calculate the amount, in dollars, a, she can spend before tax and tip.

$$1.2(a + 0.065a) \leq 25$$

Which of the following shows the solution to this inequality?

A. $a \leq 22.74$
B. $a \leq 22.34$
C. $a \leq 19.76$
★ **D.** $a \leq 19.56$

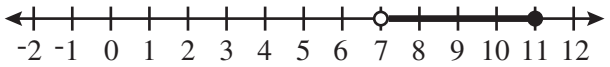
Item Context Business Management and Administration

Sample Item 10 **MC**

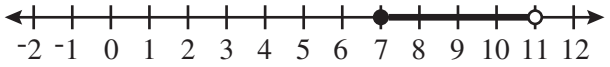
Which graph shows the solution to the inequality shown below?

$$15 \leq 7n - 2(n - 10) < 35$$

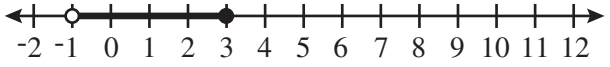
A.



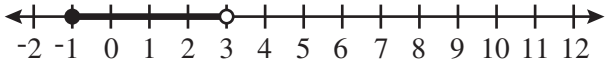
B.



C.



★ **D.**



Item Context Science, Technology, Engineering, and Mathematics

Benchmark MA.912.A.3.5

Body of Knowledge	Algebra
Reporting Category	Functions, Linear Equations, and Inequalities
Standard	**Standard 3** Solve linear equations and inequalities.
Benchmark	**MA.912.A.3.5 Symbolically represent and solve multi-step and real-world applications that involve linear equations and inequalities.**
Item Types	This benchmark will be assessed using MC and FR items.
Benchmark Clarification	Students will interpret a real-world application and write and/or solve a multi-step linear equation or linear inequality.
Content Limits	In items where an equation or inequality is presented, all variables should be defined in the context of the problem so that the student is required to interpret the real-world application. Items will not include the use of interval notation, e.g., $(3, \infty)$, or set notation, e.g., $\{ x \mid x > 3\}$.
Stimulus Attribute	Items must be set in real-world contexts.

Sample Item 11 **MC**

The out-of-pocket costs to an employee for health insurance and medical expenses for one year are shown in the chart below.

EMPLOYEE'S ANNUAL HEALTH CARE COSTS

Type of Cost	Definition	Cost to Employee
Premium	Total amount employee pays insurance company for the policy	$3,626
Deductible	Amount of medical expenses employee pays before insurance company pays for anything	$ 500
Copayment	Percentage of medical expenses employee has to pay after the first $500	20%

According to the plan outlined in the chart, total annual health care costs, C, depend on the employee's medical expenses for that year. If x represents the total medical expenses of an employee on this plan and $x \geq 500$, which of the following equations can be used to determine this employee's total health care costs for that year?

A. $C = 3626 - 500 + 0.20(x - 500)$
B. $C = 3626 - 500 + 0.20x$
★ **C.** $C = 3626 + 500 + 0.20(x - 500)$
D. $C = 3626 + 500 + 0.20x$

Item Context Business Management and Administration

Sample Item 12 **FR**

Ethan's job at a local home improvement store is to mix paint to make different colors. For a particular customer, he mixed p liters of blue paint, $0.8p$ liters of yellow paint, and $p - 0.4$ liters of orange paint. He then divided the mixture evenly into two cans. If each can contains 1.9 liters of paint, how many liters of blue paint did he use?

1	.	5				

Sample Response 1.5

Item Context Business Management and Administration

Benchmark MA.912.A.3.8

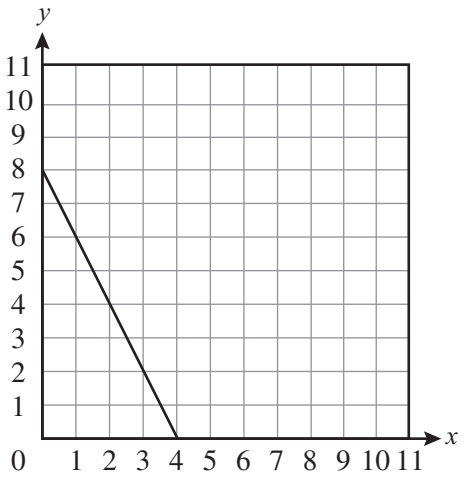
Body of Knowledge	Algebra
Reporting Category	Functions, Linear Equations, and Inequalities
Standard	**Standard 3** Solve linear equations and inequalities.
Benchmark	**MA.912.A.3.8 Graph a line given any of the following information: a table of values, the *x*- and *y*-intercepts, two points, the slope and a point, the equation of the line in slope-intercept form, standard form, or point-slope form.** Also assesses MA.912.A.3.12 Graph a linear equation or inequality in two variables with and without graphing technology. Write an equation or inequality represented by a given graph.
Item Type	This benchmark will be assessed using MC items.
Benchmark Clarifications	Students will identify graphs given: • a table of values; • the *x*- and *y*-intercepts; • two points; • the slope and a point; or • the equation of the line in slope-intercept form, standard form, or point-slope form. Students will identify graphs of linear inequalities given: • the equation of the linear inequality in slope-intercept form; or • the equation of the linear inequality in standard form.
Content Limit	Items may include lines that have zero slope or undefined slope.
Stimulus Attributes	Items may include linear equations in various forms, including standard, slope-intercept, and point-slope forms. Graphics should be used in all items. Equations should not be presented in function notation.

Sample Item 13 **MC**

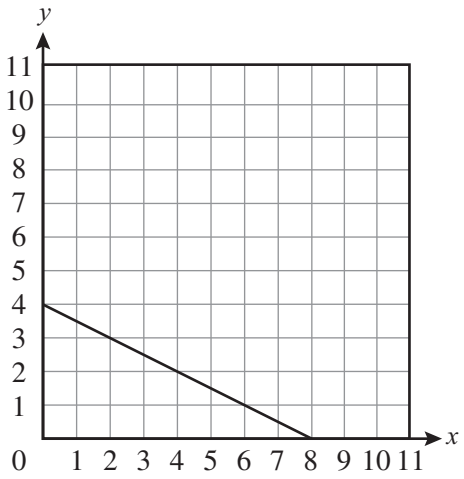
Robert goes to a garage sale where hardcover books sell for $5 each and paperback books sell for $2.50 each. He has $20 to spend. The equation below can be used to find how many books of each type Robert can buy, where x is the number of hardcover books and y is the number of paperback books.

$$5x + 2.5y = 20$$

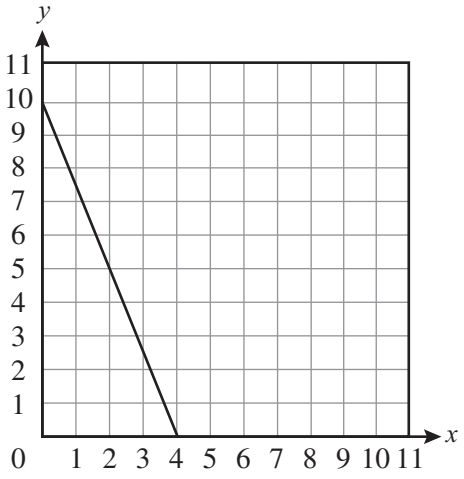
Which of the following shows the graph of this equation?



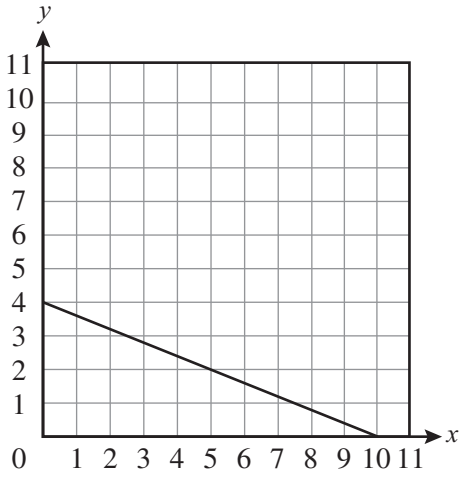
★ **A.**



C.



B.

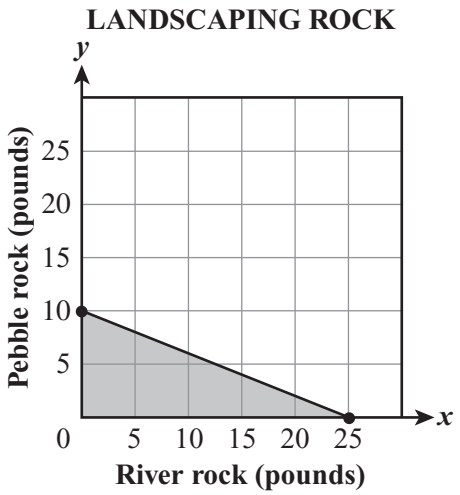


D.

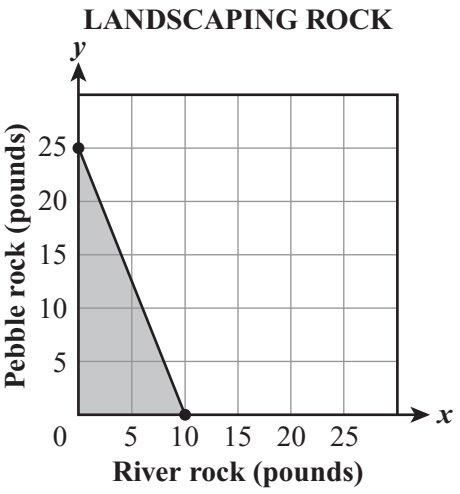
Item Context Business Management and Administration

Sample Item 14 **MC**

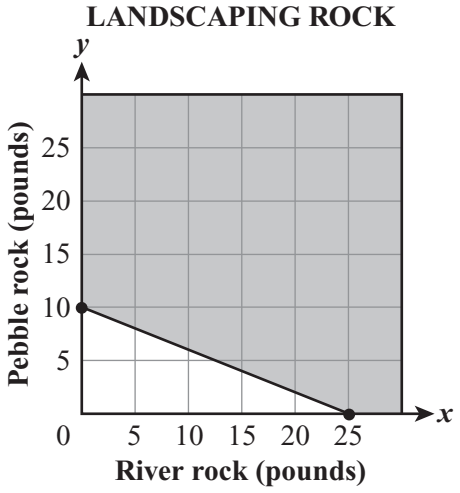
Kristen can spend up to \$50 on rock to landscape her yard. She decides to use both pebble rock and river rock. Pebble rock costs \$2 per pound, and river rock costs \$5 per pound. The inequality $5x + 2y \leq 50$ models the possible number of pounds of pebble rock and river rock that Kristen can purchase. Which graph represents the inequality?



