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| CENTRAL FLORIDA ASSESSMENT COLLABORATIVE |
| Individual Test Item Specifications |
| Liberal Arts Mathematics 1 |
| 2014 |

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I. 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** | 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. |
| **Item Types**  | are used to assess the benchmark or group of benchmark. |
| **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.  |

# II. Individual Benchmark Specifications

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| **Reporting Category** | Algebra |
| **Standard** | Arithmetic with Polynomials and 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 |
| **Cognitive Complexity Level** | Low |
| **Benchmark Clarification** | Students will add, subtract, and multiply polynomials using the distribution property. |
| **Content Limits** | Polynomials will have rational coefficients.  |
| **Stimulus Attributes** | Items may be set in real world situation or mathematical context. |
| **Response Attributes** | None Specified |

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| **Sample Items** | 1. Find the sum of the following:

$\left(5a^{2}-4b^{2}-a\right)+(2b-4+8b^{2}$)1. $12b^{2}+5a^{2}-a+2b-4$
2. $13a^{2}+4b^{2}+b-4$
3. $5a^{2}+3b^{2}-a+2b-4 $
4. $5a^{2}+3b^{2}-a+2b+4$

**Correct Answer: C**1. Find the product:

$$(-5mp^{3}n^{2})(-2m^{4}p^{2}n)$$1. $10m^{4}p^{6}n^{2}$
2. $-10m^{5}p^{6}n^{3}$
3. $10m^{5}p^{5}n^{3}$
4. $-7m^{5}p^{5}n^{3}$

**Correct Answer:**  **C**1. Simplify the following:

$$\left(6h^{2}-4h+6\right)\left(-3h^{2}+2h-8\right)$$1. $-9h^{2}-2h-48$
2. $18h^{2}-2h+48$
3. $18h^{4}+2h+48$
4. $-18h^{4}-2h-48$

**Correct Answer: D** |

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| **Reporting Category** | Algebra |
| **Standard** | Creating Equations |
| **Benchmark Number** | MAFS.912.A-CED.1.1 |
| **Benchmark** | Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational, absolute, and exponential functions. |
| **Also Assesses** | MAFS.912.A-REI.1.1MAFS.912.A-SSE.1.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer  |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will create equations and inequalities and then they will use the information to solve problems. |
| **Content Limits** | Items will assess linear, quadratic, absolute, and simple exponential functions. Items will not assess rational functions. |
| **Stimulus Attributes** | Items may be set in real world situation or mathematical context. |
| **Response Attributes** | None Specified |
| **Sample Items** | 1. Jane’s grandparents gave her $65 to spend at the County Fair. She spent $12 on roses. If each vase costs $4, what is the most number of vases that Jane can purchase?

**Correct Answer:** **12** |

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| **Reporting Category** | Algebra |
| **Standard** | Creating Equations |
| **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-REI.1.1MAFS.912.A-SSE.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, absolute, and quadratic. |
| **Stimulus Attributes** | Items may be set in real world situation or mathematical context. |
| **Response Attributes** | None Specified |

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| **Sample Items** | 1. If Alexis started her bank account with $350, and she deposited $75 per week. Which of the following best expresses the total amount of money $T$ in her account after $w$ weeks?
	1. $T= 75w-350$
	2. $T=350w+75$
	3. $T=350w-75$
	4. $T=75w+350$

**Correct Answer: D**1. The cost of admission to an amusement park is $29.50 plus $1.50 per ride. Which of the following best expresses the total amount of money spent $S$ if $r$ rides are taken?
2. $S= 1.5r+29.50$
3. $S=1.5r– 29.50$
4. $S=-1.5r+29.50$
5. $S=-1.5r - 29.50$

