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| CENTRAL FLORIDA ASSESSMENT COLLABORATIVE |
| Individual Test Item Specifications |
| Analytic Geometry |
| 2013 |

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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.

Each MAFS benchmark is labeled with a system of letters and numbers.

* The four letters in the *first position* of the label identify the **Subject**.
* The number(s) in the *second position* represents the **Grade Level**.
* The letter(s) in the *third position* represents the **Category**.
* The number in the fourth position shows the **Domain**.
* The number in the *fifth position* identifies the **Cluster**.
* The number in the last position identifies the specific **Benchmark**.



**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.  |

# Individual Benchmark Specifications

Description: Ellipse graphed on Cartesian Coordinate plane with center at (-2, -1), major axis parallel to x-axis of length 10, and minor axis parallel to y-axis of length 6.

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| **Reporting Category** | Algebra |
| **Standard** | Arithmetic with Polynomials & Rational Expressions |
| **Benchmark Number** | MAFS.912.A-APR.1.1 |
| **Benchmark** | Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials. |
| **Also Assesses** | N/A |
| **Item Types** | Selected Response (Multiple Choice), Short Answer, Gridded Response |
| **Cognitive Complexity Level** | Low |
| **Benchmark Clarification** | Students will add, subtract, and multiply polynomials. |
| **Content Limits** | Polynomials will have rational coefficients. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context. |
| **Response Attributes** | None Specified |

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| **Sample Item** | 1. Consider the polynomial:

$$\frac{2}{3}\left(2x-1\right)^{2}\left(x+1\right)-\left(x+7\right)\left(x-7\right)$$When simplified, what is the coefficient of the quadratic term?**Correct Answer: -1** |

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| **Reporting Category** | Algebra |
| **Standard** | Create Equations that Describe Numbers or Relationships |
| **Benchmark Number** | MAFS.912.A-CED.1.2 |
| **Benchmark** | Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. |
| **Also Assesses** | MAFS.912.A-CED.1.1 |
| **Item Types** | Selected Response (Multiple Choice), Short Answer |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will be able to derive equations involving two or more variables given data values presented numerically or graphically.Students will be able to graph the relationships between two variables on a Cartesian coordinate plane. |
| **Content Limits** | Equations should be limited to linear, exponential, simple rational, absolute, and quadratic. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.While equations are limited to linear, exponential, or quadratic, problems should draw from more complex situations. |
| **Response Attributes** | None Specified |

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| **Sample Item** | 1. Meredith is purchasing a new toilet for her home. Toilet A costs $149 and uses approximately 380 gallons of water per month. Toilet B costs $169 and uses approximately 300 gallons of water per month. If water costs $2.75 per 1000 gallons, write a system of equations that models this situation. How long will it take for Toilet B to be more cost effective?

**Correct Answer:** $\begin{matrix}y=149+2.75∙0.3∙x\\y=199+2.75∙0.38∙x\end{matrix}$$x=91 months$**Rubric:****2: Student was able to find a correct system of equations and the correct number of months.****1: Student was able to find either the correct system of equations or the correct number of months.****0: Student was unable to find the correct system of equations or the correct number of months.** |

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| **Reporting Category** | Algebra |
| **Standard** | Create Equations that Describe Numbers or Relationships |
| **Benchmark Number** | MAFS.912.A-CED.1.4 |
| **Benchmark** | Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.*For example, rearrange Ohm’s law V = IR to highlight resistance R.* |
| **Also Assesses** | N/A |
| **Item Types** | Selected Response (Multiple Choice), Short Answer |
| **Cognitive Complexity Level** | Low |
| **Benchmark Clarification** | Students will solve literal equations for a specified variable. |
| **Content Limits** | Equations will not involve trigonometric functions. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context. |
| **Response Attributes** | Students may need to simplify complex fractions.Students may need to algebraically manipulate their answer to match the correct response. |
| **Sample Item** | 1. Solve the following equation for t:

$$A=P\left(1+\frac{r}{n}\right)^{nt}$$1. $t=\frac{lnA-lnP}{nln\left(1+\frac{r}{n}\right)}$
2. $t=\frac{lnA+lnP}{nln\left(1+\frac{r}{n}\right)}$
3. $t=\frac{lnA-lnP}{nln\left(1-\frac{r}{n}\right)}$
4. $t=\frac{lnA+lnP}{nln\left(1-\frac{r}{n}\right)}$

