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| **Central florida assessment collaborative** |
| Individual Test Item Specifications |
| Calculus |
| 2013 |

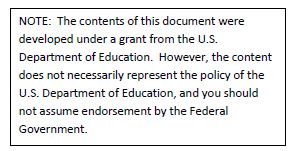


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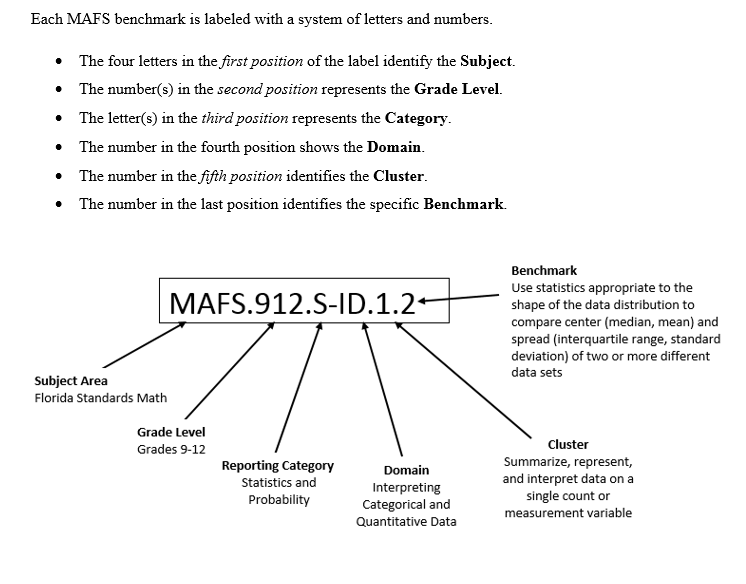
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1. Guide to the Individual Benchmark Specifications

Content specific guidelines are given in the *Individual Benchmark Specifications* for each course. The *Specifications* contains specific information about the alignment of items with the Florida Standards. It identifies the manner in which each benchmark is assessed, provides content limits and stimulus attributes for each benchmark, and gives specific information about content, item types, and response attributes.



## Definitions of Benchmark Specifications

The *Individual Benchmark Specifications* provides standard-specific guidance for assessment item development for CFAC item banks. For each benchmark assessed, the following information is provided:

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| |  |  | | --- | --- | | **Reporting Category** | is a grouping of related benchmarks that can be used to summarize and report achievement. | | **Standard** | refers to the standard statement presented in the Florida Standards. | | **Benchmark**  **Also Assesses** | refers to the benchmark statement presented in the standard statement in the Florida Standards. 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 Also Assesses statement.  refers to the benchmarks that are closely related to the benchmark (see description above). | | **Item Types**  **Cognitive Complexity Level** | are used to assess the benchmark or group of benchmark.  ideal level at which the item should be assessed. | | **Benchmark Clarifications** | explain how achievement of the benchmark will be demonstrated by students. In other words, the clarification statements explain what the student will do when responding to questions. | | **Content Limits** | define the range of content knowledge and that should be assessed in the items for the benchmark. | | **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. | | **Response Attributes** | define the characteristics of the answers that a student must choose or provide. | | **Sample Items** | are provided for each type of question assessed. The correct answer for all sample items is provided. | |  |
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# II. Individual Benchmark Specifications

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| **Reporting Category** | Calculus |
| **Standard** | Limits and Continuity |
| **Benchmark Number** | MAFS.912.C.1.1 |
| **Benchmark** | Understand the concept of limit and estimate limits from graphs and tables of values. |
| **Also Assesses** | MAFS.912.C.1.2  MAFS.912.C.1.3  MAFS.912.C.1.4  MAFS.912.C.1.5  MAFS.K12.MP.1.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will estimate limits graphically, numerically, and analytically, as well as work more with limits (please note the “Also Assesses” category).  This includes but is not limited to limits by substitution, operations involving limits, one sided limits, etc. |
| **Content Limits** | Students will not need a rigorous understanding of the Limit Definition involving delta and epsilon.  Items will focus on the representation of limits. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate. |
| **Response Attributes** | None Specified |
| **Sample Item** | What is the value of limit below?  A. 0.5  B. 1  C. 1.5  D. DNE  **Answer: A** |

