2005

FCAT

Florida Comprehensive Assessment Test

FCAT Mathematics Test Item Specifications

GRADES 9–10

FCAT Mathematics Test Item Specifications, Grades 9–10, Version 3

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Introduction

The Florida Comprehensive Assessment Test (FCAT) measures achievement in reading and mathematics for Florida students in Grades 3 through 10, in science at Grades 5, 8, and 11, and in writing at Grades 4, 8, and 10 by assessing student progress on benchmarks identified in the *Sunshine State Standards (Standards)*. This document, *FCAT Mathematics Test Item Specifications (Specifications),* details the item and design features of the mathematics portion of the FCAT.

The hierarchical arrangement of the *Standards* provides benchmarks (more specific than the standards) that tell what students should know and be able to do at the end of developmental levels of grades. The mathematics assessment, FCAT Mathematics, measures the learner expectations of the mathematics benchmarks.

History of the *Test Item Specifications*

In 1996, the Florida Department of Education (the DOE), in cooperation with the FCAT Mathematics Content Advisory Committee, developed the *Specifications* for Grades 5, 8, and 10. Initially, the DOE worked with the FCAT Content Advisory Committee to determine which of the benchmarks contained in the *Sunshine State Standards* would be assessed on FCAT and which item types for these benchmarks would be appropriate. The item review committees used the *Specifications* to review items developed for the FCAT. Comments during initial item review meetings were used to clarify and refine the first draft of the *Specifications*. In 1999, when Grades 3, 4, 6, 7, and 9 were added to FCAT Mathematics, the same review process was maintained.

Purpose of the *Test Item Specifications*

The *Specifications* are designed to be broad enough to ensure that test items will be developed to measure the concepts presented in each benchmark. The *Specifications* for Grades 9–10 is a resource document that all item writers and reviewers should use to define the content and format of test items and should serve as a source of information about FCAT design for educators and the general public.

Scope of this Document

The *Specifications* for Grades 9–10 provides both general and grade-specific guidelines for the development of all test items used in FCAT Mathematics for Grades 9–10. Two additional documents provide the same information for Grades 3–5 and 6–8.

General Specifications

This section of the *Specifications* describes the guidelines that apply to all test items and performance tasks developed for FCAT.

Overall Considerations

Overall considerations are broad item development issues that should be addressed during the development of test items and performance tasks. Other sections of the General Specifications relate more specifically to one aspect of the development (for example, individual item types or content limits).

1. Each 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. Items should be appropriate for students in terms of grade-level difficulty, cognitive complexity, and reading level.

4. At a given grade level, the test items will exhibit a varied range of difficulty.

5. For mathematics items, the reading level should be approximately one grade level below the grade level of the test, except for specifically assessed mathematical terms or concepts.

6. Items should not provide an advantage or disadvantage to a particular group of students. Items should not exhibit or reflect disrespect to any segment of the population with regard to age, gender, race, ethnicity, language, religion, socioeconomic status, disability, or geographic region.

7. At Grades 3–6, all items should be written so they can be answered without using a calculator. At Grades 7–10, students are allowed to use a four-function calculator, although items should still be written to be answered without a calculator within the timing guidelines for each item type.

8. Items may require the student to apply mathematical knowledge described in the *Sunshine State Standards* benchmarks from lower grades.

9. Some items should provide information for students to analyze and use in order to respond to the items.

10. Items should provide clear and complete instructions to students.

11. Each item should be written to clearly and unambiguously elicit the desired response.

12. A reference sheet of appropriate formulas and conversions is provided to students in Grades 6–10 for use during testing. Copies of the reference sheets are included after the General Content Limits section of this document.

13. If formulas are needed in Grades 3–5, they should be included with the item.

Criteria for FCAT Mathematics Test Items

FCAT Mathematics includes four types of test items: multiple-choice items (MC), gridded-response items (GR), short-response performance tasks (SR), and extended-response performance tasks (ER). The SRs and ERs are called “Think, Solve, Explain” performance tasks. The general specifications on pages 3 through 15 cover the following criteria for the FCAT:

- Use of Graphics
- Item Style and Format
- Scope of Items
- Cognitive Complexity of Mathematics Items
- Universal Design
- Guidelines for Item Writers
- Benchmark Classification System

Use of Graphics

Graphics are used extensively in the FCAT 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. The benchmarks assessed by the FCAT require different levels of graphics and illustrations. For example, the mathematics strand “Geometry and Spatial Sense” depends heavily upon graphics to present geometric concepts and/or properties required for answering a question. In contrast, items or tasks in other strands may contain graphics or pictures that illustrate and enhance interest but are not required to answer the question.

Most of the individual benchmark specifications in the *Specifications* indicate the extent to which graphics should be used to support test items and performance tasks developed for the benchmark. When no reference is made to the use of graphics, graphics are not necessary, even though 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 type of item to be developed.

General Guidelines

1. Items should be clear and concise, and they should use vocabulary and sentence structure appropriate for the grade level being assessed.

2. The final sentence of any MC or GR 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 performance tasks (SR and ER items) that require estimation strategies, all uppercase letters should be used for the words ESTIMATE and ESTIMATION. For MC and GR 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 items (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 unless the number indicates a metric unit. 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).

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 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 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 item stem, any numbers needed to compute answers should be presented as numerals.

Multiple-Choice (MC) Items

1. MC items should take an average of 1 minute per item to solve.

2. MC items are worth 1 point each.

3. MC items should have four answer choices (A, B, C, D or F, G, H, I for alternating items).

4. During item development and review, the correct response should be indicated with a star next to the answer choice letter.

5. During item development and review, the rationale for distractors (incorrect answer choices) should be indicated and set off in brackets.

6. In most cases, answer choices 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 (Grade 4 graphics should not be stacked.):

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

8. If the answer choices 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, choices should be arranged as they are presented in the item stem.

9. If the answer choices for an item are neither strictly numerical nor denominate numbers, the choices should be arranged by the logic presented in the question 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.

Gridded-Response (GR) Items

1. GR items should take an average of 1.5 minutes per item to complete.

2. GR items are worth 1 point each.

3. The bubble grids used with GR items contain either four or five columns. Each column contains the digits 0 through 9 enclosed in bubbles.