**Correct Answer: A** |

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| **Reporting Category** | Algebra  |
| **Standard** | Creating Equations |
| **Benchmark Number** | MAFS.912.A-CED.1.3 |
| **Benchmark** | Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods. |
| **Also Assesses** | MAFS.912.A-REI.3.5MAFS.912.A-REI.3.6MAFS.912.A.REI.4.10MAFS.912.A.REI.4-11MAFS.912.A-REI.4.12 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Cognitive Complexity Level** | High |
| **Benchmark Clarification** | Students will solve systems of equations and inequalities and be able to interpret solutions in terms of the real world context. Additionally, students will be able to interpret the domain and ranges of viable solutions both in terms of the real world context as well as any potential mathematical constraints. |
| **Content Limits** | Items will not assess rational functions.Systems will be limited to linear and exponential equations.Items will not assess systems of linear equations in three variables. |
| **Stimulus Attributes** | While items may be set in a mathematical context, they should focus on real world modeling situations.  |
| **Response Attributes** | Not Applicable. |
| **Sample Item** | 1. The cost of 3 large candles and 5 small candles is $16.40. The cost of 4 large candles and 6 small candles is $17.50. Which pair of equations can be used to determine, *t*, the cost of a large candle, and *s*, the cost of a small candle?

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| * 1. $3t+5s=16.40$

$$4t+6s=17.50$$* 1. $t+s=10$
 |
| $$4t+6s=17.50$$ |
| * 1. $3t+5s=16.40$

$$t+s=8$$ |
| * 1. $5t+3s=16.40$

$$6t+4s=17.50$$ |

**Correct Answer: A**2. Alexis a student in college can buy notebooks for $4.00 each and pens for $1.25 each. Alexis needs to have at least 8 notebooks. She has a total of $27.00 to spend. Which pair of system of inequalities shows how many notebooks and pens Alexis can buy?A. $n+p\geq 8$$$4n+1.25p>27$$B. $4n\geq 8$$$n+p\leq 27$$C. $4n\geq 8$$$4n+1.25p\leq 27$$D. $n\geq 8$$$4n+1.25p\leq 27$$**Correct Answer: D** |

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| **Reporting Category**  | Algebra  |
| **Standard**  | Reasoning with Equations and Inequalities |
| **Benchmark Number**  | MACC.912.A-REI.1.2 |
| **Benchmark**  | Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.  |
| **Also Assesses**  | N/A |
| **Item Types**  | Selected-Response (Multiple Choice), Gridded-Response, Short Answer  |
| **Cognitive Complexity****Level** | High |
| **Benchmark Clarification**  | Students will be able to solve equations that involve a variable under a radical, rational equations, and equations that are both rational and radical. Students will also understand that sometimes algebraic manipulation produces extraneous solutions and be able to recognize these situations in dealing with radical and rational equations. |
| **Content Limits**  | Items will be limited to one variable and involve simple radical and rational equations. Radical equations will be limited to square root and cube root equations.Solutions must fall within the real number system. |
| **Stimulus Attributes**  | Items may be set in real world situation or mathematical context. |
| **Response Attributes**  | Items that require domain restrictions for viable solutions will allow for those restrictions to be expressed using inequalities, set notation, interval notation, or verbal descriptions. |
| **Sample Items**  | 1. Lamar solved the following radical equation and obtained two solutions, $x=4 and \frac{1}{9}$.

$$3x - 5\sqrt{x} = 2 $$Which solution is extraneous? Justify your answer.**Correct Answer:** $x=\frac{1}{9}$**, because when plugged back into the equation, the solution returned is** $-2=2$ **which is not accurate.****Rubric:****2 – Student gives correct response and correct justification****1 – Student gives correct response or correct justification****0 – Student gives neither a correct response or correct justification** |

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| **Reporting Category**  | Algebra |
| **Standard**  | Reasoning with Equations & Inequalities |
| **Benchmark Number**  | MAFS.912.A-REI.2.3 |
| **Benchmark**  | Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. |
| **Also Assesses**  | MAFS.912.A-CED.1.4 |
| **Item Types**  | Selected-Response (Multiple Choice), Gridded Response, or Short Answer |
| **Cognitive Complexity Level** | Moderate  |
| **Benchmark Clarification**  | Students will be able to solve multi-step equations and inequalities. Students may have to express answers in terms of specified letters when the equations have coefficients represented by letters. |
| **Content Limits**  | Equations and Inequalities are limited to linear equations and inequalities. |
| **Stimulus Attributes**  | Items may be set in real world situation or mathematical context. |
| **Response Attributes**  | None Specified |
| **Sample Items**  | 1. Solve the equation in terms of A and B.

$$\frac{2 }{5 }x-( x+ A) =B$$**Correct Answer:** $-\frac{5}{3}\left(A+B\right)$1. The side lengths of a triangle are three consecutive integers. Given that the perimeter of the triangle is 129 inches, what is the length of the longest side in inches?