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| **Reporting Category** | Calculus |
| **Standard** | Limits and Continuity |
| **Benchmark Number** | MAFS.912.C.1.6 |
| **Benchmark** | Find limits at infinity. |
| **Also Assesses** | MAFS.912.C.1.7  MAFS.912.C.1.9  MAFS.912.C.1.10  MAFS.912.C.1.12  MAFS.K12.MP.3.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will find limits at infinity as well as find limits at a point of discontinuity of a function, describe asymptotic behavior with limits, the Intermediate Value Theorem, and discuss continuity in terms of limits. |
| **Content Limits** | Students will not need a rigorous understanding of the Limit Definition involving delta and epsilon.  Items will focus on the representation of limits. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate. |
| **Response Attributes** | None Specified |
| **Sample Item** | Where does the following function have an asymptote(s)?  A. x = 0 only  B. x = 0 and x = -3  C. x = 0 and x = 3  D. x = 0 and x = 3 and x = -3  **Answer: B** |

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| **Reporting Category** | Calculus |
| **Standard** | Differential Calculus |
| **Benchmark Number** | MAFS.912.C.2.2 |
| **Benchmark** | State, understand, and apply the definition of derivative. |
| **Also Assesses** | MAFS.912.C.2.1  MAFS.K12.MP.7.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will answer questions about the definition of the derivative. |
| **Content Limits** | One sided derivatives will not be assessed. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate.  If necessary, the limit definition of the derivative will be provided in the stem of an item.  Different notations for the derivative will be included. |
| **Response Attributes** | Different notations for the derivative will be included. |

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| **Sample Item** | A student calculated f’(x) for the following function: f(x) = x2  The student’s work is below:  Step 1: use the formula:  Step 2:  Step 3:  Step 4:  f’(x) = 2x  Which of the following statements is correct?  A. In step 1, the incorrect formula was used.  B. In step 2, the formula was applied incorrectly.  C. In step 3, the expression was simplified incorrectly.  D. The student’s work is correct.  **Answer: C** |

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| **Reporting Category** | Calculus |
| **Standard** | Differential Calculus |
| **Benchmark Number** | MAFS.912.C.2.4 |
| **Benchmark** | Find the derivatives of sums, products, and quotients. |
| **Also Assesses** | MAFS.912.C.2.3  MAFS.K12.MP.2.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will find derivatives of sums, products and quotients (specifically using the Product and Quotient Rules) of the following types of functions: algebraic, trigonometric, logarithmic, and exponential functions. |
| **Content Limits** | Derivatives will not be inappropriately tedious.  The item may be challenging, but not long just to be long. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate.  Different notations for the derivative will be included. |
| **Response Attributes** | Multiple choice responses may be in simplified form or not. |
| **Sample Item** | What is for the following function?  y = x2sinx – π  A. x2cosx + 2xsinx  B. x2sinx + 2xcosx  C. 2xsinx  D. 2xcosx  **Answer: A** |

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| **Reporting Category** | Calculus |
| **Standard** | Differential Calculus |
| **Benchmark Number** | MAFS.912.C.2.5 |
| **Benchmark** | Find the derivatives of composite functions using the Chain Rule. |
| **Also Assesses** | MAFS.912.C.2.7  MAFS.K12.MP.5.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will find derivatives of composite functions using the Chain Rule. |
| **Content Limits** | Derivatives will not be inappropriately tedious. The item may be challenging, but not long just to be long.  Composite functions will be made of the following: algebraic, trigonometric, logarithmic, and exponential functions. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate.  Items may ask students to evaluate derivatives of composite functions only given certain points on a function and/or the derivative of the inner or outer function.  Different notations for the derivative will be included. |
| **Response Attributes** | None Specified |
| **Sample Item** | What is the slope of the tangent line to the curve at for the given function?  **Answer: 0** |