4. The GR format is designed for items that require a positive numeric solution (whole numbers, decimals, percents, or fractions).

5. 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.

6. Four-column grids are used for Grade 5 and may be preceded with a dollar sign ($) or followed by a percent sign (%), as appropriate.

7. Special grids are provided at Grade 5 for gridding decimal numbers and currency. The decimal grid is five columns wide with a fixed decimal point in the middle. That is, there are two columns preceding the column with the decimal and two columns following it. The currency grid is the same as the decimal grid with a dollar sign ($) preceding it.

8. Grades 6 through 10 use a five-column grid that includes the digits 0 through 9 plus two symbols: the decimal point (.) and the slash (/) for gridding fractions.

9. Both four- and five-column grids include light shading in alternate columns. Shading should not interfere with students' ability to read the numbers inside each column.

10. GR items should include instructions that specify the unit in which the answer is to be provided (e.g., inches).

11. GR items are written with consideration for the number of columns in the grid.

Think, Solve, Explain Performance Tasks

Two types of performance tasks are used: short-response (SR) and extended-response (ER). Instructions for completing each task should be provided in the test book.

Trained scorers score each student response using rubrics, top-score responses, and anchor papers. The materials used to train scorers include examples that illustrate each possible score point. These examples are called rangefinders or anchor papers. The general scoring rubrics used for SR and ER items are found in Appendix D.

The response space will vary according to the demands of individual performance tasks. Adequate space must be allotted for students to respond thoroughly to the task. Response areas may include coordinate planes, lines, graphics, and/or open space.

Short-Response (SR) Tasks

1. SR tasks should take approximately 3 to 5 minutes per item to complete.

2. SR tasks are worth 2 points each. Students earn a score of 0, 1, or 2 points depending on their responses.

3. Items should be written so that students are prompted to include in responses solutions to the problem, the procedures used to solve the problem, an explanation of the methods needed or used to solve the problem, and/or a justification or reason for the method used to solve the problem.

4. Items should be written so that students have opportunities to solve the problems by using different approaches.

5. The appropriate scoring rubric and an example of a top-score response should be provided for each item.

Extended-Response (ER) Tasks

1. ER tasks should take approximately 10 to 15 minutes per item to complete.

2. ER tasks are worth 4 points each. Students earn a score of 0, 1, 2, 3, or 4 points depending on their responses.

3. Items should be written to include multiple, related steps.

4. Items should be written so that students are prompted to include in responses solutions to the problem, the procedures used to solve the problem, an explanation of the methods needed or used to solve the problem, and/or a justification or reason for the method used to solve the problem.

5. Items should be written so that students have opportunities to solve the problems by using different approaches.

6. The appropriate scoring rubric and an example of a top-score response should be provided for each item.

Scope of Items

The scope of FCAT Mathematics for Grades 9–10 is presented in Appendix B, which gives the *Sunshine State Standards* benchmarks for Grades 3–10. The benchmarks serve as the objectives to which the test items are written. There may be additional specifications or restrictions by grade level; these are given in the grade-specific General Content Limits section of the *Specifications* for Grades 9–10.

Some of the *Sunshine State Standards* benchmarks are assessed across all grades (3–10), as shown in Appendix B. These benchmarks are introduced at one grade with the understanding that they will be assessed at higher levels of difficulty or complexity in each succeeding grade.

Cognitive Complexity of Mathematics Items

The benchmarks in the *Sunshine State Standards* identify knowledge and skills students are expected to acquire at each level, with the underlying expectation that students also demonstrate critical thinking. Goal 3, Standard 4, of *Florida's System of School Improvement and Accountability* makes this expectation clear: "Florida students use creative thinking skills to generate new ideas, make the best decisions, recognize and solve problems through reasoning, interpret symbolic data, and develop efficient techniques for lifelong learning." FCAT test items, while assessing *Sunshine State Standards* benchmarks, must also reflect this goal and standard. It is important to develop items that elicit the complexity of knowledge and skills required to meet these objectives.

The degree of challenge of FCAT items is currently categorized in two ways, item difficulty and cognitive complexity. Item difficulty has two meanings, depending on the stage of item development. At the item review stage (before use on the test), item difficulty is a prediction of the percentage of students who will choose the correct answer. After item review, item difficulty refers to the percentage of students who actually chose the correct answer.

Items for which students will choose the correct answer more than 70 percent of the time are considered easy. Items for which students will choose the correct answer 40–70 percent of the time are considered average. Items for which students will choose the correct answer less than 40 percent of the time are considered challenging.

Cognitive complexity refers to the cognitive level associated with the item. Since the inception of the FCAT, Bloom's Taxonomy[1] has been used for this purpose; 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, a new cognitive classification system will be used that is based largely upon Dr. Norman L. Webb's work with "Depth of Knowledge"[2] levels. The rationale for classifying items by their level of complexity is to focus on the mathematical expectations of the item, not the mathematical ability of the student. The demands on thinking that an item makes—what the item requires the student to recall, understand, reason about, and do—are made with the assumption that the student is familiar with the mathematics of the task. If a student has not learned the particular mathematics at hand, the task is more apt to have varied and heavier demands, and the student may not be as successful with it. Items are chosen for the FCAT based on the *Sunshine State Standards* and their grade-level appropriateness, but the complexity of the items remains independent of the particular curriculum a student has experienced.

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, items at the low level of complexity may ask a student to solve a one-step problem. At the moderate level, an item may ask the student to extend a pattern or retrieve information from a graph and use it to solve a problem. At the high level, an item may ask a student to perform a procedure having multiple steps and multiple decision points. The distinctions made in item complexity are intended to provide a balance across the tasks administered at each grade level.

[1]Bloom, B.S., et al. *Taxonomy of Educational Objectives, Handbook I: Cognitive Domain.* New York: McKay, 1956.
[2]Webb, N.L., 1999, *Alignment Between Standards and Assessment*, University of Wisconsin Center for Educational Research.