**Correct Answer: A** |

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| **Reporting Category** | Algebra |
| **Standard** | Reasoning With Equations and Inequalities |
| **Benchmark Number** | MAFS.912.A-REI.2.4 |
| **Benchmark** | Solve quadratic equations in one variable.1. Use the method of completing the square to transform any quadratic equation in $x$ into an equation of the form $(x – p)² = q$ that has the same solutions. Derive the quadratic formula from this form.
2. Solve quadratic equations by inspection (e.g., for $x² = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as*a ± bi* for real numbers a and b.
 |
| **Also Assesses** | MAFS.912.N-CN.3.7 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will need to solve quadratic equations by inspection, completing the square, factoring, and the quadratic formula.Students will need to solve the quadratic formula when complex roots are solutions. |
| **Content Limits** | Items may be set in either real-world or mathematical context.Students will NOT have to know how to derive the quadratic formula. They will have to know how to use it though. |
| **Stimulus Attributes** | Equations may be given in any form and not necessarily set equal to zero. |
| **Response Attributes** | None Specified |

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| **Sample Item** | 1. A student solved a quadratic equation by completing the square. The problem and student’s solution is shown below. Identify which statement best describes the error the student made within the solution process.

**Problem:**Solve: $2x^{2} + 4x + 9 = 0$**Student’s Solution:**Step 1: $2x^{2}+ 4x = - 9$Step 2: $2(x^{2} + 2x) = -9$Step 3: $2(x^{2} + 2x + 1) = -8$Step 4: $2(x + 1)^{2} = -8$Step 5: $(x + 1)^{2} = -4$Step 6: $x + 1 = 2i or -2i$Step 7: $x = -1 +2i or-1 – 2i$1. To get to step 1, the student should have added 9 to both sides.
2. To get to step 3, the student should have added 2 to both sides.
3. To get to step 5, the student should have taken the square root of both sides first.
4. In step 6, the student should only have considered $2i$ and not $-2i$.

**Correct Answer: B** |

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| **Reporting Category** | Algebra |
| **Standard** | Reasoning With Equations and Inequalities |
| **Benchmark Number** | MAFS.912.A-REI.3.7 |
| **Benchmark** | Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.*For example, find the points of intersection between the line y = –3x and the circle x² + y² = 3.* |
| **Also Assesses** | N/A |
| **Item Types** | Selected Response (Multiple Choice), Short Answer, Gridded Response |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will solve a system of equations consisting of a linear and quadratic equation. |
| **Content Limits** | The quadratic function will consist of one of the four familiar conics – circle, ellipse, parabola, or hyperbola. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context. |
| **Response Attributes** | None Specified |
| **Sample Item** | 1. Find the points of intersection between the line $y=-3x$ and the circle $x^{2}+y^{2}=3$.
2. $\left(\frac{\sqrt{30}}{5}, \frac{-3\sqrt{30}}{5}\right),\left(\frac{-\sqrt{30}}{5}, \frac{3\sqrt{30}}{5}\right) $
3. $\left(\frac{\sqrt{30}}{10}, \frac{-3\sqrt{30}}{10}\right),\left(\frac{-\sqrt{30}}{10}, \frac{3\sqrt{30}}{10}\right)$
4. $\left(\frac{\sqrt{30}}{20}, \frac{-3\sqrt{30}}{20}\right),\left(\frac{-\sqrt{30}}{20}, \frac{3\sqrt{30}}{20}\right)$
5. $\left(\frac{\sqrt{30}}{40}, \frac{-3\sqrt{30}}{40}\right),\left(\frac{-\sqrt{30}}{40}, \frac{3\sqrt{30}}{40}\right)$

**Correct Answer: B** |

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| **Reporting Category** | Algebra |
| **Standard** | Seeing Structure in Expressions |
| **Benchmark Number** | MAFS.912.A-SSE.1.1 |
| **Benchmark** | Interpret expressions that represent a quantity in terms of its context. 1. Interpret parts of an expression, such as terms, factors, and coefficients.
2. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret P*$\left(1+r\right)^{n}$ *as the product of P and a factor not depending on P.*
 |
| **Also Assesses** | N/A |
| **Item Types** | Selected Response (Multiple Choice) |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will be able to identify the different parts of an expression and explain the meaning of each part within the context of the problem. |
| **Content Limits** | Expressions may be linear, quadratic, exponential, polynomial, or rational.Items may include applications of commutative, associative, distributive, and identity properties. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context. |
| **Response Attributes** | None Specified |
| **Sample Item** | 1. A box used to package grapefruit is twice as wide as it is long. An equation that models the volume of the box is given below:

$$V=6\left(x\right)\left(2x\right)$$What does the 6 represent in the equation?1. The number of grapefruit the box can hold
2. The number of sides for the box
3. The area of the top of the box
4. The depth of the box