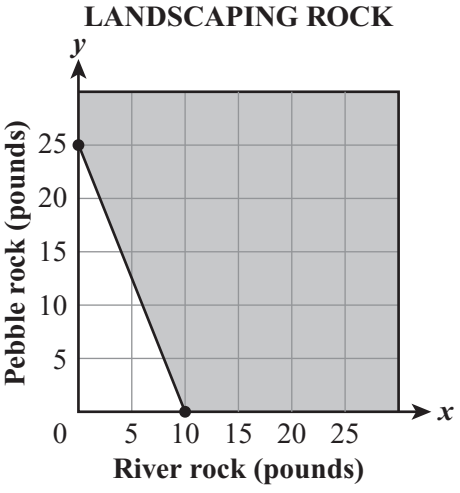
A.



★ C.



B.



D.

Item Context Business Management and Administration

Benchmark MA.912.A.3.9

Body of Knowledge	Algebra
Reporting Category	Functions, Linear Equations, and Inequalities
Standard	**Standard 3** Solve linear equations and inequalities.
Benchmark	**MA.912.A.3.9 Determine the slope, *x*-intercept, and *y*-intercept of a line given its graph, its equation, or two points on the line.**
Item Types	This benchmark will be assessed using MC and FR items.
Benchmark Clarification	Students will determine the slope, *x*-intercept, and/or *y*-intercept of a line given its graph, its equation, or two points on the line.
Content Limit	Items may include lines that have zero slope or undefined slope.
Stimulus Attributes	Items may include linear equations in various forms, including standard, slope-intercept, and point-slope forms. Graphics should be used in most of these items, as appropriate.
Response Attribute	Fill-in response items may require that students provide a slope, the *x*-coordinate of the *x*-intercept, the *y*-coordinate of the *y*-intercept, or the *x*-coordinate or *y*-coordinate of a point of interest.

Sample Item 15 **MC**

An architect designed an outdoor staircase for a house. The relationship between the height of the steps and the length of the tread is modeled by the equation $57x - 95y = 0$. Which of the following represents the slope of the equation?

A. $\frac{5}{3}$

B. $\frac{3}{2}$

C. $\frac{2}{3}$

★ **D.** $\frac{3}{5}$

Item Context Science, Technology, Engineering, and Mathematics

Sample Item 16 **FR**

Brianna plotted the two points (20, 75) and (45, 150) on a graph. What is the x-coordinate of the x-intercept of the line that contains these two points?

-	5					

Sample Response -5

Item Context Science, Technology, Engineering, and Mathematics

Sample Item 17 **FR**

Samuel graphed the equation shown below.

$$70x + 50y = 630$$

What is the y-intercept of the line?

1	2	.	6			

Sample Response 12.6

Item Context Science, Technology, Engineering, and Mathematics

Benchmark MA.912.A.3.10

Body of Knowledge	Algebra
Reporting Category	Functions, Linear Equations, and Inequalities
Standard	**Standard 3** Solve linear equations and inequalities.
Benchmark	**MA.912.A.3.10 Write an equation of a line given any of the following information: two points on the line, its slope and one point on the line, or its graph. Also, find an equation of a new line parallel to a given line, or perpendicular to a given line, through a given point on the new line.** Also assesses MA.912.A.3.7 Rewrite equations of a line into slope-intercept form and standard form. Also assesses MA.912.A.3.12 Graph a linear equation or inequality in two variables with and without graphing technology. Write an equation or inequality represented by a given graph. Also assesses MA.912.G.1.4 Use coordinate geometry to find slopes, parallel lines, perpendicular lines, and equations of lines.
Item Types	This benchmark will be assessed using MC and FR items.
Benchmark Clarifications	Students will write linear equations, including lines parallel or perpendicular to a given line. Students will rewrite equations of lines from standard form to slope-intercept form, and vice versa. Given a graph, students will identify a linear inequality in slope-intercept form.
Content Limits	Information given to determine equations of lines may include two points, the slope and a point, a graph, or an equation in a different form. Items may include lines that have zero slope or undefined slope. Given coordinates will be limited to rational numbers.
Stimulus Attributes	Items may include linear equations in various forms, including standard, slope-intercept, and point-slope forms. Graphics should be used in most of these items, as appropriate.

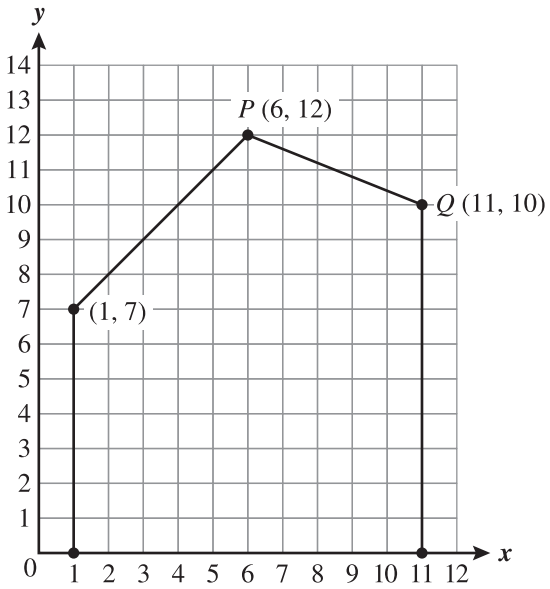
Response Attributes Items may require that students provide the x-intercept, the y-intercept, or a point of interest of a parallel or perpendicular line.

Fill-in response items may require that students provide a slope of a line parallel or a perpendicular to a given line.

Fill-in response items may require that students provide coefficients for a linear equation.

Sample Item 18 **MC**

In a technical drawing class, students are analyzing the side view of a house that has been positioned on a coordinate grid, as shown below.



Which of the following equations best represents the line that contains $\overline{PQ}$?

A. $y = -\frac{5}{2}x + 14.4$

B. $y = \frac{5}{2}x + 27$

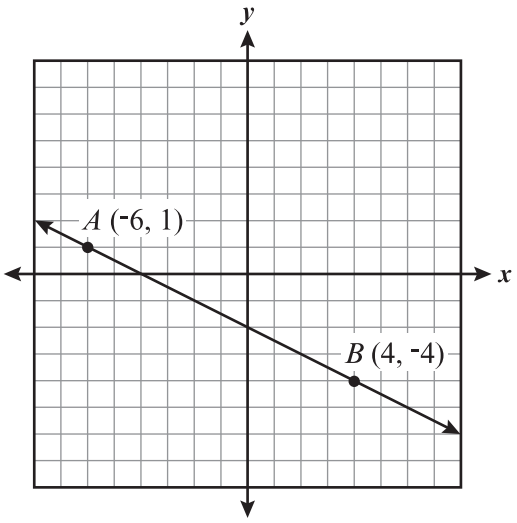
★ **C.** $y = -\frac{2}{5}x + 14.4$

D. $y = \frac{2}{5}x + 27$

Item Context Arts

Sample Item 19 **FR**

The line *AB* is graphed on the coordinate grid below.



What is the *x*-intercept of the line that is perpendicular to line *AB* at point *B*?

6						

Sample Response 6

Item Context Science, Technology, Engineering, and Mathematics

Benchmark MA.912.A.3.11

Body of Knowledge	Algebra
Reporting Category	Functions, Linear Equations, and Inequalities
Standard	**Standard 3** Solve linear equations and inequalities.
Benchmark	**MA.912.A.3.11 Write an equation of a line that models a data set, and use the equation or the graph to make predictions. Describe the slope of the line in terms of the data, recognizing that the slope is the rate of change.**
Item Types	This benchmark will be assessed using MC and FR items.
Benchmark Clarifications	Students will write an equation of a line that models data and/or use it to make predictions. Students will recognize slope as a rate of change or describe the slope of the line in terms of the data.
Content Limits	In items assessing slope as a rate of change, students will not be expected to convert units. Graphs may be located in any of the quadrants.
Stimulus Attributes	Data sets should be included in all problems. The data sets can be presented as a table of values or on a graph. In items with a graph with several data points, two specific data points must be clearly identified for the purpose of writing an equation. Items should be set in a real-world context. Graphics should be used in most of these items, as appropriate.

Sample Item 20 **MC**

David is training for a marathon. He writes down the time and distance for each training run and then records the data on a scatter plot. He has drawn a line of best fit on the scatter plot, as shown below.

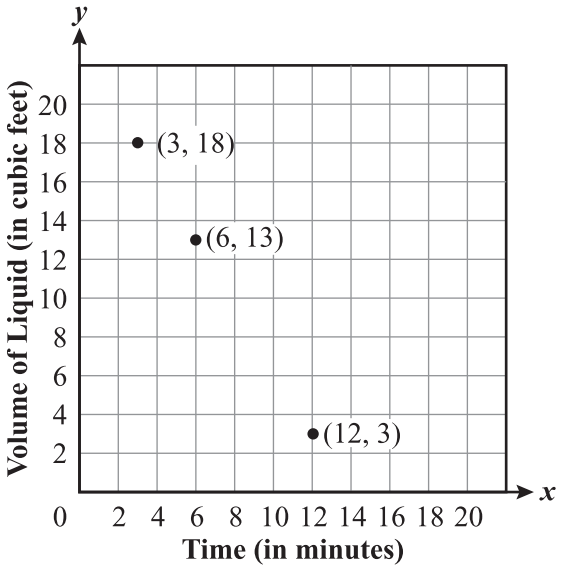
Which statement best expresses the meaning of the slope as a rate of change for this line of best fit?

A. The slope represents the number of miles he will have to run to finish the marathon.
★ **B.** The slope represents the average speed, in miles per hour, of his training runs.
C. The slope represents the number of hours he will need to finish the marathon.
D. The slope represents the distances, in miles, that he ran while he was training.

Item Context Health and Physical Education

Sample Item 21 **FR**

A tank containing water is being drained at a constant rate. The points on the grid below represent the volume of water remaining in the tank as a function of time.



At what rate, in cubic feet per minute, is the volume of the water changing?

-	5	/	3			

Sample Response -5/3

Item Context Science, Technology, Engineering, and Mathematics

Benchmark MA.912.A.3.14

Body of Knowledge	Algebra
Reporting Category	Functions, Linear Equations, and Inequalities
Standard	**Standard 3** Solve linear equations and inequalities.
Benchmark	**MA.912.A.3.14 Solve systems of linear equations and inequalities in two and three variables using graphical, substitution, and elimination methods.** Also assesses MA.912.A.3.13 Use a graph to approximate the solution of a system of linear equations or inequalities in two variables with and without technology. Also assesses MA.912.A.3.15 Solve real-world problems involving systems of linear equations and inequalities in two and three variables.
Item Types	This benchmark will be assessed using MC and FR items.
Benchmark Clarification	Students will solve systems of linear equations in two variables.
Content Limits	Items will not specify a method for solving systems of linear equations. Items may ask students to write and/or solve systems of linear equations in two variables. In items that use a graph, one of the two equations should be graphed on the coordinate plane. Items will not assess systems of linear inequalities. Items will not assess systems of linear equations in three variables.
Response Attribute	Fill-in response items may ask students to provide the x-coordinate (or y-coordinate) of a solution to a system of linear equations.