Low Complexity

This category relies 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. The list below illustrates some, but not all, of the demands that low-complexity items might make.

- 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 construct an equivalent representation.
- Evaluate a variable 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.

Low Complexity Examples

An influenza virus is 0.00000012 meter in diameter. Which of these expresses this distance in scientific notation?

A. 1.2×10^{-6}

★ B. 1.2×10^{-7}

C. 12×10^{-6}

D. 12×10^{-7}

To get the full benefit from aerobic exercise, an athlete's heart rate should reach a target heart rate. To figure the appropriate target heart rate, the formula $198 - 0.9a = T$ may be used, where T represents the target heart rate and a represents the athlete's age. Which of the following equations is equivalent to $198 - 0.9a = T$?

A. $T - 0.9a = {}^{-}198$

B. $T - 0.9a = 198$

C. $T + 0.9a = {}^{-}198$

★ D. $T + 0.9a = 198$

Moderate Complexity

Items in the moderate complexity category involve more flexibility of thinking and choice among alternatives than do those in the low complexity category. They require a response that goes beyond the habitual, is not specified, 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. The list below illustrates some, but not all, of the demands that moderate-complexity items might make.

- Solve a problem requiring multiple operations.
- Solve a problem involving spatial visualization and/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.
- Provide a justification for steps in a solution process.
- Formulate a routine problem, given data and conditions.
- Represent a situation mathematically in more than one way.
- Select and/or use different representations, depending on situation and purpose.

Moderate Complexity Examples

David and Terri drove a small motorboat down a river with the current. The rate the boat traveled in still water was r miles per hour and the current's average speed was c miles per hour. It took them 1.5 hours to travel 4 miles downstream. Which of the following equations can be used to represent this information?

A. $1.5 = (r + c)\,4$

B. $1.5 = (r - c)\,4$

★ C. $4 = (r + c)\,1.5$

D. $4 = (r - c)\,1.5$

The "lightweighting" process makes it possible for manufacturers to use less material to produce glass bottles. In 1972 it took 75.7 pounds of glass to produce one hundred 16-ounce glass bottles. In 1992 it took 48 pounds of glass to make the same size and number of bottles. To the nearest whole percent, what is the percent decrease in the number of pounds of glass used in 1972 compared with 1992 to produce one hundred 16-ounce bottles?

Gridded response: 37

High Complexity

High complexity items make heavy demands on student thinking. Students must engage in more abstract reasoning, planning, analysis, judgment, and creative thought. The item requires that the student think in an abstract and sophisticated way. The list below illustrates some, but not all, of the demands that high-complexity items might make.

- Perform a procedure having multiple steps and multiple decision points.
- Describe how different representations can be used for different purposes.
- Solve a non-routine 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.
- Explain and justify a solution to a problem.
- Describe, compare, and contrast solution methods.
- Formulate a mathematical model for a complex situation.
- Analyze or produce a deductive argument.
- Provide a mathematical justification.

NOTE:
The complexity of an item is generally NOT dependent on the multiple-choice distractors. The options may affect the difficulty of the item but not the complexity of the item. The intent of the item writer weighs heavily in determining the complexity of an item.

Items that seem to fit a particular bulleted phrase under one category are at least that level of complexity. An item can fit one or more bulleted phrases, but should be classified in the highest level of complexity demanded by the item. For example, the following item fits "solve a problem requiring multiple operations" under moderate complexity and "perform a procedure having multiple steps and multiple decision points" under high complexity; therefore, this item is classified as "high complexity."

High Complexity Examples

A science lab needs a right circular cylindrical container that holds exactly 15 gallons of liquid and is 24 inches tall. A reference manual states that 231 cubic inches is equivalent to 1 gallon. Which is the approximate radius, in inches, of the container?

A. 1.92 inches

★ B. 6.78 inches

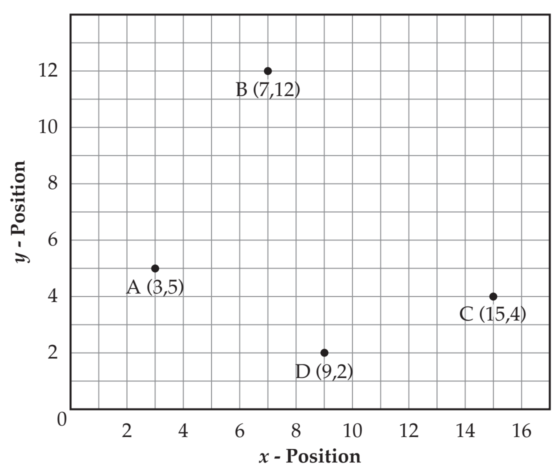
C. 22.99 inches

D. 45.98 inches

The course of the monorail at an amusement park must be changed to make room for a new parking lot. Engineers have decided that only the main supporting column located at point C on the grid below should be relocated. They have also decided that the rebuilt course should be in the shape of a parallelogram.

Part A Plot the new location of the supporting column and write its coordinates. Label the new location C′.

MONORAIL COURSE



Part B Use the definition or properties of a parallelogram to verify that the new monorail course is a parallelogram. You must use the slopes of the sides, the lengths of the sides, or both, to help verify your answer.

Below is a list showing the target range for the percentage of points by cognitive complexity level on each FCAT Mathematics test.

Percentage of Points by Cognitive Complexity Level for FCAT Mathematics

Grades	Low Level (Approximate Percentages)	Moderate Level (Approximate Percentages)	High Level (Approximate Percentages)
3–4	25–35	50–70	5–15
5*	10–20	50–70	20–30
6–7	10–20	60–80	10–20
8*	10–20	50–70	20–30
9	10–20	60–80	10–20
10*	10–20	50–70	20–30

*Performance task grades have a greater percentage of high complexity points due to the nature of performance tasks.

Universal Design

The application of universal design principles assists in developing assessments that are accessible to the greatest number of people, including students with disabilities and non-native speakers of English. Instead of constructing a test accessible only to certain groups of students, universal design promotes greater accessibility at the beginning of the process.