**Correct Answer: 44** |

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| **Reporting Category**  | Functions |
| **Standard**  | Interpreting Functions |
| **Benchmark Number**  | MAFS.912.F-IF.1.1 |
| **Benchmark**  | Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If $f$ is a function and $x$ is an element of its domain, then $f(x)$ denotes the output of $f$ corresponding to the input $x$. The graph of $f$ is the graph of the equation $y=f(x)$. |
| **Also Assesses**  | N/A |
| **Item Types**  | Selected Response (Multiple Choice) and Gridded Response |
| **Cognitive Complexity Level** | Low |
| **Benchmark Clarification**  | Students will demonstrate an awareness of functions including the terms domain and range, the nature of a functions domain matching to only one element in the range, and how a graph of a function is represented on a coordinate plane. Students will be able to do these things numerically with a table of values, algebraically, and graphically. |
| **Content Limits**  | When given a table of values, a series of coordinates or ordered pairs, or a set of values in a domain and range, items will be limited to no more than 10 points. |
| **Stimulus Attributes**  | Emphasis on items should be placed on translating between various representations of functions.  |
| **Response Attributes** | None Specified |

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| **Sample Items**  | 1. Determine whether the following table of values illustrate selected points from a relation or a function and explain why.

|  |  |
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| Domain | Range |
| -2 | 2 |
| -1 | 3 |
| 0 | -1 |
| 1 | 0 |
| 2 | 4 |
| 3 | 3 |
| 4 | 2 |

1. Relation because in a function, range values must match up to only one element in the domain.
2. Relation because in a function, domain values must match up to only one element in the range.
3. Function because in a function, range values must match up to only one element in the domain.
4. Function because in a function, domain values must match up to only one element in the range.

**Correct Answer: D**1. Which of the following best explains why the vertical line $x=k$ drawn below proves the graph is not a function.

$$x=k$$Description: A graph is drawn on a coordinate pane. The line $x=k$ is drawn vertically and intercepts the graph twice.1. The line $x=k$ shows there are multiple elements in the domain matched to a single element in the range.
2. The line $x=k$ shows there are multiple elements in the range matched to a single element in the domain.
3. The line $x=k$ shows the graph is not a straight line.
4. The line $x=k$ shows there are multiple intersection points

**Correct Answer: B** |
| **Reporting Category** | Algebra  |
| **Standard** | Interpreting Functions  |
| **Benchmark Number** | MAFS.912.F-IF.1.2 |
| **Benchmark** | Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. |
| **Also Assesses** | N/A |
| **Item Types** | Selected Response (Multiple Choice) |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will evaluate be able to evaluate functions at various values and interpret the meaning using correct units in the given situation. |
| **Content Limits** | Items must utilize function notation as appropriate. Items should not ask students to evaluate one function at multiple input values.  |
| **Stimulus Attributes** | Items may be set in real world situation or mathematical context.All units should be given for items set in a real world situation. |
| **Response Attributes** | Not Applicable  |

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| **Sample Items** | 1. Find the value of $\left[f\left(-6\right)+g\left(3\right)\right]$ if $f\left(x\right)=-5x+8$ and $g\left(x\right)=7x+24x^{2}$.
2. 143
3. 203
4. 215
5. 275

**Correct Answer: D**1. The amount of water $W$ in gallons that a sprinkler can spray onto a lawn as a function of $t$ hours can be measured by the function $W(t)$. Using correct units, explain the meaning of $W\left(2\right)=4$.

**Correct Answer: After 2 hours, the sprinkler sprays 4 gallons of water.****Rubric****2: The student uses correct units and properly explains the meaning.****1: The student properly explains the meaning but does not use both correct units.****0: The student does not explain the meaning correctly.** |

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| **Reporting Category** | Algebra  |
| **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.  |
| **Also Assesses** | MAFS.912.F-IF.2.5 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, Short Answer |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will be able to translate a verbal and tabular representation of a relationship between two quantities into a graphical representation. Students will be able to identify the 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 will assess linear, quadratic, or exponential relationships only.Items that require the student to graph a verbal description will only require a rough sketch and will specify the key features required. Additionally, the item will specify for the student the domain and range the graph should be drawn within. |
| **Stimulus Attributes** | Items may be set in real world situation or mathematical context |
| **Response Attributes** | Gridded-response or short response items may ask students to provide the x- or y- coordinates of an intercept.Intervals can be written in interval notation, set notation, or using inequalities. |