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| **Reporting Category** | Calculus |
| **Standard** | Differential Calculus |
| **Benchmark Number** | MAFS.912.C.2.6 |
| **Benchmark** | Find the derivatives of implicitly-defined functions. |
| **Also Assesses** | MAFS.K12.MP.6.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will find derivatives of implicitly-defined functions.  The Chain Rule is of key importance for this concept. |
| **Content Limits** | Students will not be asked to implicitly differentiate a function in order to find third or higher derivatives.  Students will only find first and second derivatives implicitly. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate.  Items being differentiated implicitly will usually not be functions.  Different notations for the derivative will be included. |
| **Response Attributes** | Responses may be simplified in different manners.  Students may need to algebraically manipulate their answer to match the correct response. |
| **Sample Item** | What is the slope of the tangent line of the following function at the point ?  x3 + y3 = 3xy  **Answer: -1** |

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| **Reporting Category** | Calculus |
| **Standard** | Differential Calculus |
| **Benchmark Number** | MAFS.912.C.2.8 |
| **Benchmark** | Find second derivatives and derivatives of higher order. |
| **Also Assesses** | MAFS.K12.MP.8.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will find higher order derivatives. |
| **Content Limits** | Derivatives will not be inappropriately tedious. The item may be challenging, but not long just to be long. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Items may ask students to take very high ordered derivatives. In this case, students are expected to recognize patterns (such as the nth derivative of a polynomial will eventually be zero).  Graphics may be used, as appropriate.  Different notations for the derivative will be included. |
| **Response Attributes** | None Specified |
| **Sample Item** | Consider the function:  f(x) = sin(3x)  What is f’’’(x)?  A. 27sin(3x)  B. 27cos(3x)  C. -27sin(3x)  D. -27cos(3x)  **Answer: D** |

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| **Reporting Category** | Calculus |
| **Standard** | Differential Calculus |
| **Benchmark Number** | MAFS.912.C.2.11 |
| **Benchmark** | Understand and apply the Mean Value Theorem. |
| **Also Assesses** | MAFS.K12.MP.4.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will answer questions relating to the Mean Value Theorem and Rolle’s Theorem. |
| **Content Limits** | Items may ask about the hypothesis and/or conclusion of either Rolle’s Theorem or the Mean Value Theorem. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Items may reference Rolle’s Theorem as well.  Graphics may be used, as appropriate.  Different notations for the derivative will be included. |
| **Response Attributes** | None Specified |
| **Sample Item** | Let. On the interval [1, 9], what is the value of c such that:  **Answer: 4** |

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| **Reporting Category** | Calculus |
| **Standard** | Applications of Derivatives |
| **Benchmark Number** | MAFS.912.C.3.1 |
| **Benchmark** | Find the slope of a curve at a point, including points at which there are vertical tangent lines and no tangent lines. |
| **Also Assesses** | MAFS.K12.MP.1.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will find tangent slopes and equations of tangent lines to curves.  Undefined slopes and slopes equal to zero are of special importance. |
| **Content Limits** | None Specified |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate.  Different notations for the derivative will be included.  Items may ask for equations of lines in different forms (i.e. point slope, slope intercept, standard, etc.) |
| **Response Attributes** | None Specified |
| **Sample Item** | What is the slope of the line tangent to the graph of the equation y = x3 at the point  (2, 8)?  **Answer: 12** |

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| **Reporting Category** | Calculus |
| **Standard** | Applications of Derivatives |
| **Benchmark Number** | MAFS.912.C.3.3 |
| **Benchmark** | Decide where functions are decreasing and increasing. Understand the relationship between the increasing and decreasing behavior of *f* and the sign of *f'*. |
| **Also Assesses** | MAFS.912.C.3.6  MAFS.K12.MP.7.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will use the first derivative to gather information about the function – namely whether the function is increasing or decreasing.  Also, students will work specifically with the sign of the derivative to solicit this information about the function. |
| **Content Limits** | When setting the first derivative equal to zero, the resulting equation will not be excessively complex. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate.  Different notations for the derivative will be included. |
| **Response Attributes** | None Specified |
| **Sample Item** | For what values of x, is the function increasing?  **Answer: C** |