The DOE incorporates as many universal design elements as is feasible into FCAT Mathematics tests. The following is a list of important assessment principles that affect and direct the selection and implementation of universal design elements:

- Every student should be included in the assessment population so that students with varying learning needs can demonstrate their abilities with regard to content.
- The test should assess what it is designed to assess and have nonconstruct-oriented barriers removed.
- The items should not provide an advantage or disadvantage to a particular group of students.
- The test should be designed so that exceptional education students who need more time or other considerations can get them without compromising validity or the comparability of student scores.
- Instructions should be in clear language that allows students to work independently on the test. To ensure that students clearly understand what is expected, practice materials should be available before testing.
- The vocabulary, sentence complexity, required skills, and interest level of content should be appropriate for the targeted students. The material should be clearly organized, and the questions should be clearly framed. Graphic aids should be directly related to the content and should improve comprehension.
- The text should allow students to read the material with little effort or confusion.

Throughout the development process for FCAT Mathematics, these elements are carefully monitored. The review processes, pilot tests, and field tests are used to ensure appropriateness, clarity, and fairness.

Guidelines for Item Writers

FCAT Mathematics 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 measuring the mathematics benchmarks of the *Sunshine State Standards* without introducing extraneous elements that reflect bias for or against a group of students.

Item writers for FCAT Mathematics must submit items in a particular format and must include the following information about each item. Since 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 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 item. Acceptable sources include up-to-date textbooks, magazines and journals respected by the mathematics community, and Internet sites operated 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 of the distractors is incorrect.
- For gridded-response items, this includes explanations of why the correct answer is correct, and an explanation of additional possible correct answers.
- For performance tasks, this includes an example of a response that might earn each score point. For example, extended-response items should include a possible top-score response, a sample 3-point response, a sample 2-point response, and a sample 1-point response. Each response should demonstrate a different level of understanding of the assessed benchmark.

Submission of Items

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

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

Benchmark Classification System

Each benchmark in the *Sunshine State Standards* is labeled with a system of numbers and letters.

- The first two letters in the *first two positions* of the code identify the **subject area** (e.g., MA for mathematics).
- The letter in the *third position* represents the **strand**, or category of knowledge, to which the benchmark belongs. In mathematics, FCAT assesses five strands: Number Sense, Concepts, and Operations (A); Measurement (B); Geometry and Spatial Sense (C); Algebraic Thinking (D); and Data Analysis and Probability (E).
- The number in the *fourth position* of the code represents the **standard** to which the benchmark belongs.
- The number in the *fifth position* shows the developmental **level** of the benchmark:

  1 indicates PreK–2

  2 indicates Grades 3–5

  3 indicates Grades 6–8

  4 indicates Grades 9–12

- The number in the *last position* in the code states the specific **benchmark** under the grade cluster within the standard.

MA. D. 1. 4. 2

Subject Area
Mathematics

Strand
Algebraic Thinking

Level
Grades 9–12

Benchmark
"[The student] determines the impact when changing parameters of given functions."

Standard
"The student describes, analyzes, and generalizes a wide variety of patterns, relations, and functions."

GENERAL CONTENT LIMITS BY GRADE LEVEL

Grade 3 General Content Limits

The content limits described below are applicable to all items developed for Grade 3; however, the content limits defined in the individual benchmark specifications can supersede these general content limits.

Whole numbers

- Items should not require the use of more than one operation.
- Place values should range from ones through hundred thousands.

Addition

- Items should not require the use of more than 3 addends.
- Addends should not exceed 3 digits.

Subtraction

- Subtrahends, minuends, and differences should not exceed 3 digits.

Multiplication

- Products should not exceed 2 digits, unless one or both factors are multiples of 10, and should not involve regrouping.

Division

- Divisors should not exceed 1 digit, and dividends should not exceed 2 digits.
- Quotients should not have remainders.

Decimals

- Place value of decimal numbers should be limited to money.

Addition

- Addends should not exceed 3 digits.
- Items should not require the use of more than 3 addends.

Subtraction

- Subtrahends, minuends, and differences should not exceed 3 digits.

Multiplication

- Not assessed at Grade 3.

Division

- Not assessed at Grade 3.

Fractions

- Fractions should have denominators of 2, 3, 4, 5, 6, 8, or 10.
- Items should not involve mixed numbers.

Addition

- Items should not require the use of more than 2 addends and should have like denominators.

Subtraction

- See benchmark.

Multiplication

- Not assessed at Grade 3.

Division

- Not assessed at Grade 3.

Percent

- Not assessed at Grade 3.

Measurement

- Items will be limited to assessment of length, weight/mass, time, temperature, perimeter, area, volume/capacity, and right angles.

Grade 4 General Content Limits

The content limits described below are applicable to all items developed for Grade 4; however, the content limits defined in the individual benchmark specifications can supersede these general content limits.

Whole numbers

- Items should not require the use of more than two operations.
- Place values should range from ones through millions.

Addition

- Items should not exceed 3 addends.
- Addends should not exceed 4 digits.

Subtraction

- Subtrahends, minuends, and differences should not exceed 4 digits.

Multiplication

- Products should not exceed 4 digits, unless one or both factors is/are a multiple of 10.

Division

- Divisors should not exceed 1 digit, unless the divisor is a multiple of 10 up to 100.
- Dividends should not exceed 3 digits.

Decimals

- Place values should range from tenths through hundredths. This applies to the operations of addition and subtraction.

Addition

- Items should not require the use of more than 3 addends.
- Addends should not exceed 4 digits.

Subtraction

- Subtrahends, minuends, and differences should not exceed 4 digits.

Multiplication

- Items are limited to money (multiplied by a 1-digit whole number).

Division

- Items are limited to money (divided by a 1-digit whole number).
- Quotients should not have remainders.

Fractions

- Items should have denominators of 2, 3, 4, 5, 6, 8, 10, 12, 20, 25, 100, or 1000.

Addition

- Items should not require the use of more than 3 addends.
- Items should not require the use of more than 2 unlike denominators.
- Items with unlike denominators must have 1 denominator be a multiple of the other.

Subtraction

- Items with unlike denominators must have 1 denominator be a multiple of the other.

Multiplication

- Not assessed at Grade 4.