Sample Item 22 **MC**

Russ bought 3 medium sandwiches and 2 large sandwiches for a total of $29.95. Stacy bought 4 medium sandwiches and 1 large sandwich for a total of $28.45.

Which statement shows the cost of each medium sandwich and each large sandwich?

A. Each medium sandwich costs $5.69, and each large sandwich costs $6.89.
B. Each medium sandwich costs $5.69, and each large sandwich costs $6.39.
★ **C.** Each medium sandwich costs $5.39, and each large sandwich costs $6.89.
D. Each medium sandwich costs $5.39, and each large sandwich costs $6.39.

Item Context Business Management and Administration

Sample Item 23 **FR**

A website that sells songs for downloading increased its price per song from $0.99 to $1.29. Ariana spent $15.36 downloading songs before and after the price increase. She downloaded 4 more songs at $0.99 than at $1.29. The set of equations below represents the situation where x is the number of songs Ariana downloaded at $0.99 and y is the number of songs she downloaded at $1.29.

$$x = y + 4$$
$$0.99x + 1.29y = 15.36$$

What is the exact number of songs Ariana downloaded at the $0.99 price?

						9

Sample Response 9

Item Context Business Management and Administration

Benchmark MA.912.A.4.1

Body of Knowledge	Algebra
Reporting Category	Polynomials
Standard	**Standard 4** Perform operations on polynomials. Find factors of polynomials, learning special techniques for factoring quadratics. Understand the relationships among the solutions of polynomial equations, the zeros of a polynomial function, the *x*-intercepts of a graph, and the factors of a polynomial.
Benchmark	**MA.912.A.4.1 Simplify monomials and monomial expressions using the laws of integral exponents.**
Item Types	This benchmark will be assessed using MC and FR items.
Benchmark Clarification	Students will simplify monomial expressions by applying the laws of exponents.
Content Limits	Exponents should be integers. Items must have a variable base and may include a numerical base. Monomials may have no more than three variables.
Response Attributes	Items may be simplified to quotients or written with negative exponents in the format $x^a y^b z^c$. Fill-in response items may require that students provide an exponent for a specified monomial term.

Sample Item 24 **MC**

The expression $(m^6n^5q^3)^2$ is equivalent to which of the following?

★ **A.** $m^{12}n^{10}q^6$

B. $m^{36}n^{25}q^9$

C. $2m^8n^7q^5$

D. $2m^{12}n^{10}q^6$

Item Context Science, Technology, Engineering, and Mathematics

Sample Item 25 **FR**

Mina simplified the expression shown below.

$$\left(a^3b^{-6}\right)\left(a^2b^2\right)$$

Her final answer was in the form a^mb^n. If she simplified the expression correctly, what is the value of n, the exponent of b?

-	4					

Sample Response -4

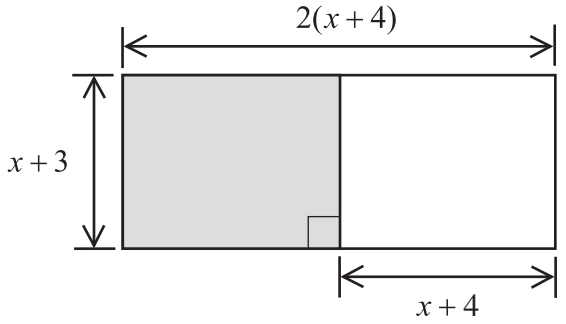
Item Context Science, Technology, Engineering, and Mathematics

Benchmark MA.912.A.4.2

Body of Knowledge	Algebra
Reporting Category	Polynomials
Standard	**Standard 4** Perform operations on polynomials. Find factors of polynomials, learning special techniques for factoring quadratics. Understand the relationships among the solutions of polynomial equations, the zeros of a polynomial function, the *x*-intercepts of a graph, and the factors of a polynomial.
Benchmark	**MA.912.A.4.2 Add, subtract, and multiply polynomials.**
Item Types	This benchmark will be assessed using MC and FR items.
Benchmark Clarification	Students will simplify (add, subtract, and multiply) polynomial expressions.
Content Limits	Items requiring multiplication of polynomials are limited to a product of a monomial and a binomial, a monomial and a trinomial, or two binomials. Items requiring addition and subtraction are limited to combining monomials, binomials, and/or trinomials. The simplified sum or difference should contain no more than five terms.
Response Attribute	Fill-in response items may require that students provide an exponent or coefficient for a specified term.

Sample Item 26 **MC**

Which expression is equivalent to the perimeter of the shaded portion of the rectangle?



A. $2x + 10$
B. $2x + 12$
★ **C.** $4x + 14$
D. $8x + 28$

Item Context Science, Technology, Engineering, and Mathematics

Sample Item 27 **FR**

New photo-imaging techniques on computers allow artists to distort an image from its original shape. Figure 1 is a square image. Figure 2 is stretched 4 units wider and shrunk 4 units shorter than Figure 1.

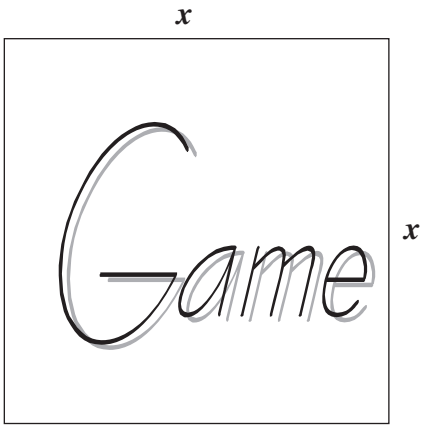


Figure 1

Figure 2

How many square units greater is the area of Figure 1 than the area of Figure 2?

					1	6

Sample Response 16

Item Context Arts

Benchmark MA.912.A.4.3

Body of Knowledge	Algebra
Reporting Category	Polynomials
Standard	**Standard 4** Perform operations on polynomials. Find factors of polynomials, learning special techniques for factoring quadratics. Understand the relationships among the solutions of polynomial equations, the zeros of a polynomial function, the *x*-intercepts of a graph, and the factors of a polynomial.
Benchmark	**MA.912.A.4.3 Factor polynomial expressions.** Also assesses MA.912.A.5.1 Simplify algebraic ratios.
Item Type	This benchmark will be assessed using MC items.
Benchmark Clarifications	Students will completely factor polynomial expressions, which may include a greatest common factor, difference of two squares, and trinomials. Students will use factoring methods to simplify rational expressions.
Content Limits	All monomials in items will have, at most, two variables. Coefficients must be integers. In items requiring first factoring the greatest common factor and then factoring the remaining polynomial, the remaining polynomial must have a maximum degree of two. In items that require simplifying algebraic ratios, the following factoring methods may be used: greatest common factor, difference of two squares, and/or trinomials.
Stimulus Attribute	Items that include rational expressions should state restrictions to the domain or note that the value of the denominator is not equal to zero.
Response Attribute	Distractors of rational expression items will not include expressions that are equivalent to the correct answer.

Sample Item 28 **MC**

The area of a rectangle is $2x^2 - 7x - 15$. Which of the following shows possible dimensions of the rectangle?

★ **A.** $(2x + 3)$ and $(x - 5)$
B. $(2x - 3)$ and $(x + 5)$
C. $(2x + 3)$ and $(2x - 10)$
D. $(2x - 3)$ and $(2x + 10)$

Item Context Science, Technology, Engineering, and Mathematics

Sample Item 29 **MC**

If $x \neq 3$, which of the following shows the expression below in simplest form?

$$\frac{3x^2 - 27}{x - 3}$$

★ **A.** $3(x + 3)$
B. $3(x - 3)$
C. $3(x + 9)$
D. $3(x - 9)$

Item Context Science, Technology, Engineering, and Mathematics

Benchmark MA.912.A.4.4

Body of Knowledge	Algebra
Reporting Category	Polynomials
Standard	**Standard 4** Perform operations on polynomials. Find factors of polynomials, learning special techniques for factoring quadratics. Understand the relationships among the solutions of polynomial equations, the zeros of a polynomial function, the *x*-intercepts of a graph, and the factors of a polynomial.
Benchmark	**MA.912.A.4.4 Divide polynomials by monomials and polynomials with various techniques, including synthetic division.**
Item Type	This benchmark will be assessed using MC items.
Benchmark Clarification	Students will divide polynomials by monomials.
Content Limits	Items will be limited to dividing a polynomial by a monomial. Synthetic division will not be assessed.
Stimulus Attributes	Items should be set in a mathematical context. Items including rational expressions must state restrictions to the domain. Monomials in items should be limited to three variables with positive exponents.
Response Attribute	Quotients will either not have a remainder or be presented as a rational expression.

Sample Item 30 **MC**

If $x \neq 0$ and $y \neq 0$, which expression is equivalent to the expression shown below?

$$(6x^6y^2 - 12x^4y^3 + 3x^2y) \div (3x^2y)$$

A. $2x^4y - 4x^2y^2$

★ **B.** $2x^4y - 4x^2y^2 + 1$

C. $3x^3y^2 - 9x^2y^3$

D. $3x^3y^2 - 9x^2y^3 + 1$

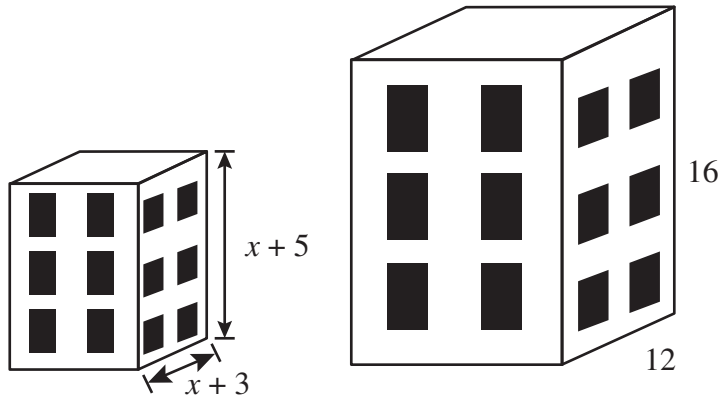
Item Context Science, Technology, Engineering, and Mathematics

Benchmark MA.912.A.5.4

Body of Knowledge	Algebra
Reporting Category	Rationals, Radicals, Quadratics, and Discrete Mathematics
Standard	**Standard 5** Simplify rational expressions, and solve rational equations using what has been learned about factoring polynomials.
Benchmark	**MA.912.A.5.4 Solve algebraic proportions.**
Item Types	This benchmark will be assessed using MC and FR items.
Benchmark Clarification	Students will solve algebraic proportions.
Content Limits	Products of the means and extremes of proportions may not exceed degree 1. When appropriate, items must state restrictions to the domain. In items set in a real-world context, restrictions on the domain need not be noted because the context will naturally set the restrictions. Items that are set in the context of similar figures should have the proportion given in the stem.