**Correct Answer: D** |

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| **Reporting Category** | Algebra |
| **Standard** | Seeing Structure in Expressions |
| **Benchmark Number** | MAFS.912.A-SSE.1.2 |
| **Benchmark** | Use the structure of an expression to identify ways to rewrite it. *For example, see*$ x^{4}-y^{4}$ *as* $(x²)² – (y²)²$*, thus recognizing it as a difference of squares that can be factored as (*$x² – y²)(x² + y²).$ |
| **Also Assesses** | N/A |
| **Item Types** | Selected Response (Multiple Choice) |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will be able to rewrite expressions in equivalent forms using techniques such as factoring, combining like terms, distributive property, grouping, difference of two squares, sum or difference of two cubes, or a combination of the above. |
| **Content Limits** | Items will not require students to complete the square in solving quadratic expressions.Expressions may be linear, quadratic, exponential, polynomial, or rational. |
| **Stimulus Attributes** | Items may assess special forms such as the difference of two squares. |
| **Response Attributes** | Some responses may be equivalent but not necessarily factored completely. |
| **Sample Item** | 1. The equation $\left(x^{2}-8x\right)∙6e^{6x}+e^{6x}\left(2x-8\right)$ can be factored to the equation below:

$$R\left(3x^{2}-23x-4\right)$$Find the value of $R$.1. $e^{6x}$
2. $2e^{6x}$
3. $2xe^{6x}$
4. $2e^{6x}\left(x-4\right)$

**Correct Answer: B** |

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| **Reporting Category** | Functions |
| **Standard** | Building Functions |
| **Benchmark Number** | MAFS.912.F-BF.2.3 |
| **Benchmark** | Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k∙f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.* |
| **Also Assesses** | N/A |
| **Item Types** | Selected Response (Multiple Choice), Short Answer |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will transform graphs by multiplying or adding a constant on the inside or outside of a function.Students will be able to find the value of the constant based on the transformation displayed in a graph or described in words.Students will need to recognize even and odd functions based on their equations and/or graphs. |
| **Content Limits** | Items may involve polynomial (includes linear and quadratic), exponential, logarithmic, and trigonometric functions. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.Graphics may be used, as appropriate.The stimulus may represent a function transformation algebraically, graphically or numerically. |
| **Response Attributes** | None Specified |

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| **Sample Item** | 1. Given a function $f(x)$, describe the transformations performed on $f(x)$ below:

$3f\left(x-1\right)+2$ 1. Vertical stretch by a factor of 3, shifted right 1, shifted up 2
2. Vertical stretch by a factor of 3, shifted right 2, shifted up 1
3. Vertical stretch by a factor of 2, shifted right 1, shifted up 3
4. Vertical stretch by a factor of 2, shifted right 3, shifted up 1

**Correct Answer: A** |

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| **Reporting Category** | Functions |
| **Standard** | Interpreting Functions |
| **Benchmark Number** | MAFS.912.F-IF.2.4 |
| **Benchmark** | For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* |
| **Also Assesses** | N/A |
| **Item Types** | Selected Response (Multiple Choice), Short Answer |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will interpret and possibly create graphs and tables – especially highlighting key features (intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity). |
| **Content Limits** | Items may involve polynomial (includes linear and quadratic), exponential, logarithmic, and trigonometric functions. |
| **Stimulus Attributes** | Items will have a mathematical or real-world context.Graphics may be used, as appropriate. |
| **Response Attributes** | None Specified |

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| **Sample Item** | 1. Consider the function $f(x)$ shown below.