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| **Reporting Category** | Calculus |
| **Standard** | Applications of Derivatives |
| **Benchmark Number** | MAFS.912.C.3.4 |
| **Benchmark** | Find local and absolute maximum and minimum points. |
| **Also Assesses** | MAFS.K12.MP.3.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will find local and absolute extrema. |
| **Content Limits** | When setting the first derivative equal to zero, the resulting equation will not be excessively complex. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate.  Different notations for the derivative will be included.  Students may need to find x-values, y-values, values of the derivative, coordinate points, etc. |
| **Response Attributes** | None Specified |
| **Sample Item** | Consider the function:  g(x) = 3x5 – 5x3  Does this function have a relative minimum? If so, where does this occur?  A. No relative minimum  B. Relative minimum at x = -1  C. Relative minimum at x = 0  D. Relative minimum at x = 1  **Answer: D** |

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| **Reporting Category** | Calculus |
| **Standard** | Applications of Derivatives |
| **Benchmark Number** | MAFS.912.C.3.5 |
| **Benchmark** | Find points of inflection of functions. Understand the relationship between the concavity of f and the sign of f". Understand points of inflection as places where concavity changes. |
| **Also Assesses** | MAFS.912.C.3.6  MAFS.K12.MP.5.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will find and answer questions about points of inflection.  Students will also evaluate the concavity of functions once the second derivative is known and vice versa. |
| **Content Limits** | When setting the second derivative equal to zero, the resulting equation will not be excessively complex. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate.  Different notations for the derivative will be included. |
| **Response Attributes** | None Specified |
| **Sample Item** | Consider the graph of the function f(x) = x3 – 3x. What is (are) the point(s) of inflection of f(x)?  A. (0, 0) only  B. (0, 0) and (1, -2)  C. (1, -2) only  D. No points of inflection  **Answer: A** |

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| **Reporting Category** | Calculus |
| **Standard** | Applications of Derivatives | |
| **Benchmark Number** | MAFS.912.C.3.8 | |
| **Benchmark** | Solve optimization problems. | |
| **Also Assesses** | MAFS.K12.MP.4.1 | |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer | |
| **Benchmark Clarification** | Students will solve optimization problems. | |
| **Content Limits** | None Specified | |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate.  Different notations for the derivative will be included. | |
| **Response Attributes** | None Specified | |
| **Sample Item** | You want to enclose a rectangular field with an area of 5,000 m2. What is the shortest length, in meters, of fencing you can use? (Round your answer to the nearest tenth.)  **Answer: 282.8m** | |

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| **Reporting Category** | Calculus |
| **Standard** | Applications of Derivatives |
| **Benchmark Number** | MAFS.912.C.3.9 |
| **Benchmark** | Find average and instantaneous rates of change. Understand the instantaneous rate of change as the limit of the average rate of change. Interpret a derivative as a rate of change in applications, including velocity, speed, and acceleration. |
| **Also Assesses** | MAFS.912.C.3.10  MAFS.K12.MP.4.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will average and instantaneous rates of change.  Students will also find important instantaneous rates of change such as velocity and acceleration. |
| **Content Limits** | Algebraic, trigonometric, logarithmic, and exponential functions will be used. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate.  Limits of rates of change may be included.  Different notations for the derivative will be included. |
| **Response Attributes** | None Specified |
| **Sample Item** | The vertical distance traveled by an object within the earth’s gravitational field (and neglecting air resistance) is given by the equation:    where g is the force on the object due to earth’s gravity, vo is the initial velocity, *x*o is the initial height above the ground, t is the time in seconds, and down is the negative vertical direction.  What is the average speed (in m/s) for an object, initially at rest, 3 seconds after it is dropped from a 100m tall cliff? Use a  .  **Answer: -15** |