Sample Item 31 **MC**

Tammy made similar models of a building, with the dimensions, in inches, shown in the diagram below.



Tammy used the information to set up the following proportion.

$$\frac{x + 5}{16} = \frac{x + 3}{12}$$

What is the value, in inches, of x?

★ **A.** 3
B. 4
C. 5
D. 6

Item Context Arts

Sample Item 32 **FR**

If $x \neq 0$ and $x \neq 14$, what is the solution of the equation below?

$$\frac{2}{x - 14} = \frac{3}{4x}$$

-	4	2	/	5		

Sample Response -42/5 or -8.4

Item Context Science, Technology, Engineering, and Mathematics

Benchmark MA.912.A.6.2

Body of Knowledge	Algebra
Reporting Category	Rationals, Radicals, Quadratics, and Discrete Mathematics
Standard	**Standard 6** Simplify and perform operations on radical expressions and equations. Rationalize square root expressions, and understand and use the concepts of negative and rational exponents. Add, subtract, multiply, divide, and simplify radical expressions and expressions with rational exponents. Solve radical equations and equations with terms that have rational exponents.
Benchmark	**MA.912.A.6.2 Add, subtract, multiply, and divide radical expressions (square roots and higher).** Also assesses MA.912.A.6.1 Simplify radical expressions.
Item Type	This benchmark will be assessed using MC items.
Benchmark Clarification	Students will add, subtract, multiply, and/or divide radical expressions and simplify the results.
Content Limits	Items will assess square roots only. Radicands with variables will contain positive integral exponents. Items with variables must state restrictions to the domain.
Stimulus Attribute	Items should be set in a mathematical context.
Response Attribute	Multiple-choice options must be presented with rationalized denominators.

Sample Item 33 **MC**

In the expression below, $x > 0$.

$$\sqrt{\frac{16x^7}{2x^2}}$$

Which of the following is equivalent to this expression?

A. $2\sqrt{x^5}$

★ **B.** $2x^2\sqrt{2x}$

C. $4x^3\sqrt{2x}$

D. $8\sqrt{x^5}$

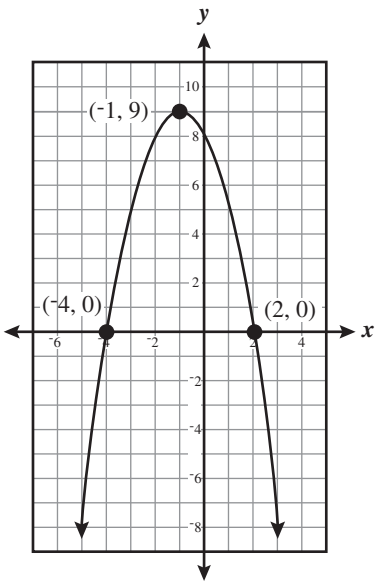
Item Context Science, Technology, Engineering, and Mathematics

Benchmark MA.912.A.7.1

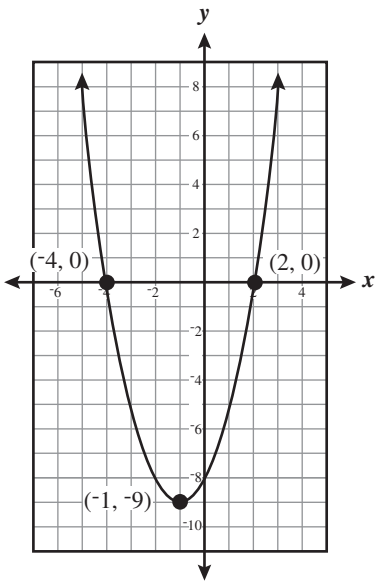
Body of Knowledge	Algebra
Reporting Category	Rationals, Radicals, Quadratics, and Discrete Mathematics
Standard	**Standard 7** Draw graphs of quadratic functions. Solve quadratic equations and solve these equations by factoring, completing the square, and by using the quadratic formula. Use graphing calculators to find approximate solutions of quadratic equations.
Benchmark	**MA.912.A.7.1 Graph quadratic equations with and without graphing technology.** Also assesses MA.912.A.7.8 Use quadratic equations to solve real-world problems.
Item Type	This benchmark will be assessed using MC items.
Benchmark Clarifications	Students will identify the graph of a quadratic function given its equation. Students will use the graph of a quadratic function to solve a real-world problem.
Content Limits	In items set in a real-world context, the quadratic equation should be presented. The context of the problem should require the student to interpret which value will be the solution. Items must use quadratic equations with integral coefficients except for items set in a real-world context. Items whose roots would be nonintegral should have the vertex and at least two other points labeled. Quadratic equations will be presented in standard form only. Graphics should be used in all of these items.

Sample Item 34 **MC**

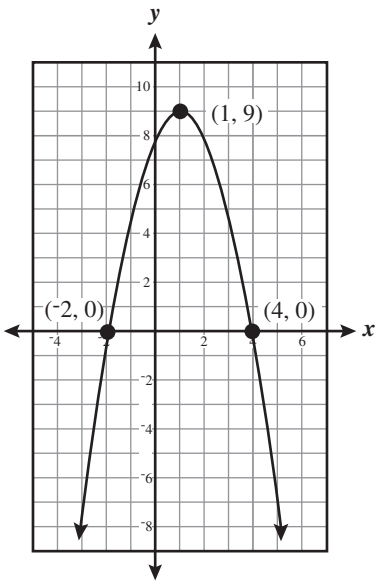
Which of the following is the graph of $y = x^2 + 2x - 8$?



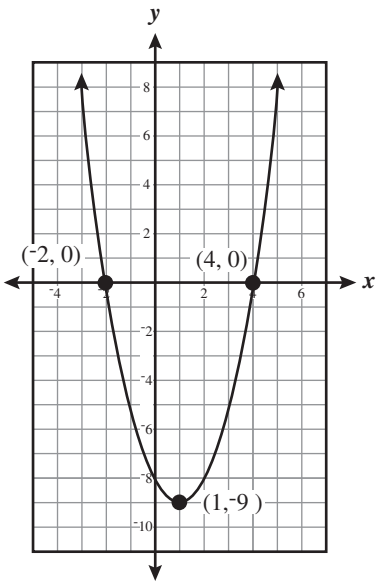
A.



★ C.



B.

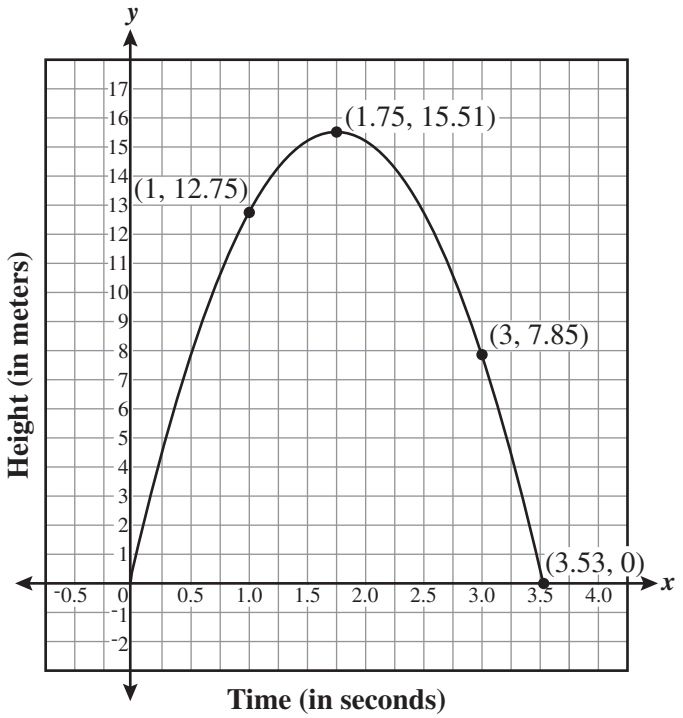


D.

Item Context Science, Technology, Engineering, and Mathematics

Sample Item 35 **MC**

Timmy and Kelli had a water balloon launcher. When launched, the water balloon's height could be modeled by the quadratic equation $y = -4.9x^2 + 17.15x + 0.5$. The graph shown below represents the water balloon's height.



Which of the following is true about the water balloon?

A. The water balloon reaches a height of 16 meters.
★ **B.** The water balloon reaches the height of 7.85 meters twice.
C. The water balloon has a maximum height of 17.15 meters.
D. The water balloon travels for 4.9 seconds before it hits the ground.

Item Context Reading and Literature

Benchmark MA.912.A.7.2

Body of Knowledge	Algebra
Reporting Category	Rationals, Radicals, Quadratics, and Discrete Mathematics
Standard	**Standard 7** Draw graphs of quadratic functions. Solve quadratic equations and solve these equations by factoring, completing the square, and by using the quadratic formula. Use graphing calculators to find approximate solutions of quadratic equations.
Benchmark	**MA.912.A.7.2 Solve quadratic equations over the real numbers by factoring and by using the quadratic formula.** Also assesses MA.912.A.1.8 Use the zero product property of real numbers in a variety of contexts to identify solutions to equations. Also assesses MA.912.A.7.8 Use quadratic equations to solve real-world problems.
Item Types	This benchmark will be assessed using MC and FR items.
Benchmark Clarification	Students will solve quadratic equations over the set of real numbers.
Content Limits	Items must have real solutions only. Quadratic equations must have integer coefficients only. Items may assess special forms, such as the difference of squares and perfect square trinomials. Items will not require the use of the "completing the square" method of solving quadratic equations.
Response Attributes	MC options may be given in the form that results from application of the quadratic formula, e.g., $\frac{-2 \pm \sqrt{3}}{7}$. MC options may be given using set notation. Fill-in response items may ask the student to provide the greater (or lesser) of two solutions explicitly or implicitly.

Sample Item 36 **MC**

Jeannie solved the quadratic equation shown below by factoring.

$$x^2 + 2x - 8 = 0$$

Which of the following is a step in solving the equation above?

A. $(x + 2)(x + 4) = 0$
B. $(x + 2)(x - 4) = 0$
★ **C.** $(x - 2)(x + 4) = 0$
D. $(x - 2)(x - 4) = 0$

Item Context Science, Technology, Engineering, and Mathematics

Sample Item 37 **FR**

A ball is kicked from ground level into the air. Its height, y, in feet, after x seconds can be represented by the equation $y = 40x - 16x^2$. What is the total elapsed time, in seconds, from the time the ball is kicked until it reaches ground level again?