Description: A function drawn on a Cartesian Coordinate plane on the domain [1, 4.5] with a range of [-1, 6]. The function starts at (1,-1) and rises to a point where it levels off at (3, 4) and then continues rising to (4.5, 6).Where is $f(x)$ increasing?1. After the x-intercept
2. Before the x-intercept
3. On entire domain
4. Only at the x-intercept

**Correct Answer: C** |

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| **Reporting Category** | Functions |
| **Standard** | Interpreting Functions |
| **Benchmark Number** | MAFS.912.F-IF.2.5 |
| **Benchmark** | Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function* $h(n)$ *gives the number of person-hours it takes to assemble* $n$ *engines in a factory, then the positive integers would be an appropriate domain for the function.*  |
| **Also Assesses** | N/A |
| **Item Types** | Selected Response (Multiple Choice), Short Answer, Gridded Response |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will find and interpret the domain of functions and graphs. |
| **Content Limits** | Items may involve polynomial (includes linear and quadratic), rational, radical, exponential, logarithmic, and trigonometric functions. |
| **Stimulus Attributes** | Items will have a mathematical or real-world context.Graphics may be used, as appropriate. |
| **Response Attributes** | Intervals may be given in interval notation, set builder notation, or quantitatively or qualitatively described. |

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| **Sample Item** | 1. Given the function:

$$g\left(x\right)= \frac{x^{2}-1}{x^{2}+x}$$The graph is shown below:Description: A function is graphed on a Cartesian coordinate plane. There is a vertical asymptote at $x=0$ and a horizontal asymptote at $y=1$. The graph is increasing from $(-\infty ,0)$ and $(0,\infty )$.What is the domain of the function?1. Any number
2. Any number except 0
3. Any number except 1
4. Any number except 0 and 1

**Correct Answer: B**  |

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| **Reporting Category** | Functions |
| **Standard** | Interpreting Functions |
| **Benchmark Number** | MAFS.912.F-IF.2.6 |
| **Benchmark** | Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. |
| **Also Assesses** | N/A |
| **Item Types** | Selected Response (Multiple Choice), Short Answer, Gridded Response |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will calculate the average rate of change of a function between two x values, given the function in symbolic, numerical, or graphical representations. |
| **Content Limits** | Tasks may involve polynomial, exponential, logarithmic, and trigonometric functions. |
| **Stimulus Attributes** | Items will have a real-world context.Graphics may be used, as appropriate. |
| **Response Attributes** | None Specified |

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| **Sample Item** | 1. The monthly cost of a text message plan can be modeled by the function $C\left(t\right)=t^{3}+5t^{2}-3t+5$, where $t$ corresponds to the number of hundreds of text messages sent in the month.

Find the average rate of change of $C(t)$ over the interval [1, 5]. (Round your answer to the nearest tenth if necessary).**Correct Answer: 58** |

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| **Reporting Category** | Functions |
| **Standard** | Interpreting Functions |
| **Benchmark Number** | MAFS.912.F-IF.3.7 |
| **Benchmark** | Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.1. Graph linear and quadratic functions and show intercepts, maxima, and minima.
2. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
3. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
4. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
5. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude, and using phase shift.
 |
| **Also Assesses** | N/A |
| **Item Types** | Selected Response (Multiple Choice), Short Answer |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will be able to graph a variety of functions given the symbolic representation.Students will be able to identify key features of a graph including intercepts, zeroes, minimum values, and maximum values and describe the end behavior of the graph. |
| **Content Limits** | Functions will be limited to linear, quadratic, square root, cube root, piecewise, absolute value, step, polynomial, rational, exponential, logarithmic, and trigonometric functions. |
| **Stimulus Attributes** | Graphs may be used.Items will have a mathematical or real-world context. |
| **Response Attributes** | None Specified |

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| **Sample Item** | 1. Consider the function $f\left(θ\right)=2\sin(\left(θ-\frac{π}{4}\right))+1$. Identify the amplitude and period. Then graph the function on the interval $[0,2π]$.