Division

- Not assessed at Grade 4.

Percent

- Not assessed at Grade 4.

Measurement

- Items will be limited to assessment of length, weight/mass, time, temperature, perimeter, area, volume/capacity, and right and straight angles.

Grade 5 General Content Limits

The content limits described below are applicable to all items developed for Grade 5; however, the content limits defined in the individual benchmark specifications can supersede these general content limits.

Whole numbers

- Items should not require the use of more than two operations.
- Place values should range from ones through hundred millions.

Addition

- Items should not require the use of more than 4 addends.
- Addends should not exceed 4 digits.
- Items with 4 addends should not use 4-digit numbers.

Subtraction

- Subtrahends, minuends, and differences should not exceed 4 digits.

Multiplication

- Products should not exceed 6 digits.

Division

- Divisors should not exceed 2 digits.
- Dividends should not exceed 4 digits.

Decimals

- Place values should range from tenths through thousandths.

Addition

- Items should not require the use of more than 4 addends.
- Addends should not exceed 4 digits.
- Items with 4 addends should not use 4-digit numbers.

Subtraction

- Subtrahends, minuends, and differences should not exceed 4 digits.

Multiplication

- Products should not exceed 6 digits.

Division

- Divisors should not exceed 2 digits and must be whole numbers.
- Dividends should not exceed 4 digits.
- Quotients should terminate within 2 decimal places.

Fractions
- Items should have denominators of 2, 3, 4, 5, 6, 8, 9, 10, 12, 15, 16, 18, 20, 25, 50, 75, 100, or 1000.

Addition
- Items should not require the use of more than 3 addends.
- Items should not require the use of more than 2 unlike denominators.

Subtraction
- Items should not require the use of more than 2 unlike denominators.

Multiplication
- See benchmark.

Division
- Not assessed at Grade 5.

Percent
- When finding equivalent fractions and decimals, items will be limited to percents that are multiples of 5, up to and including 100.

Measurement
- Items will be limited to assessment of length, weight/mass, time, temperature, perimeter, area, volume/capacity, and angles.

Gridded-Response Items
- Answers may not exceed 4 digits.

Grade 6 General Content Limits

The content limits described below are applicable to all items developed for Grade 6; however, the content limits defined in the individual benchmark specifications can supersede these general content limits.

Whole numbers

- Items should not require the use of more than 2 operations.
- Place values should range from ones through hundred millions.

Addition

- Items should not exceed 5 addends.
- Addends should not exceed 5 digits.
- Items with 5 addends should not use 5-digit numbers.

Subtraction

- Subtrahends, minuends, and differences should not exceed 5 digits.

Multiplication

- Products should not exceed 7 digits.

Division

- Divisors should not exceed 2 digits.
- Dividends should not exceed 4 digits.
- Quotients should be terminating decimals.

Decimals

- Place values should range from tenths through thousandths.

Addition

- Items should not require the use of more than 5 addends.
- Addends should not exceed 5 digits.
- Items with 5 addends should not use 5-digit numbers.

Subtraction

- Subtrahends, minuends, and differences should not exceed 5 digits.

Multiplication

- Products should not exceed 7 digits.

Division

- Divisors should not exceed 2 digits.
- Dividends should not exceed 4 digits.

Fractions

- Items should use denominators of 2, 3, 4, 5, 6, 8, 9, 10, 12, 15, 16, 18, 20, 25, 50, 75, 100, or 1000.
- Items may use additional denominators that are multiples of 2, 3, and 5, through 100.

Addition

- Items should not require the use of more than 3 addends.
- Items should not require the use of more than 2 unlike denominators.

Subtraction

- See benchmark.

Multiplication

- See benchmark.

Division

- Items should be limited to contexts involving a whole number divided by a fraction.

Percent

- See benchmark.

Measurement

- Items will be limited to assessment of linear measure, weight/mass, time, temperature, perimeter, area, volume/capacity, conversions within systems, angles, effects of changing dimensions, and appropriate tools and units.

Grade 7 General Content Limits

The content limits described below are applicable to all items developed for Grade 7; however, the content limits defined in the individual benchmark specifications can supersede these general content limits.

Whole numbers

- Items should not require the use of more than 3 operations.

Addition
- Items should not require the use of more than 5 addends.
- Addends should not exceed 6 digits.

Subtraction
- Subtrahends, minuends, and differences should not exceed 6 digits.

Multiplication
- Products should not exceed 8 digits.

Division
- Divisors should not exceed 3 digits.
- Dividends should not exceed 5 digits.

Decimals

- Place values should range from tenths through ten-thousandths.

Addition
- Items should not exceed 5 addends.
- Addends should not exceed 6 digits.

Subtraction
- Subtrahends, minuends, and differences should not exceed 6 digits.

Multiplication
- Products should not exceed 8 digits.

Division
- Divisors should not exceed 3 digits.
- Dividends should not exceed 5 digits.
- Quotients should not exceed 7 digits.

Fractions

- Items should use denominators of 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 15, 16, 18, 20, 25, 50, 75, 100, or 1000.
- Items may use additional denominators that are multiples of 2, 3, and 5, through 100.

Addition

- Items should not require the use of more than 3 addends.

Subtraction

- See benchmark.

Multiplication

- See benchmark.

Division

- Divisors cannot be mixed numbers.

Percent

- See benchmark.

Measurement

- Items will be limited to assessment of linear measure, weight/mass, time, temperature, perimeter, area, volume/capacity, circumference, conversions within systems, angles, effects of changing dimensions, and appropriate tools and units.
- Items involving pi (π) will be in MC format only.

Grade 8 General Content Limits

The content limits described below are applicable to all items developed for Grade 8; however, 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 6 addends.
- Addends should not exceed 6 digits.

Subtraction
- Subtrahends, minuends, and differences should not exceed 6 digits.

Multiplication
- Products should not exceed 8 digits.

Division
- Divisors should not exceed 3 digits.
- Dividends should not exceed 5 digits.

Decimals

Addition
- Items should not require the use of more than 6 addends.
- Addends should not exceed 6 digits.

Subtraction
- Subtrahends, minuends, and differences should not exceed 6 digits.