				2	.	5

Sample Response 2.5

Item Context Health and Physical Education

Benchmark MA.912.D.7.1

Body of Knowledge	Discrete Mathematics
Reporting Category	Rationals, Radicals, Quadratics, and Discrete Mathematics
Standard	**Standard 7** Operate with sets, and use set theory to solve problems.
Benchmark	**MA.912.D.7.1 Perform set operations such as union and intersection, complement, and cross product.**
Item Types	This benchmark will be assessed using MC and FR items.
Benchmark Clarification	Students will perform set operations such as union and intersection, complement, and cross product.
Content Limits	Items should not assess cross product with union, intersection, or complement. Items may include set notation and symbols from set theory. Finite sets should contain no more than a total of 15 unordered elements and no more than 30 ordered elements. If an item follows a numerical pattern, data may be represented by infinite sets, e.g., Natural numbers {1, 2, 3, 4 . . .}. Notation for the complement of set A will be limited to A' and $\sim A$.
Stimulus Attribute	Sets should list all elements in the stem (e.g., do not use *natural numbers between 2 and 5*).

Sample Item 38 **MC**

The set T represents several Taurine breeds of cattle.

$T = \{\text{Angus, Devon, Shorthorn, Texas longhorn}\}$

The set Z represents several Zebu breeds of cattle.

$Z = \{\text{Boran, Nelore, Ponwar}\}$

What is the total number of elements in the set $T \times Z$?

A. 7
B. 9
★ **C.** 12
D. 20

Item Context Business Management and Administration

Sample Item 39 **FR**

Set D lists the ages of Dianna's grandchildren.

$D = \{2, 5, 6, 8, 10, 11\}$

Set K lists the ages of Karen's grandchildren.

$K = \{2, 10, 18\}$

Set P lists the ages of Patrick's grandchildren.

$P = \{10, 11, 14\}$

What is the greatest age in the set $(K \cup P) \cap D$?

1	1					

Sample Response 11

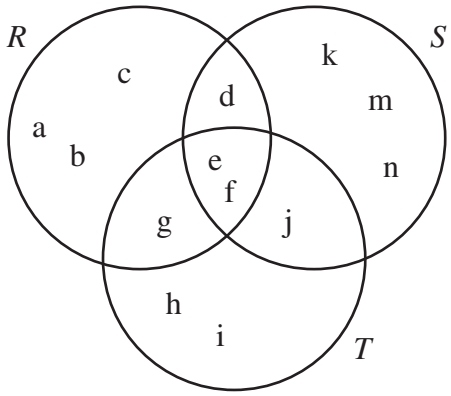
Item Context Reading and Literature

Benchmark MA.912.D.7.2

Body of Knowledge	Discrete Mathematics
Reporting Category	Rationals, Radicals, Quadratics, and Discrete Mathematics
Standard	**Standard 7** Operate with sets, and use set theory to solve problems.
Benchmark	**MA.912.D.7.2 Use Venn diagrams to explore relationships and patterns and to make arguments about relationships between sets.**
Item Types	This benchmark will be assessed using MC and FR items.
Benchmark Clarification	Students will use Venn diagrams to explore relationships and patterns and to make arguments about relationships between sets.
Content Limits	Items may include set notation and symbols from set theory. Items should contain no more than a total of 15 ordered data points. Notation for the complement of set A will be limited to A' and $\sim A$.
Stimulus Attributes	Graphics should be used for most of these items, as appropriate. Fill-in response items may ask the student to provide the number of elements in a set or a specific element if it is the only element in that set.

Sample Item 40 **MC**

The universal set contains only sets *R*, *S*, and *T*. These sets are related as shown in the Venn diagram below.



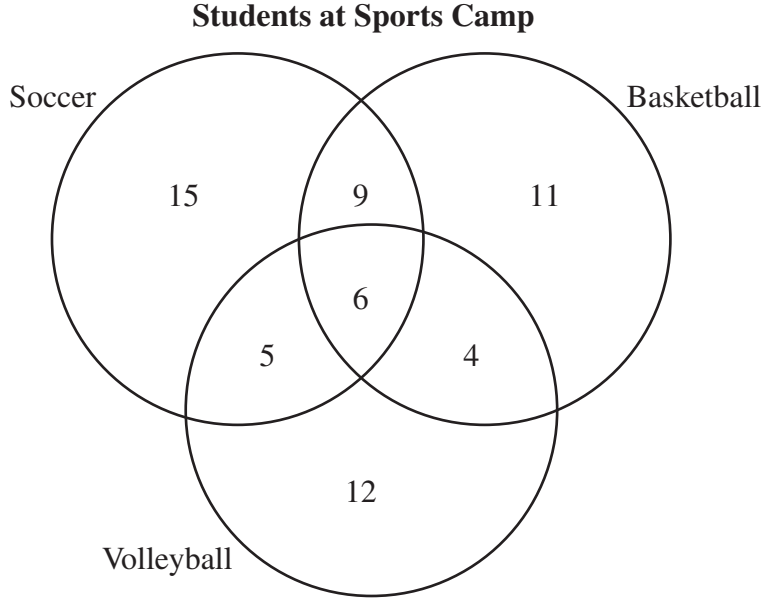
Which set represents $(\sim R \cap S) \cup (\sim T \cap S)$?

A. {d, e, f, j}
★ **B.** {d, j, k, m, n}
C. {d, e, f, j, k, m, n}
D. {d, e, f, g, j, k, m, n}

Item Context Science, Technology, Engineering, and Mathematics

Sample Item 41 **FR**

The Venn diagram below shows the number of students who chose to participate in each of the three sports offered at Sports Camp.



Based on the diagram, what is the total number of students who did NOT participate in volleyball?

					3	5

Sample Response 35

Item Context Health and Physical Education

FCAT 2.0 and EOC Topics Florida's NGSSS

Topics, or item contexts, for FCAT 2.0 and EOC assessment items can be found on the DOE website at http://fcat.fldoe.org/fcat2/pdf/MathematicsAppendixA.pdf.

Mathematics Content Assessed by the Algebra 1 EOC Assessment and Item Types by Benchmark

Algebra 1 End-of-Course Assessment				
Body of Knowledge Algebra				
Standard 1 Real and Complex Number Systems **Expand and deepen understanding of real and complex numbers by comparing expressions and performing arithmetic computations, especially those involving square roots and exponents. Use the properties of real numbers to simplify algebraic expressions and equations, and convert between different measurement units using dimensional analysis.**				
MA.912.A.1.8 Use the zero product property of real numbers in a variety of contexts to identify solutions to equations. Assessed with MA.912.A.7.2.				
Standard 2 Relations and Functions **Draw and interpret graphs of relations. Understand the notation and concept of a function, find domains and ranges, and link equations to functions.**				
MA.912.A.2.3 Describe the concept of a function, use function notation, determine whether a given relation is a function, and link equations to functions. Also assesses MA.912.A.2.13. **MC, FR**	**MA.912.A.2.4** Determine the domain and range of a relation. Also assesses MA.912.A.2.13. **MC, FR**	**MA.912.A.2.13** Solve real-world problems involving relations and functions. Assessed with MA.912.A.2.3 and MA.912.A.2.4.		

Prior Knowledge: Items may require the student to apply mathematical knowledge described in NGSSS benchmarks from lower grades; however, the benchmarks from lower grades will not be assessed in isolation. MC = Multiple choice FR = Fill-in response

Mathematics Content Assessed by the Algebra 1 EOC Assessment and Item Types by Benchmark

Algebra 1 End-of-Course Assessment				
Body of Knowledge Algebra				
Standard 3 Linear Equations and Inequalities **Solve linear equations and inequalities.**				
MA.912.A.3.1 Solve linear equations in one variable that include simplifying algebraic expressions. Also assesses MA.912.A.3.2. **MC, FR**	**MA.912.A.3.2** Identify and apply the distributive, associative, and commutative properties of real numbers and the properties of equality. Assessed with MA.912.A.3.1.	**MA.912.A.3.3** Solve literal equations for a specified variable. **MC**	**MA.912.A.3.4** Solve and graph simple and compound inequalities in one variable, and be able to justify each step in a solution. **MC**	**MA.912.A.3.5** Symbolically represent and solve multi-step and real-world applications that involve linear equations and inequalities. **MC, FR**
MA.912.A.3.7 Rewrite equations of a line into slope-intercept form and standard form. Assessed with MA.912.A.3.10.	**MA.912.A.3.8** Graph a line given any of the following information: a table of values, the x- and y-intercepts, two points, the slope and a point, the equation of the line in slope-intercept form, standard form, or point-slope form. Also assesses MA.912.A.3.12. **MC**	**MA.912.A.3.9** Determine the slope, x-intercept, and y-intercept of a line given its graph, its equation, or two points on the line. **MC, FR**	**MA.912.A.3.10** Write an equation of a line given any of the following information: two points on the line, its slope and one point on the line, or its graph. Also, find an equation of a new line parallel to a given line, or perpendicular to a given line, through a given point on the new line. Also assesses MA.912.A.3.7, MA.912.A.3.12, and MA.912.G.1.4. **MC, FR**	**MA.912.A.3.11** Write an equation of a line that models a data set, and use the equation or the graph to make predictions. Describe the slope of the line in terms of the data, recognizing that the slope is the rate of change. **MC, FR**

Prior Knowledge: Items may require the student to apply mathematical knowledge described in NGSSS benchmarks from lower grades; however, the benchmarks from lower grades will not be assessed in isolation. MC = Multiple choice FR = Fill-in response

Mathematics Content Assessed by the Algebra 1 EOC Assessment and Item Types by Benchmark

Algebra 1 End-of-Course Assessment				
Body of Knowledge Algebra				
Standard 3 Linear Equations and Inequalities **Solve linear equations and inequalities.**				
MA.912.A.3.12 Graph a linear equation or inequality in two variables with and without graphing technology. Write an equation or inequality represented by a given graph. Assessed with MA.912.A.3.8 and MA.912.A.3.10.	**MA.912.A.3.13** Use a graph to approximate the solution of a system of linear equations or inequalities in two variables with and without technology. Assessed with MA.912.A.3.14.	**MA.912.A.3.14** Solve systems of linear equations and inequalities in two and three variables using graphical, substitution, and elimination methods. Also assesses MA.912.A.3.13 and MA.912.A.3.15. **MC, FR**	**MA.912.A.3.15** Solve real-world problems involving systems of linear equations and inequalities in two and three variables. Assessed with MA.912.A.3.14.	
Standard 4 Polynomials **Perform operations on polynomials. Find factors of polynomials, learning special techniques for factoring quadratics. Understand the relationships among the solutions of polynomial equations, the zeros of a polynomial function, the *x*-intercepts of a graph, and the factors of a polynomial.**				
MA.912.A.4.1 Simplify monomials and monomial expressions using the laws of integral exponents. **MC, FR**	**MA.912.A.4.2** Add, subtract, and multiply polynomials. **MC, FR**	**MA.912.A.4.3** Factor polynomial expressions. Also assesses MA.912.A.5.1. **MC**	**MA.912.A.4.4** Divide polynomials by monomials and polynomials with various techniques, including synthetic division. **MC**	