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| **Sample Items** | 1. Given the graph below, which of the following correctly describes the graph?

http://mathbits.com/MathBits/StudentResources/GraphPaper/10x10.gifDescription: A function drawn on a coordinate axis on the approximate domain (-∞,∞) and range (-∞,∞). There is a relative maximum at (-3,5) and a relative minimum at (2,-8).1. The end behavior of the graph is $f\left(x\right)\rightarrow \infty as x\rightarrow \infty $ and $f\left(x\right)\rightarrow -\infty as x\rightarrow -\infty $.
2. The function is increasing on the interval $\left(-\infty ,\infty \right)$.
3. The function has 3 y-intercepts and 1 x-intercept.
4. The function appears on this interval to be periodic.

**Correct Answer: A**1. The following table provides selected values from a continuous function.

|  |  |
| --- | --- |
| $$x$$ | $$f(x)$$ |
| -1 | 3 |
| 0 | 1 |
| 1 | -2 |
| 2 | 5 |
| 3 | 6 |

Which of the following must be correct?1. $f\left(x\right)$ has a relative minimum at $x=1$
2. $f\left(x\right)$ has a relative maximum at $x=3$
3. $f(x)$ has at least 2 x-intercepts
4. $f(x)$ has no more than 2 x-intercepts

**Correct Answer: C** |

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| **Reporting Category** | Algebra  |
| **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) and Gridded Response |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will identify the rate of change from multiple representations including a table of values, a graph, or algebraically using the function. Students will interpret, in context with correct units, the average rate of change of a function over a specified interval. |
| **Content Limits** | Rates of change can be positive, negative, or zero.If students are asked to calculate the average rate of change between two points, the coordinates of both points should either be clearly delineated either with coordinates labeled if presented graphically, or specific equations if presented algebraically. |
| **Stimulus Attributes** | Items may be set in real world or mathematical context. |
| **Response Attributes** | Not Applicable |

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| **Sample Item** | 1. Candy drove from her house to school at an average speed of 45 miles per hour. The drive took her 25 minutes. If the drive home took her 30 minutes and she used the same route in reverse, what was her average speed going home?
2. 17.5 miles per hour
3. 22.5 miles per hour
4. 32.0 miles per hour
5. 21.7 miles per hour

**Correct Answer: B** 1. When programming the timing of a traffic light, engineers monitor the traffic flow through the intersection. The following chart shows the total number of cars that have driven through a particular intersection since 8:00am when the study began.

|  |  |
| --- | --- |
| Time | Total Number of Cars |
| 8:00 | 0 |
| 8:15 | 12 |
| 8:30 | 44 |
| 8:45 | 89 |
| 9:00 | 102 |

Which of the following correctly identifies and interprets the meaning of the average rate of change between 8:30 and 8:45am?1. The average rate of change in traffic flow between 8:30 and 8:45am is 3 cars per hour.
2. The average rate of change in traffic flow between 8:30 and 8:45am is 45 cars.
3. The average rate of change in traffic flow between 8:30 and 8:45am is 89 cars.
4. The average rate of change in traffic flow between 8:30 and 8:45am is 180 cars per hour.

**Correct Answer: D** |

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| **Reporting Category**  | Geometry  |
| **Standard**  | Similarity, Right Triangles, and Trigonometry  |
| **Benchmark Number**  | MAFS.912.G-SRT.1.2  |
| **Benchmark**  | Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.  |
| **Also Assesses**  | MAFS.912.G-SRT.1.3  |
| **Item Types**  | Selected Response (Multiple Choice) and Short Answer  |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification**  | Students will use the definition of similarity to determine if two figures are similar by verifying angle measures are preserved and side lengths are proportional. Focus should be placed on applying similarity transformations on one figure to map onto another. Students will understand a similarity transformation is a rigid motion followed by a dilation.  |
| **Content Limits**  | Figures used should have no more than six vertices.  |
| **Stimulus Attributes**  | Students may be asked to determine what additional information is required to prove that two figures are similar. Items may be set in either real-world or mathematical contexts.Items may ask for statements and/or justifications to complete formal or informal proofs. Focus shall be placed on informal proofs. Graphics should be used in most of these items, as appropriate.  |
| **Response Attributes**  | Not applicable  |

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| **Sample Item** | 1. Triangles $∆PQR$and $∆TUV$are shown below. Based on the drawing, which statement is true?