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| **Reporting Category** | Calculus |
| **Standard** | Applications of Derivatives |
| **Benchmark Number** | MAFS.912.C.3.11 |
| **Benchmark** | Model rates of change, including related rates problems. |
| **Also Assesses** | MAFS.K12.MP.4.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will solve related rates problems. |
| **Content Limits** | Rates will be related using equations students will be familiar with such as: areas, volumes, Pythagorean Theorem, etc. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate.  Different notations for the derivative will be included. |
| **Response Attributes** | None Specified |
| **Sample Item** | One boat is heading due south at 10 mph. Another boat is heading due west at 15 mph.  Both boats are heading toward the same point. If the boats maintain their speeds and directions, they will meet in two hours. What is the rate (in miles per hour) that the distance between them is decreasing exactly one hour before they meet? (round your answer to the nearest tenth)  **Answer: 18.0** |

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| **Reporting Category** | Calculus |
| **Standard** | Integral Calculus |
| **Benchmark Number** | MAFS.912.C.4.1 |
| **Benchmark** | Use rectangle approximations to find approximate values of integrals. |
| **Also Assesses** | MAFS.912.C.4.2  MAFS.912.C.4.8  MAFS.K12.MP.1.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will use rectangles and trapezoids (see “Also Assessed”) to approximate area. |
| **Content Limits** | Without technology, approximations will consist of no more than 6 rectangles or trapezoids. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate.  Students may be asked to calculate (lower or upper sums) or (left, middle or right endpoint sums) or trapezoidal sums. |
| **Response Attributes** | None Specified |
| **Sample Item** | Approximate the area bound by the following curves:  f(x) = x2  y = 0  x = 0  x = 2  Use 4 rectangles. What is the upper sum?  **Answer: 7.5** |

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| **Reporting Category** | Calculus |
| **Standard** | Integral Calculus |
| **Benchmark Number** | MAFS.912.C.4.5 |
| **Benchmark** | Use the Fundamental Theorem of Calculus to evaluate definite and indefinite integrals and to represent particular antiderivatives. Perform analytical and graphical analysis of functions so defined. |
| **Also Assesses** | MAFS.912.C.4.3  MAFS.K12.MP.2.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will evaluate indefinite and definite integrals. |
| **Content Limits** | When evaluating definite integrals, calculations without technology will not be too tedious. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate.  Items involving integration may use common symbols or simply ask for an antiderivative. |
| **Response Attributes** | Responses may be functions or values. |
| **Sample Item** | What is the value of the following integral?   1. e5 – e 2. 4 3. e4 – e 4. ln4   **Answer: A** |

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| **Reporting Category** | Calculus |
| **Standard** | Integral Calculus |
| **Benchmark Number** | MAFS.912.C.4.6 |
| **Benchmark** | Use these properties of definite integrals:   * http://www.cpalms.org/Uploads/Benchmark/216/img/ba.png[f(x) + g(x)]dx =  http://www.cpalms.org/Uploads/Benchmark/216/img/ba.pngf(x)dx + http://www.cpalms.org/Uploads/Benchmark/216/img/ba.pngg(x)dx * http://www.cpalms.org/Uploads/Benchmark/216/img/ba.pngk • f(x)dx = k http://www.cpalms.org/Uploads/Benchmark/216/img/ba.pngf(x)dx * http://www.cpalms.org/Uploads/Benchmark/216/img/aa.pngf(x)dx = 0 * http://www.cpalms.org/Uploads/Benchmark/216/img/ba.pngf(x)dx = - http://www.cpalms.org/Uploads/Benchmark/216/img/ab.pngf(x)dx * http://www.cpalms.org/Uploads/Benchmark/216/img/ba.pngf(x)dx + http://www.cpalms.org/Uploads/Benchmark/216/img/cb.pngf(x)dx = http://www.cpalms.org/Uploads/Benchmark/216/img/ca.pngf(x)dx * If f(x) ≤ g(x) on [a, b], then http://www.cpalms.org/Uploads/Benchmark/216/img/ba.pngf(x)dx ≤ http://www.cpalms.org/Uploads/Benchmark/216/img/ba.pngg(x)dx |
| **Also Assesses** | MAFS.K12.MP.8.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will use common properties of integrals to evaluate expressions and/or solve equations. |
| **Content Limits** | None Specified |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate.  Items may inquire about simply indefinite integrals and/or areas between curves and the x-axis. |
| **Response Attributes** | None Specified |
| **Sample Item** | Given:  What is the value of ?  **Answer: -7** |