Prior Knowledge: Items may require the student to apply mathematical knowledge described in NGSSS benchmarks from lower grades; however, the benchmarks from lower grades will not be assessed in isolation. MC = Multiple choice FR = Fill-in response

Mathematics Content Assessed by the Algebra 1 EOC Assessment and Item Types by Benchmark

Algebra 1 End-of-Course Assessment				
Body of Knowledge Algebra				
Standard 5 Rational Expressions and Equations **Simplify rational expressions, and solve rational equations using what has been learned about factoring polynomials.**				
MA.912.A.5.1 Simplify algebraic ratios. Assessed with MA.912.A.4.3.	**MA.912.A.5.4** Solve algebraic proportions. **MC, FR**			
Standard 6 Radical Expressions and Equations **Simplify and perform operations on radical expressions and equations. Rationalize square root expressions, and understand and use the concepts of negative and rational exponents. Add, subtract, multiply, divide, and simplify radical expressions and expressions with rational exponents. Solve radical equations and equations with terms that have rational exponents.**				
MA.912.A.6.1 Simplify radical expressions. Assessed with MA.912.A.6.2.	**MA.912.A.6.2** Add, subtract, multiply, and divide radical expressions (square roots and higher). Also assesses MA.912.A.6.1. **MC**			

Prior Knowledge: Items may require the student to apply mathematical knowledge described in NGSSS benchmarks from lower grades; however, the benchmarks from lower grades will not be assessed in isolation. MC = Multiple choice FR = Fill-in response

Mathematics Content Assessed by the Algebra 1 EOC Assessment and Item Types by Benchmark

Algebra 1 End-of-Course Assessment				
Body of Knowledge Algebra				
Standard 7 Quadratic Equations **Draw graphs of quadratic functions. Solve quadratic equations and solve these equations by factoring, completing the square, and by using the quadratic formula. Use graphing calculators to find approximate solutions of quadratic equations.**				
MA.912.A.7.1 Graph quadratic equations with and without graphing technology. Also assesses MA.912.A.7.8. **MC**	**MA.912.A.7.2** Solve quadratic equations over the real numbers by factoring and by using the quadratic formula. Also assesses MA.912.A.1.8 and MA.912.A.7.8. **MC, FR**	**MA.912.A.7.8** Use quadratic equations to solve real-world problems. Assessed with MA.912.A.7.1 and MA.912.A.7.2.	**MA.912.A.7.10** Use graphing technology to find approximate solutions of quadratic equations. Not assessed.	
Standard 10 Mathematical Reasoning and Problem Solving **In a general sense, all of mathematics is problem solving. In all of mathematics, use problem-solving skills, choose how to approach a problem, explain the reasoning, and check the results.**				
MA.912.A.10.1 Use a variety of problem-solving strategies, such as drawing a diagram, making a chart, guessing-and-checking, solving a simpler problem, writing an equation, working backwards, and creating a table. Assessed throughout.	**MA.912.A.10.2** Decide whether a solution is reasonable in the context of the original situation. Assessed throughout.	**MA.912.A.10.3** Decide whether a given statement is always, sometimes, or never true (statements involving linear or quadratic expressions, equations, or inequalities, rational or radical expressions, or logarithmic or exponential functions). Not assessed.		

Prior Knowledge: Items may require the student to apply mathematical knowledge described in NGSSS benchmarks from lower grades; however, the benchmarks from lower grades will not be assessed in isolation. MC = Multiple choice FR = Fill-in response

Mathematics Content Assessed by the Algebra 1 EOC Assessment and Item Types by Benchmark

Algebra 1 End-of-Course Assessment				
Body of Knowledge Discrete Mathematics				
Standard 7 Set Theory **Operate with sets, and use set theory to solve problems.**				
MA.912.D.7.1 Perform set operations such as union and intersection, complement, and cross product. **MC, FR**	**MA.912.D.7.2** Use Venn diagrams to explore relationships and patterns and to make arguments about relationships between sets. **MC, FR**			
Algebra 1 End-of-Course Assessment				
Body of Knowledge Geometry				
Standard 1 Points, Lines, Angles, and Planes **Understand geometric concepts, applications, and their representations with coordinate systems. Find lengths and midpoints of line segments, slopes, parallel and perpendicular lines, and equations of lines. Using a compass and straightedge, patty paper, a drawing program or other techniques, construct lines and angles, explaining and justifying the processes used.**				
MA.912.G.1.4 Use coordinate geometry to find slopes, parallel lines, perpendicular lines, and equations of lines. Assessed with MA.912.A.3.10.				

Prior Knowledge: Items may require the student to apply mathematical knowledge described in NGSSS benchmarks from lower grades; however, the benchmarks from lower grades will not be assessed in isolation. MC = Multiple choice FR = Fill-in response

Reporting Categories for FCAT 2.0 Mathematics and End-of-Course Assessments

Reporting Categories

The following table represents the content reporting categories for the Algebra 1 End-of-Course and Geometry End-of-Course Assessments along with the approximate percentage of raw-score points derived from each content category.

Course	Reporting Category 1	Reporting Category 2	Reporting Category 3
Algebra 1	Functions, Linear Equations, and Inequalities (55%)	Rationals, Radicals, Quadratics, and Discrete Mathematics (25%)	Polynomials (20%)
Geometry	Two-Dimensional Geometry (65%)	Three-Dimensional Geometry (20%)	Trigonometry and Discrete Mathematics (15%)

Mathematics Glossary
Algebra 1 EOC and Geometry EOC

The following glossary is a reference list provided for item writers and is **not** intended to comprise a comprehensive vocabulary list for students.

The terms defined in this glossary pertain to the NGSSS in mathematics for EOC assessments in Algebra 1 and Geometry.

Acute angle—An angle that has a measure between 0° and 90°.

Additive identity—The number zero (0). When zero (0) is added to another number, the sum is the number itself (e.g., $5 + 0 = 5$).

Additive inverse property—A number and its additive inverse have a sum of zero (0) (e.g., in the equation $3 + {}^{-}3 = 0$, 3 and $^{-}3$ are additive inverses of each other).

Altitude—The perpendicular distance from a vertex in a polygon to its opposite side.

Angle—Two rays extending from a common endpoint called the vertex.

Angle of depression—An angle defined by a horizontal ray and a ray extending from the common endpoint to a point below the horizontal ray.

Angle of elevation—An angle defined by a horizontal ray and a ray extending from the common endpoint to a point above the horizontal ray.

Apothem—The perpendicular distance from the center of a regular polygon to the midpoint of any of its sides.

Arc—A continuous part of a circle. The measure of an arc is the measure of the angle formed by two radii with endpoints at the endpoints of the arc.

Area—The measure, in square units, of the interior region of a closed two-dimensional figure (e.g., a rectangle with sides of 4 units by 6 units has an area of 24 square units).

Associative property—The way in which three or more numbers are grouped for addition or multiplication does not change their sum or product, respectively [e.g., $(5 + 6) + 9 = 5 + (6 + 9)$ or $(2 \times 3) \times 8 = 2 \times (3 \times 8)$].

Axiom—See postulate.

Base—The segment or face of a geometric figure that is perpendicular to the height.

Base of a power—The number or variable that undergoes repeated multiplication. For example, 2^3 is the exponential form of $2 \times 2 \times 2$. The numeral two (2) is the base.

Mathematics Glossary
Algebra 1 EOC and Geometry EOC

Binomial—A polynomial with two terms. In $2x + 5$, the terms are $2x$ and 5.

Bisect—To divide into two congruent parts.

Break—A zigzag on the *x*- or *y*-axis in a line or bar graph indicating that the data being displayed do not include all of the values that exist on the number line used. Also called a squiggle.

Center of dilation—The intersection of the lines that connect each point of a figure with the corresponding point of the similar figure.

Central angle—An angle that has its vertex at the center of a circle and with radii as its sides.

Centroid—The point of concurrency of the three medians of a triangle.

Chord—A line segment with endpoints on the circle.

Circumcenter of a triangle—The point of concurrency of three perpendicular bisectors of a triangle.

Circumference—The distance around a circle.

Circumscribed—A descriptor for a geometric figure that is drawn around and encloses (while certain points are touching) another geometric figure.

Closed figure—A two-dimensional figure that divides the plane into two parts—the part inside the figure and the part outside the figure (e.g., circles, squares, rectangles).

Coefficient—The number that multiplies the variable(s) in an algebraic expression (e.g., $4xy$). If no number is specified, the coefficient is 1.

Commutative property—The order in which two numbers are added or multiplied does not change their sum or product, respectively (e.g., $2 + 3 = 3 + 2$, or $4 \times 7 = 7 \times 4$).

Complement of set *A*—Denoted by A' or $\sim A$, the set of all elements in the universal set that are not in A.

Complementary angles—Two angles in which the measures have the sum of exactly 90°.

Compound inequality—Two inequalities that are combined into one statement by the words *and* or *or*.

Concave polygon—A polygon with one or more diagonals that have points outside the polygon.

Mathematics Glossary
Algebra 1 EOC and Geometry EOC

Concentric circles—Two or more coplanar circles that share the same center.

Conclusion—The "then" part of a conditional statement.

Conditional statement—A logical statement consisting of two parts, a hypothesis and a conclusion.

Congruent—Having the same size and shape.

Conjecture—An unproven statement based on observations.

Contrapositive—The statement formed by negating and reversing the hypothesis and conclusion of a conditional statement.

Converse—The statement formed by reversing the hypothesis and conclusion of a conditional statement.

Convex polygon—A polygon with each interior angle measuring less than 180º. All diagonals of a convex polygon lie inside the polygon.

Coordinate grid—A two-dimensional network of horizontal and vertical lines that are parallel and evenly spaced; especially designed for locating points, displaying data, or drawing maps. Also called a coordinate plane or rectangular coordinate system.

Coordinates—Numbers that correspond to points on a coordinate plane in the form (x, y), or a number that corresponds to a point on a number line.

Cosine (cos)—In a right triangle, the ratio of the length of the leg adjacent to the reference angle to the length of the hypotenuse.

Cross product of sets (discrete mathematics)—The set of all pairs wherein the first element is a member of the set A and the second element is a member of the set B [e.g., let $A = \{1, 2\}$ and $B = \{x, y, z\}$. Then $A \times B = \{(1, x), (1, y), (1, z), (2, x), (2, y), (2, z)\}$].

Cube—A solid figure with six congruent square faces.

Degree of a monomial—The sum of the exponents of the variables in a monomial.

Degree of a polynomial—The greatest degree of the monomials in a polynomial.

Dependent variable—The output of a function.

Diameter—A line segment from any point on a circle or sphere passing through the center to another point on the circle or sphere.

Mathematics Glossary
Algebra 1 EOC and Geometry EOC

Dilation—A transformation of a polygon that involves a proportional increase or decrease in size of all dimensions.