Multiplication
- Products should not exceed 8 digits.

Division
- Divisors should not exceed 3 digits.
- Dividends should not exceed 5 digits.
- Quotients should not exceed 7 digits.

Fractions

- Items should not require the use of more than 3 addends or factors.

Percent

- See benchmark.

Measurement

- See benchmark.

Grade 9 General Content Limits

The content limits described below are applicable to all items developed for Grade 9; 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 6 addends.
- Addends should not exceed 6 digits.

Subtraction
- Subtrahends, minuends, and differences should not exceed 6 digits.

Multiplication
- Products should not exceed 8 digits.

Division
- Divisors should not exceed 3 digits.
- Dividends should not exceed 5 digits.

Decimals

Addition
- Items should not require the use of more than 6 addends.
- Addends should not exceed 6 digits.

Subtraction
- Subtrahends, minuends, and differences should not exceed 6 digits.

Multiplication
- Products should not exceed 8 digits.

Division
- Divisors should not exceed 3 digits, unless dealing with currency.
- Dividends should not exceed 5 digits, unless dealing with currency.
- Quotients should not exceed 7 digits.

Fractions

- Items should not require the use of more than 3 addends or factors.

Percent

- See benchmark.

Measurement

- See benchmark.

Grade 10 General Content Limits

The content limits described below are applicable to all items developed for Grade 10; 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 6 addends.
- Addends should not exceed 6 digits.

Subtraction

- Subtrahends, minuends, and differences should not exceed 6 digits.

Multiplication

- Products should not exceed 8 digits.

Division

- Divisors should not exceed 3 digits.
- Dividends should not exceed 5 digits.

Decimals

Addition

- Items should not require the use of more than 6 addends.
- Addends should not exceed 6 digits.

Subtraction

- Subtrahends, minuends, and differences should not exceed 6 digits.

Multiplication

- Products should not exceed 8 digits.

Division

- Divisors should not exceed 3 digits, unless dealing with currency.
- Dividends should not exceed 5 digits, unless dealing with currency.
- Quotients should not exceed 7 digits.

Fractions

- Items should not require the use of more than 3 addends or factors.

Percent

- See benchmark.

Measurement

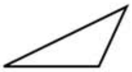
- See benchmark.

FCAT Mathematics Reference Sheets

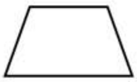
The following reference sheets of appropriate formulas and conversions are provided to students in Grades 6–10 for use during testing. They are provided in the Grades 3–5 *Specifications* for reference only. If formulas are needed in Grades 3–5, they are included with each associated item.

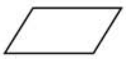
Grades 6–8 FCAT Mathematics Reference Sheet

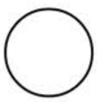
Area


Triangle $A = \frac{1}{2}bh$


Rectangle $A = lw$


Trapezoid $A = \frac{1}{2}h(b_1 + b_2)$


Parallelogram $A = bh$


Circle $A = \pi r^2$

KEY	
b = base	d = diameter
h = height	r = radius
l = length	A = area
w = width	C = circumference
$S.A.$ = surface area	V = volume

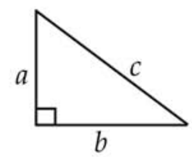
Use 3.14 or $\frac{22}{7}$ for π.

In a polygon, the sum of the measures of the interior angles is equal to $180(n - 2)$, where n represents the number of sides.

Circumference

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

Pythagorean Theorem

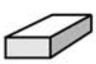


$a^2 + b^2 = c^2$

Volume/Capacity

Total Surface Area


Right Circular Cylinder $V = \pi r^2 h$ $S.A. = 2\pi rh + 2\pi r^2$


Rectangular Prism $V = lwh$ $S.A. = 2(lw) + 2(hw) + 2(lh)$

Conversions

1 yard = 3 feet = 36 inches
1 mile = 1760 yards = 5280 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

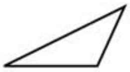
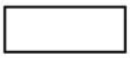
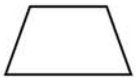
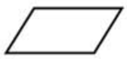
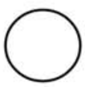
1 liter = 1000 milliliters = 1000 cubic centimeters
1 meter = 100 centimeters = 1000 millimeters
1 kilometer = 1000 meters
1 gram = 1000 milligrams
1 kilogram = 1000 grams

1 pound = 16 ounces
1 ton = 2000 pounds

Metric numbers with four digits are presented without a comma (e.g., 9960 kilometers). For metric numbers greater than four digits, a space is used instead of a comma (e.g., 12 500 liters).

Grades 9–10 FCAT Mathematics Reference Sheet

Area

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

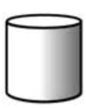
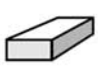
KEY

b	= base	d	= diameter
h	= height	r	= radius
l	= length	A	= area
w	= width	C	= circumference
ℓ	= slant height	V	= volume
$S.A.$	= 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
	Right Circular Cone	$V = \frac{1}{3}\pi r^2 h$	$S.A. = \frac{1}{2}(2\pi r)\ell + \pi r^2$ or $S.A. = \pi r\ell + \pi r^2$
	Right Square Pyramid	$V = \frac{1}{3}lwh$	$S.A. = 4(\frac{1}{2}l\ell) + l^2$ or $S.A. = 2l\ell + l^2$
	Sphere	$V = \frac{4}{3}\pi r^3$	$S.A. = 4\pi r^2$
	Right Circular Cylinder	$V = \pi r^2 h$	$S.A. = 2\pi rh + 2\pi r^2$
	Rectangular Prism	$V = lwh$	$S.A. = 2(lw) + 2(hw) + 2(lh)$

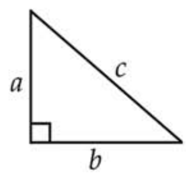
In the following formulas, n represents the number of sides.

In a polygon, the sum of the measures of the interior angles is equal to $180(n-2)$.

In a regular polygon, the measure of an interior angle is equal to $\frac{180(n-2)}{n}$.