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| **Reporting Category** | Calculus |
| **Standard** | Integral Calculus |
| **Benchmark Number** | MAFS.912.C.4.7 |
| **Benchmark** | Use integration by substitution (or change of variable) to find values of integrals. |
| **Also Assesses** | MAFS.K12.MP.6.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will integrate functions – specifically using substitution. |
| **Content Limits** | None Specified |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate. |
| **Response Attributes** | None Specified |
| **Sample Item** | What is the value of this integral?   1. ecosx 2. esinx 3. -ecosx 4. -esinx   **Answer: C** |

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| **Reporting Category** | Calculus |
| **Standard** | Applications of Integration |
| **Benchmark Number** | MAFS.912.C.5.1 |
| **Benchmark** | Find specific antiderivatives using initial conditions, including finding velocity functions from acceleration functions, finding position functions from velocity functions, and solving applications related to motion along a line. |
| **Also Assesses** | MAFS.K12.MP.4.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will solve integrals/approximations involving rectilinear motion. |
| **Content Limits** | None Specified |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate.  Functions will be given in tabular, analytical and/or graphical form. |
| **Response Attributes** | Units will be given if applicable. |
| **Sample Item** | A bead on a wire moves so that its velocity (in cm/s), after t seconds, is given by v(t) = 3cos(3t). Given that it starts 2 cm to the left of the midpoint of the wire, what is its position after 5 seconds?     1. -2 2. -1.35 3. 0.65 4. 2.65   **Answer: B** |

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| **Reporting Category** | Calculus |
| **Standard** | Applications of Integration |
| **Benchmark Number** | MAFS.912.C.5.5 |
| **Benchmark** | Use definite integrals to find the area between a curve and the x-axis or between two curves. |
| **Also Assesses** | MAFS.K12.MP.5.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will use definite integrals to find the area between a function and the x-axis or between two curves. |
| **Content Limits** | None Specified |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate.  Curves may be above or below the-axis.  Students may also need to find points of intersections. |
| **Response Attributes** | Units will be given if applicable. |
| **Sample Item** | What is the area bound by the two curves?   1. 0.111 2. 0.222 3. 0.333 4. 0.444   **Answer: C** |

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| **Reporting Category** | Calculus |
| **Standard** | Applications of Integration |
| **Benchmark Number** | MAFS.912.C.5.7 |
| **Benchmark** | Use definite integrals to find the volume of a solid with known cross-sectional area, including solids of revolution. |
| **Also Assesses** | MAFS.K12.MP.1.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will use definite integrals to find the volume of a solid (with known cross section, as well as solids of revolution). |
| **Content Limits** | All solids of revolution problems will be solvable using the disc and washer method.  Finding the volume by cylindrical shells may be possible but will not be necessary. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.  Graphics may be used, as appropriate.  Curves may be above or below the-axis.  Students may also need to find points of intersections. |
| **Response Attributes** | Responses may be exact or approximate. |
| **Sample Item** | A cone with its vertex at the origin lies symmetrically along the x-axis. The base of the cone is at x = 5 and the base radius is 7. Which expression represents the volume of the cone?  **Answer: A** |

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| **Reporting Category** | Calculus |
| **Standard** | Applications of Integration |
| **Benchmark Number** | MAFS.912.C.5.8 |
| **Benchmark** | Apply integration to model, and solve problems in physical, biological, and social sciences. |
| **Also Assesses** | MAFS.K12.MP.4.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Benchmark Clarification** | Students will solve application problems involving integrals. |
| **Content Limits** | None Specified |
| **Stimulus Attributes** | Items will be set in a real-world context.  Graphics may be used, as appropriate. |
| **Response Attributes** | Units will be given if applicable. |
| **Sample Item** | During an acceleration trial, a test vehicle traveling in a straight line has a velocity given by the equation v(t) = sin t, where t is in seconds and velocity is in feet per second. What is the total distance traveled by the test car during the time interval from 0 seconds to 1.5 seconds?   1. 0.929 2. 1.003 3. 1.458 4. 1.781   **Answer: A** |