Distributive property—The distribution of multiplication over addition [e.g., $x(a + b) = ax + bx$].

Dodecahedron—A polyhedron with twelve faces.

Domain—The complete set of possible values of the independent variable in a function.

Edge—A line segment where two faces of a polyhedron meet.

Element—A number, letter, point, line, or any other object contained in a set.

Enlargement—A dilation in which the scale factor, or size change, is greater than one.

Equation—A mathematical sentence stating that the two expressions have the same value.

Equilateral triangle—A triangle with three congruent sides.

Exponent—The value that indicates how many times the base occurs as a factor (e.g., 2^3 is the exponential form of $2 \times 2 \times 2$). The numeral two (2) is called the base, and the numeral three (3) is called the exponent.

Expression—A collection of numbers, symbols, and/or operation signs that stands for a number.

Exterior angle—The angle formed by any side of a polygon and an extended adjacent side.

Face—One of the plane surfaces bounding a three-dimensional figure; a side.

Flow chart proof—A convincing argument that uses boxes and arrows to show the logical connections between the statements.

Formal proof—A convincing argument containing statements and reasons.

Function—A relation in which each value of the independent variable is paired with a unique value of the dependent variable.

Geometric mean—The geometric mean between two positive numbers a and b is the positive number x where: $\frac{a}{x} = \frac{x}{b}$.

Mathematics Glossary
Algebra 1 EOC and Geometry EOC

Great circle—A circle formed when a plane intersects a sphere with its center at the center of the sphere. A great circle divides a sphere into two hemispheres.

Hexahedron—A polyhedron with six faces.

Hypotenuse—The side opposite the right angle.

Hypothesis—The "if" part of a conditional statement. Plural: hypotheses.

Icosahedron—A polyhedron with twenty faces.

Incenter—The point of concurrency of the three angle bisectors of a triangle.

Independent variable—The input of a function.

Indirect proof—A proof in which the statement to be proven is assumed to be false, and this assumption leads to a contradiction.

Inequality—A sentence that states one expression is greater than, greater than or equal to, less than, less than or equal to, or not equal to, another expression (e.g., $a \neq 5$ or $x < 7$ or $2y + 3 \geq 11$).

Inscribed angle—An angle that has a vertex on a circle and sides that contain chords of the circle.

Intercept—On a graph, the values where a function intersects the axes.

Interior angle—An angle formed by two sides of a polygon sharing a common vertex.

Intersection of sets—The intersection of sets A and B is the set of elements of A that are also elements of B. It is denoted by $A \cap B$ and is read "A intersection B."

Inverse—The statement formed by negating both the hypothesis and conclusion of a conditional statement.

Irrational numbers—The set of real numbers that cannot be expressed as a ratio of two integers (e.g., $\sqrt{2}$).

Isosceles triangle—A triangle with at least two congruent sides.

Kite—A quadrilateral with two distinct pairs of adjacent, congruent sides.

Lateral area—The surface area of a three-dimensional figure that includes only the area of the lateral faces.

Mathematics Glossary
Algebra 1 EOC and Geometry EOC

Lateral edge—The edges formed by the intersection of the lateral faces of a prism or pyramid.

Lateral face—A face of a prism or pyramid that is not being used as a base.

Leading coefficient—The coefficient of the first term of a polynomial whose terms are written in descending order from largest degree to smallest degree.

Line of best fit—A line drawn on a scatter plot of data that comes closest to all points in the data set.

Line of symmetry—The line over which two figures are mirror images of each other.

Line segment—A part of a line that consists of two defined endpoints and all the points in between.

Mapping diagram—A diagram that illustrates how the elements of a relation's domain are paired with the elements of the relation's range.

Median of a triangle—The line segment that connects a vertex with the midpoint of the opposite side.

Midpoint of a line segment—The point on a line segment that is equidistant from the endpoints.

Monomial—A number, variable, or the product of a number and one or more variables with whole number exponents.

Net—A two-dimensional diagram that can be folded or made into a three-dimensional figure.

Oblique—A relationship between lines and/or plane figures that is not perpendicular or parallel.

Obtuse angle—An angle with a measure between 90° and 180°.

Octahedron—A polyhedron with eight faces.

Ordered pair—The location of a single point on a rectangular coordinate system where the first and second values represent the position relative to the x-axis and y-axis, respectively [e.g., (x, y) or $(3, -4)$].

Origin—The point of intersection of the x- and y-axes in a rectangular coordinate system, where the x-coordinate and y-coordinate are both zero (0).

Orthocenter—The point of concurrency of the three altitudes of a triangle.

Mathematics Glossary
Algebra 1 EOC and Geometry EOC

Parabola—The shape of the graph of a quadratic function.

Paragraph proof—A convincing argument that uses statements and reasons connected in sentences.

Parallel lines—Two lines that are coplanar and do not intersect.

Parallelogram—A quadrilateral in which both pairs of opposite sides are parallel.

Perimeter—The distance around a polygon.

Perpendicular—Lines, line segments, rays, or planes that intersect to form a right angle.

Pi (π)—The symbol designating the ratio of the circumference of a circle to its diameter. It is an irrational number with common approximations of either 3.14 or $\frac{22}{7}$.

Platonic solid—A polyhedron for which the faces are regular congruent polygons with the same number of edges meeting at each vertex. The five Platonic solids are: tetrahedron, hexahedron, octahedron, dodecahedron, and icosahedron.

Point—A specific location in space that has no discernible length or width.

Point of concurrency—A point where three or more lines intersect.

Point-slope form—A form of a linear equation, $y - y_1 = m(x - x_1)$, where m is the slope of the line and (x_1, y_1) is a point on the line.

Polygon—A closed-plane figure, having at least three sides that are line segments and are connected at their endpoints.

Polyhedron—A solid figure bounded by polygons. Plural: polyhedra.

Polynomial—A monomial or the sum or difference of two or more monomials.

Postulate—A mathematical statement accepted as true without proof. Also called an axiom.

Prism—A polyhedron that has two congruent and parallel faces joined by faces that are parallelograms. Prisms are named by their bases.

Proof—A logical argument that demonstrates the truth of a given statement. In a formal proof, each step can be justified with a reason, such as a given, a definition, an axiom, or a previously proven property or theorem.

Mathematics Glossary
Algebra 1 EOC and Geometry EOC

Proportion—A mathematical equation stating that two ratios are equal.

Pyramid—A three-dimensional figure in which the base is a polygon and the faces are triangles with a common vertex.

Radical—An expression that has a root (square root, cube root, etc.). For example, $\sqrt{25}$ is a radical. Any root can be specified by an index number, b, in the form $\sqrt[b]{a}$ (e.g., $\sqrt[3]{8}$). A radical without an index number is understood to be a square root.

Radical sign—The symbol ($\sqrt{\ }$) used before a number to show that the number is a radicand. See also radical.

Radicand—The number that appears within a radical sign (e.g., in $\sqrt{25}$, 25 is the radicand).

Radius—A line segment extending from the center of a circle or sphere to a point on the circle or sphere. Plural: radii.

Range—The complete set of all possible resulting values of the dependent variable of a function.

Rate of change—The ratio that compares the change in the dependent variable to the change in the independent variable.

Ratio—The comparison of two quantities (e.g., the ratio of a and b is $a:b$ or a/b, where $b \neq 0$).

Rational expression—An algebraic expression that can be written as a fraction for which numerator and denominator are polynomials.

Rational numbers—The set of all numbers that can be expressed as a ratio of two integers.

Ray—A part of a line that begins at a point and goes on indefinitely in one direction.

Real numbers—The set of all rational and irrational numbers.

Rectangular coordinate system—See coordinate grid.

Rectangular prism—A three-dimensional figure (polyhedron) with congruent, rectangular bases and lateral faces that are parallelograms.

Reflection—A transformation that produces the mirror image of a geometric figure over a line or point of reflection. A reflection over a line is also called a flip.

Regular polygon—A polygon that is both equilateral and equiangular.

Mathematics Glossary
Algebra 1 EOC and Geometry EOC

Regular polyhedron—A solid figure with congruent regular polygons for all faces.

Relation—A set of ordered pairs.

Rhombus—A parallelogram with four congruent sides.

Right angle—An angle for which the measure is exactly 90°.

Right circular cone—A three-dimensional figure that has a circular base, a vertex not in the plane of the circle, a curved lateral surface, and an altitude that contains the center of the base.

Right circular cylinder—A cylinder in which the bases are parallel circles perpendicular to the side of the cylinder.

Right prism—A prism in which all the lateral faces and edges are perpendicular to the bases.

Right square pyramid—A polyhedron in which one face, the base, is a square and the other faces, the lateral faces, are triangles with a common vertex, which is directly above the center of the base.

Right triangle trigonometry—Finding the measures of missing sides or angles of a right triangle when given the measures of other sides or angles.

Roots (zeros) of a quadratic function—See zeros of a quadratic function.

Rotation—A transformation of a figure by turning it about a center point or axis. The amount of rotation is usually expressed in the number of degrees (e.g., a 90° rotation). The direction of the rotation is usually expressed as clockwise or counterclockwise. Also called a turn.

Rule—A mathematical expression that describes a pattern or relationship, or a written description of the pattern or relationship.

Scalar drawing (or scale model)—A drawing (or model) that uses lengths in the drawing (or model) that are proportional to the actual image.

Scale factor—The constant that is multiplied by the length of each side of a figure to produce an image that is the same shape as the original figure.

Scalene triangle—A triangle having no congruent sides.

Secant of a circle—A line that intersects a circle in two points.

Sector—The region formed by a central angle and an arc.

Mathematics Glossary
Algebra 1 EOC and Geometry EOC

Set—A collection of items.

Similar figures—Figures that have corresponding angles that are congruent and have corresponding sides that are proportional in length.

Sine (sin)—In a right triangle, the ratio of the length of the leg opposite the reference angle to the length of the hypotenuse.

Slant height of a regular pyramid—The distance from the vertex to the midpoint of an edge of the base.

Slant height of a right cone—The distance from a vertex to a point on the edge of the base.

Slope—The ratio of change in the vertical axis (y-axis) to change in the horizontal axis (x-axis) in the form $\frac{\text{rise}}{\text{run}}$ or $\frac{\Delta y}{\Delta x}$. Also, the constant, m, in the linear equation for the slope-intercept form $y = mx + b$.

Slope-intercept form—A form of a linear equation, $y = mx + b$, where m is the slope of the line and b is the y-intercept.

Sphere—A three-dimensional figure in which all points on the figure are equidistant from a center point.

Square root—A positive real number that can be multiplied by itself to produce a given number (e.g., the square root of 144 is 12 or $\sqrt{144} = 12$).

Squiggle—See break.

Standard form of a linear equation—$Ax + By = C$.

Straight angle—An angle that measures exactly 180°.

Supplementary angles—Two angles in which the measures have the sum of exactly 180°.