Grades 9–10 FCAT Mathematics Reference Sheet

Pythagorean theorem:



$$a^2 + b^2 = c^2$$

Slope-intercept form of an equation of a line:

$$y = mx + b$$

where m = slope and b = the y-intercept.

Distance, rate, time formula:

$$d = rt$$

where d = distance, r = rate, t = time.

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 $P_2(x_2, y_2)$:

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

Simple interest formula:

$$I = prt$$

where p = principal, r = rate, t = time.

Conversions

1 yard = 3 feet = 36 inches
1 mile = 1760 yards = 5280 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 liter = 1000 milliliters = 1000 cubic centimeters
1 meter = 100 centimeters = 1000 millimeters
1 kilometer = 1000 meters
1 gram = 1000 milligrams
1 kilogram = 1000 grams

1 pound = 16 ounces
1 ton = 2000 pounds

Metric numbers with four digits are presented without a comma (e.g., 9960 kilometers). For metric numbers greater than four digits, a space is used instead of a comma (e.g., 12 500 liters).

FCAT Mathematics Review Procedures

Prior to appearing on any FCAT, all mathematics items must pass several levels of review as part of the FCAT development process. Florida educators and citizens, in conjunction with the DOE and FCAT 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 of 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 non-parents 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 FCAT criteria.

Review Procedures for Test Items

The DOE and the FCAT contractor review all test items during the item development process.

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

FCAT test items are first pilot-tested with small groups of students at the appropriate grade levels, then field-tested with a larger 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.

Structure of the Grades 9–10 Individual Benchmark Specifications

The *Specifications* for Grades 9–10 identify how the *Sunshine State Standards* benchmarks are assessed on the FCAT at Grades 9 and 10. For each benchmark, information is divided into two classifications: that which pertains to all grades in the range and that which is grade-specific.

Grade Range Information

For each benchmark assessed on FCAT Mathematics for Grades 9–10, the following information is given:

Strand refers to the broad content areas in the *Sunshine State Standards*. The five mathematics strands are Number Sense, Concepts, and Operations (A); Measurement (B); Geometry and Spatial Sense (C); Algebraic Thinking (D); and Data Analysis and Probability (E). The strands are the same for all grade levels.

Standard refers to the standard statement presented in the *Sunshine State Standards*. The standards are general statements of expected student achievement within each strand.

Benchmark refers to the benchmark statement presented in the *Sunshine State Standards*. The benchmarks are specific statements of expected student achievement. The benchmarks are different for the different grade levels 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 necessarily addresses another benchmark. Such groupings are indicated in the benchmark statement.

Grade-Specific Information

The different sections found in each of the individual benchmark specifications are defined as follows:

Item Types are used to assess the benchmark or group of benchmarks. The types of items used on the FCAT are described in the Item Style and Format section of the *Specifications*. In the Item Types section and the Sample Items section that follow, the item types are abbreviated as MC for multiple-choice, GR for gridded-response, SR for short-response, and ER for extended-response.

Benchmark Clarification explains how the achievement of the benchmark will be demonstrated by students for each specific item type. In other words, the clarification statements explain what the student will do when responding to questions of each type.

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

These specific content limits are to be used in conjunction with the General Content Limits identified for each grade level in the *Specifications*. The content limits defined in the Individual Benchmark Specifications 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 items, including the appropriate use of graphic materials and item context or content.

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 star.
- For GR items, the acceptable answers are given.
- For the Think, Solve, Explain performance tasks (SR and ER items), an example of the expected top-score response is given. The holistic scoring rubrics can be found in Appendix D.

Item Contexts

The situation in which a test question is presented is called the item context. FCAT Mathematics questions may be presented in either a real-world or mathematical context; however, other variables also must be considered. Several of these considerations are listed below, and others are described in the Individual Benchmark Specifications. Sample contexts can be found in Appendix A.

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 Florida *Sunshine State Standards* should be used where appropriate. For example, items may require students to work with topics related to The Arts, Language Arts, Social Studies, Science, Foreign Language, or Health/Physical Education. (See Appendix A for major subject areas and strand titles.) In addition, topics related to the workplace should be included for Grades 6–10.

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 should not be 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 AT GRADES 9–10

SUNSHINE STATE STANDARDS BENCHMARK GRADES 9–10	ITEM FORMATS Grade 9	Grade 10
STRAND A: NUMBER SENSE, CONCEPTS, AND OPERATIONS		
MA.A.1.4.1 associates verbal names, written word names, and standard numerals with integers, rational numbers, irrational numbers, real numbers, and complex numbers.	Assessed with A.1.4.4	Assessed with A.1.4.4
MA.A.1.4.2 understands the relative size of integers, rational numbers, irrational numbers, and real numbers.	MC	MC
MA.A.1.4.3 understands concrete and symbolic representations of real and complex numbers in real-world situations.	Assessed with A.1.4.4	Assessed with A.1.4.4
MA.A.1.4.4 understands that numbers can be represented in a variety of equivalent forms, including integers, fractions, decimals, percents, scientific notation, exponents, radicals, absolute value, and logarithms. (Also assesses A.1.4.1 and A.1.4.3)	MC, GR	MC, GR
MA.A.2.4.1 understands and uses the basic concepts of limits and infinity.	Not assessed	Not assessed
MA.A.2.4.2 understands and uses the real number system.	Assessed with A.3.4.1, A.3.4.2, and A.3.4.3	Assessed with A.3.4.1, A.3.4.2, and A.3.4.3
MA.A.2.4.3 understands the structure of the complex number system.	Not assessed	Not assessed
MA.A.3.4.1 understands and explains the effects of addition, subtraction, multiplication, and division on real numbers, including square roots, exponents, and appropriate inverse relationships. (Also assesses A.2.4.2)	MC	MC
MA.A.3.4.2 selects and justifies alternative strategies, such as using properties of numbers, including inverse, identity, distributive, associative, transitive, that allow operational shortcuts for computational procedures in real-world or mathematical problems. (Also assesses A.2.4.2 and A.3.3.2)	MC	MC
MA.A.3.4.3 adds, subtracts, multiplies, and divides real numbers, including square roots and exponents, using appropriate methods of computing, such as mental mathematics, paper and pencil, and calculator. (Also assesses A.2.4.2)	MC, GR	MC, GR
MA.A.4.4.1 uses estimation strategies in complex situations to predict results and to check the reasonableness of results. (Also assesses A.4.2.1 and B.3.4.1)	MC	MC
MA.A.5.4.1 applies special number relationships such as sequences and series to real-world problems.	Not assessed	Not assessed