A. $∆PQR≈∆TUV$by the Angle-Angle Similarity PostulateB. $∆PQR≈∆TUV$by the Side-Angle-Side Similarity TheoremC. $∆PQR≈∆TUV$by the Side-Side-Side Similarity TheoremD. $∆PQR$and $∆TUV$are not similar.**Correct Answer: A** |

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| **Reporting Category** | Geometry |
| **Standard** | Similarity, Right Triangle and Trigonometry |
| **Benchmark Number** | MAFS.912.G-SRT.2.4 |
| **Benchmark** | Prove theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity. |
| **Also Assesses**  | N/A |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, and Short Answer |
| **Cognitive Complexity Level** | High |
| **Benchmark Clarification** | Students will use the definition of similarity to find missing sides and angles in triangles.Students will use triangle similarity to prove a line parallel to one side of a triangle divides the other two proportionally and its converse as well as the Pythagorean Theorem.  |
| **Content Limits** | None Specified  |
| **Stimulus Attributes** | Students may be asked to determine what additional information is required to prove that two figures are similar. Items may be set in either real-world or mathematical contexts.Items may ask for statements and/or justifications to complete formal or informal proofs. Focus shall be placed on informal proofs. Graphics should be used in most of these items, as appropriate.  |
| **Response Attributes** | None Specified |

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| **Sample Item** | 1. Two ladders are set up against a house such that they make the same angle with the ground. The 18 ft. ladder reaches 12 ft. up the wall.

HouseDescription: A rectangle is drawn signifying the house. Two lines parallel to each other are drawn signifying the ladders.18 ft24 ft12 ft?How much further up the wall would the 24 foot ladder reach up the wall beyond the 18 foot ladder? **Correct Answer: 4 ft.**1. Line segment $AB$ is drawn parallel to side $EF$ in $∆DEF$ splitting side $\overbar{DE}$ into lengths 9 for $\overbar{DA}$ and 3 for $\overbar{AE}$.

Description: $∆DEF$ is drawn with segment AB drawn parallel to side EF. Segment DA is labeled as 9 and AE is labeled as 3.ADEFB93If $\overbar{DB}$ has a length of 6, what is the length of $\overbar{BF}$?**Correct Answer: 4** |

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| **Reporting Category**  | Geometry  |
| **Standard**  | Similarity, Right Triangles, and Trigonometry  |
| **Benchmark Number**  | MAFS.912.G-SRT.2.5  |
| **Benchmark**  | Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.  |
| **Also Assesses**  | N/A |
| **Item Types**  | Selected-Response (Multiple Choice), Gridded-Response, and Short Answer |
| **Cognitive Complexity Level** | High |
| **Benchmark Clarification**  | Students will use the criteria used to establish congruency and similarity of triangles to solve problems including, but not limited to, the use of the Corresponding Parts of Congruent Triangles are Congruent (CPCTC) theorem. |
| **Content Limits**  | Students may be asked to find missing angle measures or side lengths. Angles will be measured in degrees. Items may ask for statements and/or justifications to complete formal or informal proofs. Focus shall be placed on informal proofs. |
| **Stimulus Attributes**  | Items may be set in either real-world or mathematical contexts. Graphics should be used in most of these items, as appropriate.  |
| **Response Attributes** | None Specified  |

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| **Sample Items** | 1. Two adjoining triangles, $∆ABE$ and $∆CDE$, are shown below.

Description: Two triangles formed by line AC and line BD intersecting at point E. The third sides of the triangles are formed by the parallel lines AB and DC. If $\overbar{DC}$ is parallel to $\overbar{AB}$, $AE=4$, $DC=7,$ and $EC=8$ what is the length of $\overbar{AB}$? 1. 3
2. 3.5
3. 4.6
4. 5

**Correct Answer: B**1. Jack runs on the trails in a local park. He normally runs five complete laps around the trail represented by $∆ABC$. However, today he decides to run a shorter trail represented by $∆EFG$. The length of each side of trail ABC is shown in meters (m) in the diagram below.