Symmetry—A term describing the result of a line drawn through the center of a figure such that the two halves of the figure are reflections of each other across the line. When a figure is rotated around a point and fits exactly on itself, the figure has rotational symmetry.

Tangent (tan)—In a right triangle, the ratio of the length of the leg opposite the reference angle to the length of the leg adjacent to the given angle.

Mathematics Glossary
Algebra 1 EOC and Geometry EOC

Tangent to a circle—A line in the plane of the circle that intersects the circle in exactly one point, called the point of tangency.

Term—A number, variable, product, or quotient in an expression. A term is not a sum or difference (e.g., $5x^2 + 6$ has two terms, $5x^2$ and 6).

Tessellation—A covering of a plane without overlaps or gaps using combinations of congruent figures.

Tetrahedron—A polyhedron with four faces.

Theorem—A mathematical statement that can be shown to be true based on postulates, definitions, or other proven theorems.

Three-dimensional figure—A figure having length, height, and width (depth).

Transformation—An operation on a geometric figure by which an image is created. Common transformations include reflections (flips), translations (slides), rotations (turns), and dilations.

Translation—A transformation in which every point in a figure is moved in the same direction and by the same distance.

Transversal—A line that intersects two or more lines at different points.

Trapezoid—A quadrilateral with exactly one pair of parallel sides.

Trigonometric ratio—The ratio of two sides of a right triangle (e.g., cosine, sine, and tangent).

Two-column proof—A proof in which the statements are written in the left column and the reasons are written in the right column.

Union of sets—The union of two sets A and B is the set of elements that are in A or in B or in both. It is denoted by $A \cup B$ and is read "A union B."

Variable—A symbol used to represent a quantity that can change.

Venn diagram—A diagram that shows relationships among sets.

Vertex—The point common to the two rays that form an angle; the point common to any two sides of a polygon; the point common to three or more edges of a polyhedron. Plural: vertices.

Vertical angles—The opposite or nonadjacent angles formed when two lines intersect.

Mathematics Glossary
Algebra 1 EOC and Geometry EOC

Volume—The amount of space occupied in three dimensions and expressed in cubic units. Both capacity and volume are used to measure empty spaces; however, capacity usually refers to fluid measures, whereas volume is described by cubic units.

***x*-axis**—The horizontal number line on a rectangular coordinate system.

***x*-intercept**—The value of x at the point where a line or graph intersects the x-axis. The value of y is zero (0) at this point. Can be expressed as an ordered pair or x-intercept equals a value.

***y*-axis**—The vertical number line on a rectangular coordinate system.

***y*-intercept**—The value of y at the point where a line or graph intersects the y-axis. The value of x is zero (0) at this point. Can be expressed as an ordered pair or y-intercept equals a value.

Zero product property—If the product of two or more quantities equals zero, then at least one of the quantities is equal to zero.

Zeros (roots) of a quadratic equation—The solution(s) of an equation that has the form $Ax^2 + Bx + C = 0$.

Instructions for Item Review

Directions: A series of questions numbered 1–9 are presented below. These questions are designed to assist with your evaluation of the quality of test items you will be reviewing. The chart on the next page is an example of the one you will use to record your rating of each item. You will review the items independently before discussing each item with other committee members. If you identify any problem area in the item during the independent review, you should put a crossmark (✘) in the appropriate column. Crossmarks (✘) will indicate problem areas, and blank spaces or checks (✓) will indicate no problems.

Questions 1–9

1. Does the test item measure the benchmark?
2. Does the content measured by the item meet the content limits of the *Algebra 1 End-of-Course Assessment Test Item Specifications*?
3. Is the wording/context of the item (stem and stimulus) appropriate for the course?
4. In your professional judgment, what is the cognitive complexity of the item for students who have attained benchmark mastery? In other words, is the item best categorized as low complexity (L), moderate complexity (M), or high complexity (H)? Use the cognitive-complexity handouts in making this judgment.
5. In your professional judgment, what is the level of difficulty of the item for students who have attained benchmark mastery?
   Use: E = easy (more than 70% of the students should get the item correct)
   A = average (between 40% and 70% of the students should get the item correct)
   C = challenging (less than 40% of the students should get the item correct)
6. Is the NGSSS topic appropriate for the item?
7. Is the assigned content focus appropriate for the item?
8. Is the keyed response the correct, best, and only answer? For fill-in response items: Does the problem result in an answer that will fit in the fill-in response boxes? Do other acceptable answers need to be identified in the answer key?
9. Are the multiple-choice options appropriate, parallel (both grammatically and conceptually to the keyed response), and plausible?

Overall Quality Rate the overall quality of each test item using the following rating definitions and codes.

Overall Quality

A (Accept) **AM** (Accept with Metadata changes) **AR** (Accept as Revised)
RR (Revise and Re-present, including art) **R** (Reject)

Please provide a brief explanation of ratings of AR, RR, and R in the comment section.

After the group discussion and possible revision of an item, you may wish to change your overall rating. If so, place a slash (/) through your original rating and give the item a new rating.

Algebra 1 EOC Item Rating Form

Page # of Item	Item ID Number	Measures Benchmark	Adheres to Content Limits	Is Appropriate for Course	Appropriate Cognitive Complexity (L, M, H)	Estimated Item Difficulty (E, A, C)	Appropriate FCAT 2.0 Topic	Appropriate Content Focus	Only One Correct Answer	Appropriate Options	Overall Rating A/AM/AR/RR/R	Additional Comments
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												

Students in my (classroom, school, district) [circle one] are given the opportunity to learn the material that these items test, except as noted in my comments.	**Signature** _____ **Date** _____

FCAT 2.0 Mathematics, Algebra 1 EOC, and Geometry EOC Test Design Summary

Item Types and Numbers

The data in this table give ranges for the approximate number of items by item type on the FCAT 2.0 and EOC mathematics assessments. These ranges include both operational and field-test items.

Grade/Course	Item Types
3	50–55 MC
4	35–40 MC 10–15 GR
5	35–40 MC 10–15 GR
6	35–40 MC 10–15 GR
7	35–40 MC 10–15 GR
8	35–40 MC 20–25 GR
Algebra 1	35–40 MC 20–25 FR
Geometry	35–40 MC 20–25 FR

Duration of Tests

The table below displays the number of minutes allowed for regular test takers for FCAT 2.0 and EOC mathematics assessments.

Grade/Course	Duration (in minutes)
3	140
4	140
5	140
6	140
7	140
8	140
Algebra 1	160
Geometry	160

Length of Tests

This table provides an approximate range for the number of items on each test.

Grade/Course	Number of Items
3	50–55
4	50–55
5	50–55
6	50–55
7	50–55
8	55–60
Algebra 1	60–65
Geometry	60–65

Algebra 1 End-of-Course and Geometry End-of-Course Assessments Reference Sheet

Area

Parallelogram	$A = bh$
Triangle	$A = \frac{1}{2}bh$
Trapezoid	$A = \frac{1}{2}h(b_1 + b_2)$
Circle	$A = \pi r^2$
Regular Polygon	$A = \frac{1}{2}aP$

KEY

b	= base	A	= area
h	= height	B	= area of base
w	= width	C	= circumference
d	= diameter	V	= volume
r	= radius	P	= perimeter of base
ℓ	= slant height		
a	= apothem	$S.A.$	= surface area

Use 3.14 or $\frac{22}{7}$ for π.

Circumference

$C = \pi d$ or $C = 2\pi r$

	Volume/Capacity	Total Surface Area
 Rectangular Prism	$V = bwh$ or $V = Bh$	$S.A. = 2bh + 2bw + 2hw$ or $S.A. = Ph + 2B$
 Right Circular Cylinder	$V = \pi r^2 h$ or $V = Bh$	$S.A. = 2\pi rh + 2\pi r^2$ or $S.A. = 2\pi rh + 2B$
 Right Square Pyramid	$V = \frac{1}{3}Bh$	$S.A. = \frac{1}{2}P\ell + B$
 Right Circular Cone	$V = \frac{1}{3}\pi r^2 h$ or $V = \frac{1}{3}Bh$	$S.A. = \frac{1}{2}(2\pi r)\ell + B$
 Sphere	$V = \frac{4}{3}\pi r^3$	$S.A. = 4\pi r^2$

Sum of the measures of the interior angles of a polygon $= 180(n-2)$

Measure of an interior angle of a regular polygon $= \frac{180(n-2)}{n}$

where:

n represents the number of sides

Algebra 1 End-of-Course and Geometry End-of-Course Assessments Reference Sheet

Slope formula

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

where m = slope and (x_1, y_1) and (x_2, y_2) are points on the line

Slope-intercept form of a linear equation

$$y = mx + b$$

where m = slope and b = y-intercept

Point-slope form of a linear equation

$$y - y_1 = m(x - x_1)$$

where m = slope and (x_1, y_1) is a point on the line

Distance between two points

$P_1(x_1, y_1)$ and $P_2(x_2, y_2)$

$$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Midpoint between two points

$P_1(x_1, y_1)$ and $P_2(x_2, y_2)$

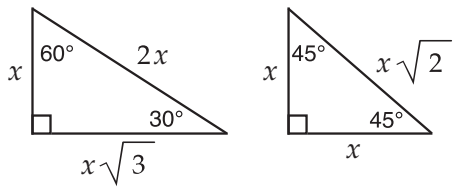
$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

Quadratic formula

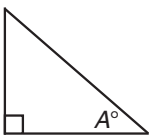
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

where a, b, and c are coefficients in an equation of the form $ax^2 + bx + c = 0$

Special Right Triangles



Trigonometric Ratios



$$\sin A° = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos A° = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\tan A° = \frac{\text{opposite}}{\text{adjacent}}$$

Conversions

1 yard = 3 feet
1 mile = 1,760 yards = 5,280 feet
1 acre = 43,560 square feet
1 hour = 60 minutes
1 minute = 60 seconds

1 cup = 8 fluid ounces
1 pint = 2 cups
1 quart = 2 pints
1 gallon = 4 quarts
1 pound = 16 ounces
1 ton = 2,000 pounds

1 meter = 100 centimeters = 1000 millimeters
1 kilometer = 1000 meters
1 liter = 1000 milliliters = 1000 cubic centimeters
1 gram = 1000 milligrams
1 kilogram = 1000 grams

Response Grids

Mathematics FR items are written with consideration for the number of columns in the fill-in response box. Students may enter a digit 0 through 9, a decimal point, a negative sign, or the symbol for the fraction bar (/) in each column in the response box. The symbol for the fraction bar may not be entered in the first or last column.

Algebra 1 EOC and Geometry EOC

The Algebra 1 EOC and Geometry EOC Assessments are computer based and use a seven-column fill-in response box.

The Florida Department of Education and its test contractors currently employ strategies to protect the environment in the production and destruction of FCAT 2.0 materials. The Department encourages schools and districts to recycle nonsecure FCAT 2.0 interpretive publications after use.