MC: multiple-choice
GR: gridded-response
SR: short-response
ER: extended-response

Benchmarks Assessed at Grades 9–10 (continued)

SUNSHINE STATE STANDARDS BENCHMARK GRADES 9–10	ITEM FORMATS Grade 9	Grade 10
STRAND B: MEASUREMENT		
MA.B.1.4.1 uses concrete and graphic models to derive formulas for finding perimeter, area, surface area, circumference, and volume of two- and three-dimensional shapes, including rectangular solids, cylinders, cones, and pyramids. (Also assesses B.1.2.2 and B.1.4.2)	MC, GR	MC, GR, SR
MA.B.1.4.2 uses concrete and graphic models to derive formulas for finding rate, distance, time, angle measures, and arc lengths. (Also assesses B.1.2.2)	MC, GR	MC, GR
MA.B.1.4.3 relates the concepts of measurement to similarity and proportionality in real-world situations.	MC, GR	Assessed with C.2.4.1
MA.B.2.4.1 selects and uses direct (measured) or indirect (not measured) methods of measurement as appropriate.	MC, GR	MC
MA.B.2.4.2 solves real-world problems involving rated measures (miles per hour, feet per second). (Also assesses B.2.3.2)	MC, GR	MC, GR
MA.B.3.4.1 solves real-world and mathematical problems involving estimates of measurements, including length, time, weight/mass, temperature, money, perimeter, area, and volume, and estimates the effects of measurement errors on calculations.	Assessed with A.4.4.1	Assessed with A.4.4.1
MA.B.4.4.1 determines the level of accuracy and precision, including absolute and relative errors or tolerance, required in real-world measurement situations.	Not assessed	Not assessed
MA.B.4.4.2 selects and uses appropriate instruments, technology, and techniques to measure quantities in order to achieve specified degrees of accuracy in a problem situation.	Not assessed	Not assessed
STRAND C: GEOMETRY AND SPATIAL SENSE		
MA.C.1.4.1 uses properties and relationships of geometric shapes to construct formal and informal proofs. (Also assesses C.1.2.1 and C.1.3.1)	MC, GR	MC, GR
MA.C.2.4.1 understands geometric concepts such as perpendicularity, parallelism, tangency, congruency, similarity, reflections, symmetry, and transformations including flips (reflections), slides (translations), turns (rotations), enlargements, rotations, and fractals. (Also assesses B.1.4.3, C.1.4.1, and C.3.4.1)	MC, GR	MC, GR, ER
MA.C.2.4.2 analyzes and applies geometric relationships involving planar cross-sections (the intersection of a plane and a three-dimensional figure).	Not assessed	MC
MA.C.3.4.1 represents and applies geometric properties and relationships to solve real-world and mathematical problems including ratio, proportion, and properties of right triangle trigonometry. (Also assesses C.2.4.1)	MC, GR	MC, GR
MA.C.3.4.2 using a rectangular coordinate system (graph), applies and algebraically verifies properties of two- and three-dimensional figures, including distance, midpoint, slope, parallelism, and perpendicularity. (Also assesses C.3.3.2 and D.2.4.1)	MC, GR	MC, GR, SR

MC: multiple-choice
GR: gridded-response
SR: short-response
ER: extended-response

Benchmarks Assessed at Grades 9–10 (continued)

SUNSHINE STATE STANDARDS BENCHMARK GRADES 9–10	ITEM FORMATS Grade 9	ITEM FORMATS Grade 10
STRAND D: ALGEBRAIC THINKING		
MA.D.1.4.1 describes, analyzes, and generalizes relationships, patterns, and functions using words, symbols, variables, tables, and graphs.	MC, GR	MC, GR
MA.D.1.4.2 determines the impact when changing parameters of given functions.	MC, GR	MC, GR, SR
MA.D.2.4.1 represents real-world problem situations using finite graphs, matrices, sequences, series, and recursive relations.	Assessed with C.3.4.2 and D.2.4.2	Assessed with C.3.4.2 and D.2.4.2
MA.D.2.4.2 uses systems of equations and inequalities to solve real-world problems graphically, algebraically, and with matrices. (Also assesses D.2.3.1, D.2.3.2, and D.2.4.1)	MC, GR	MC, GR, SR
STRAND E: DATA ANALYSIS AND PROBABILITY		
MA.E.1.4.1 interprets data that has been collected, organized, and displayed in charts, tables, and plots. (Also assesses E.1.3.1 and E.1.4.3)	MC, GR	MC, GR, ER
MA.E.1.4.2 calculates measures of central tendency (mean, median, and mode) and dispersion (range, standard deviation, and variance) for complex sets of data and determines the most meaningful measure to describe the data. (Also assesses E.1.4.3)	MC, GR	MC, GR
MA.E.1.4.3 analyzes real-world data and makes predictions of larger populations by applying formulas to calculate measures of central tendency and dispersion using the sample population data, and using appropriate technology, including calculators and computers.	Assessed with E.1.4.1 and E.1.4.2	Assessed with E.1.4.1 and E.1.4.2
MA.E.2.4.1 determines probabilities using counting procedures, tables, tree diagrams, and formulas for permutations and combinations. (Also assesses E.2.4.2)	MC, GR	MC, GR
MA.E.2.4.2 determines the probability for simple and compound events as well as independent and dependent events.	Assessed with E.2.4.1	Assessed with E.2.4.1
MA.E.3.4.1 designs and performs real-world statistical experiments that involve more than one variable, then analyzes results and reports findings. (Also assesses E.3.3.1 and E.3.4.2)	MC	MC
MA.E.3.4.2 explains the limitations of using statistical techniques and data in making inferences and valid arguments.	Assessed with E.3.4.1	Assessed with E.3.4.1

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