**Correct Answer: Amplitude = 2; Period =** $2π$Description: A sinusoidal function drawn on a coordinate plane. The maximum is at $\left(\frac{3π}{4},3\right)$ and the minimum is at $\left(\frac{7π}{4},-1\right)$.**Scoring Rubric:****2 – Student correctly identifies the amplitude and period and graphs the function accurately.****1 – Student correctly identifies the amplitude and period OR graphs the function accurately.****0 – Student does not correctly identify the amplitude and period nor graphs the function accurately.** |

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| **Reporting Category** | Functions |
| **Standard** | Interpreting Functions |
| **Benchmark Number** | MAFS.912.F-IF.3.9 |
| **Benchmark** | Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions)*. For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.* |
| **Also Assesses** | N/A |
| **Item Types** | Selected Response (Multiple Choice), Short Answer, Gridded Response |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will compare key aspects of two functions that are each represented in a different manner. |
| **Content Limits** | Functions will be explicitly given in either algebraic, numeric, or graphical form. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.Graphics may be used, as appropriate. |
| **Response Attributes** | None Specified |

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| **Sample Item** | 1. The graph of $f(x)$ is shown below.

Description: A parabola graphed on a Cartesian Coordinate plane that opens down. The graph has a maximum at (2.5, 2.25) and intercepts the x axis at $x=1$ and $x=4$.The function of $g(x)$ is given below:$$g\left(x\right)=-x^{2}+3x+1$$Which function has the higher maximum?1. $f(x)$
2. $g(x)$
3. They have the same maximum.
4. There is not enough information.

**Correct Answer: B** |

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| **Reporting Category** | Functions |
| **Standard** | Interpreting Functions |
| **Benchmark Number** | MAFS.912.F-LE.1.3 |
| **Benchmark** | Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.  |
| **Also Assesses** | N/A |
| **Item Types** | Selected Response (Multiple Choice), Short Answer, Gridded Response |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will interpret growth rates of any polynomial function (especially linear and quadratic), as compared to exponential functions. |
| **Content Limits** | Linear, quadratic and other polynomial functions will be compared to exponential functions. |
| **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** | 1. Consider the two functions below within the domain of $x>0$

$f\left(x\right)=99∙\left(3\right)^{x}+10$ and $g\left(x\right)=10x^{3}+99$Which function will eventually stay greater for any increasingly larger x value?1. $g(x)$ because $f(x)$ increases too slow in the beginning
2. $g(x)$ because for any x-value, $g(x)$ will be larger
3. $ f(x)$ because for any x-value, $f(x)$ will be larger
4. $f(x)$ because $f(x)$ will eventually increase at a greater rate as x gets larger

**Correct Answer: D** |

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| **Reporting Category** | Geometry |
| **Standard** | Similarity, Right Triangles, & Trigonometry |
| **Benchmark Number** | MAFS.912.G-SRT.1.1 |
| **Benchmark** | Verify experimentally the properties of dilations given by a center and a scale factor: 1. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
2. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
 |
| **Also Assesses** | N/A |
| **Item Types** | Selected Response (Multiple Choice), Short Answer, Gridded Response |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will perform a dilation with a given center and scale factor on a figure in the coordinate plane.Students will verify that when a side passes through the center of dilation, the side of the preimage and its image lie on the same line, that corresponding sides of the preimage and the image are parallel, and that a side length of the image is equal to the scale factor multiplied by the corresponding side length of the preimage.Students may apply one or more transformations and/or use the result(s) to determine congruence or similarity. |
| **Content Limits** | Items may include using coordinate geometry to perform transformations in the plane. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context.Graphics may be used, as appropriate. |
| **Response Attributes** | None Specified |

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| **Sample Item** | 1. Triangle ABC is plotted on a coordinate plane as shown below.

Description: Triangle ABC plotted on a coordinate plane with point A at (0,0), point B at (1,4), and point C at (5,3).CBATriangle ABC is dilated with a scale factor of 2 and a center at the origin to form the image Triangle DEF. Find the length of side EF. Round your answer to the nearest hundredth.**Correct Answer: 8.25** |

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| **Reporting Category** | [Number & Quantity](http://www.cpalms.org/Public/search/Search) |
| **Standard** | The Complex Number System |
| **Benchmark Number** | MAFS.912.N-CN.1.2 |
| **Benchmark** | Use the relation $i² = –1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.  |
| **Also Assesses** | MAFS.912.N-CN.1.1MAFS.912.N-CN.1.3 |
| **Item Types** | Selected Response (Multiple Choice), Short Answer, Gridded Response |
| **Cognitive Complexity Level** | Low |
| **Benchmark Clarification** | Students will have to perform operations involving $i$, including rationalizing denominators. |
| **Content Limits** | There will be no complex fractions. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context. |
| **Response Attributes** | Items may only ask for a part of the $\left(a+bi\right)$solution. |

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| **Sample Item** | 1. Consider the following quotient:

$$\frac{5-3i}{5+3i}$$After the denominator has been rationalized, what is the value of $b$ if the expression is written in the form of $\left(a+bi\right)$?**Correct Answer: -15/17** |

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| **Reporting Category** | Number and Quantity |
| **Standard** | Complex Number System |
| **Benchmark Number** | MAFS.912.N-CN.3.7 |
| **Benchmark** | Solve quadratic equations with real coefficients that have complex solutions.Cognitive Complexity: Level 1: Recall |
| **Also Assesses** | N/A |
| **Item Types** | Selected Response (Multiple Choice), Short Answer |
| **Cognitive Complexity Level** | Low |
| **Benchmark Clarification** | Students will solve quadratic equations (with real coefficients) that have complex solutions with and without technology. |
| **Content Limits** | N/A |
| **Stimulus Attributes** | Equations may be given in any form and not necessarily set equal to zero.Items may be set in either real-world or mathematical context. |
| **Response Attributes** | Responses may include one or both solutions.Responses will be given in $a+bi$ form. |
| **Sample Item** | 1. Find the complex solutions for the equation below:

2x2 = x + 61. $\frac{1}{4}\pm \frac{\sqrt{47}}{4}i$
2. $\frac{1}{2}\pm \frac{\sqrt{47}}{2}i$
3. $\frac{1}{4}\pm \frac{\sqrt{51}}{4}i$
4. $\frac{1}{2}\pm \frac{\sqrt{51}}{2}i$

**Correct Answer: A** |

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| **Reporting Category** | [Number & Quantity](http://www.cpalms.org/Public/search/Search) |
| **Standard** | The Real Number System |
| **Benchmark Number** | MAFS.912.N-RN.1.2 |
| **Benchmark** | Rewrite expressions involving radicals and rational exponents using the properties of exponents. Cognitive Complexity: Level 1: Recall |
| **Also Assesses** | MAFS.912.N-RN.1.1 |
| **Item Types** | Selected Response (Multiple Choice), Free Response, Gridded Response |
| **Cognitive Complexity Level** | Low |
| **Benchmark Clarification** | Students will simplify expressions involving radicals and rational exponents and be able to convert from radical representation to rational representation and vice versa. |
| **Content Limits** | Expressions will have no more than three variables.Exponents may be fractional. |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context. |
| **Response Attributes** | None Specified |

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| **Sample Item** | 1. Simplify:

$$\left(\frac{\sqrt{x}∙y^{\frac{2}{5}}}{\left(\sqrt[3]{x}∙y^{-3}\right)^{-2}}\right)^{\frac{2}{3}}$$1. $\frac{x^{\frac{7}{9}}y^{\frac{4}{15}}}{y^{4}}$
2. $\frac{x^{\frac{5}{9}}y^{\frac{7}{15}}}{y^{5}}$
3. $\frac{x^{\frac{8}{9}}y^{\frac{8}{15}}}{y^{6}}$
4. $\frac{x^{\frac{2}{9}}y^{\frac{1}{15}}}{y^{2}}$

**Correct Answer: A** |

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| **Reporting Category** | [Number & Quantity](http://www.cpalms.org/Public/search/Search) |
| **Standard** | The Real Number System |
| **Benchmark Number** | MAFS.912.N-RN.2.3 |
| **Benchmark** | Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.Cognitive Complexity: Level 2: Basic Application of Skills & Concepts |
| **Also Assesses** | N/A |
| **Item Types** | Selected Response (Multiple Choice), Free Response, Gridded Response |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** |

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| Students will know and justify that when performing addition, subtraction, multiplication, or division on two rational numbers the result is a rational number. Students will know and justify that when performing addition or subtraction with a rational number and an irrational number the result is irrational. Students will know and justify that when performing multiplication or division with a nonzero rational number and an irrational number the result is irrational.  |

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| **Content Limits** | N/A |
| **Stimulus Attributes** | Items may be set in either real-world or mathematical context. |
| **Response Attributes** | None Specified |

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| **Sample Item** | 1. Which of the following will **always** result in an irrational number?
2. Irrational Number + Irrational Number
3. Rational Number + Irrational Number
4. Rational Number $∙$ Irrational Number
5. i only
6. ii only
7. ii and iii
8. i, ii, and iii

**Correct Answer: C** |