Description: Triangle ABC and EFG are drawn separately with AB=90, BC=93, and AC=156.If the trail represented by $∆EFG$ is geometrically similar to the trail represented by $∆ABC$, and $EF=60m$, what is the distance, in meters, Brian would have to run to complete 5 laps around trail EFG? **Correct Answer: 1130 meters** |
| **Reporting Category**  | Geometry  |
| **Standard**  | Geometric Measurement and Dimension  |
| **Benchmark Number**  | MAFS.912.G-GMD.1.3  |
| **Benchmark**  | Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.  |
| **Also Assesses**  | N/A |
| **Item Types**  | Selected Response (Multiple Choice), Gridded Response, and Short Answer |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification**  | Students will apply the formulas for the volume of solids to solve problems. |
| **Content Limits**  | Solids will be limited to right-rectangular prisms, right-circular cylinders, spheres, right-rectangular pyramids, right-circular cones, and/or composites of these solids.Items may not include oblique figures. Items may ask students to apply knowledge of congruent and similar solids.  |
| **Stimulus Attributes**  | Items may be set in either real-world or mathematical contexts. Graphics should be used in most of these items, as appropriate.  |
| **Response Attributes**  | Not applicable  |

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| **Sample Items** | 1. A cylindrical glass of water with a diameter of 10 centimeters is partially filled as shown below.

Description: A cylinder with height of 20cm and diameter of 12cm is drawn with a water level at 10cm above the base.An ice cube in the shape of a solid cube with sides that measure 6 centimeters is dropped into the glass. To the nearest tenth, what is the new height of the water? 1. 11.9 centimeters
2. 13.8 centimeters
3. 14.8 centimeters
4. 16.0 centimeters

**Correct Answer: A**1. A silo is composed of a cylinder and a hemisphere as shown below.

Description: A cylinder with height of 40 ft and diameter of 15 ft is drawn with a half sphere on top. To the nearest cubic foot, what is the volume of the silo?1. 42,390
2. 35,325
3. 8,831
4. 7948

**Correct Answer: D** |
| **Reporting Category**  | Geometry  |
| **Standard**  | Geometric Measurement and Dimension  |
| **Benchmark Number**  | MAFS.912.G-GMD.2.4  |
| **Benchmark**  | Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.  |
| **Also Assesses**  | N/A  |
| **Item Types**  | Selected Response (Multiple Choice) and Short Answer |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification**  | Students will be able to correctly identify the shape either by name or through a drawing of a cross section taken from a known three-dimensional object. Students will be able to correctly identify a three dimensional object by name or drawing when a two dimensional object is rotated around an axis. |
| **Content Limits**  | Items that require students to name the cross section taken from an object will be limited in the types of cross section to triangle, quadrilaterals, pentagons, hexagons, ellipses, or circles.Cross sections will be taken at a 90 degree angle to the lateral side or base of the solid.Solids formed by the rotation of a two dimensional object will be formed when that object is rotated 360 degrees about a horizontal or vertical axis. The two dimensional object will have a side lie directly on the axis of revolution. |
| **Stimulus Attributes**  | Items may be set in either real-world or mathematical contexts. Graphics should be used in most of these items, as appropriate.  |
| **Response Attributes**  | Not applicable  |

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| **Sample Items**  | 1. A vertical plane intersects a right prism as shown below.

Description: A pentagonal-based right prism lying on its lateral side is intersected by a vertical plane parallel to its base.If the vertical plane is parallel to the base of the right prism, what is the shape of the cross-section? 1. Ellipse
2. Pentagon
3. Rectangle
4. Trapezoid

**Correct Answer: B**1. Rectangle *ABCD* is graphed on the coordinate plane as shown below.

Description: Rectangle ABCD is drawn on a coordinate axis in quadrant 1. Side AB lies on the y-axis.If rectangle *ABCD* is rotated about the *y*-axis, what three-dimensional shape is created? 1. Cone
2. Cylinder
3. Rectangular Prism
4. Rectangular Pyramid

**Correct Answer: B** |

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| **Reporting Category**  | Geometry  |
| **Standard**  | Modeling with Geometry  |
| **Benchmark Number**  | MAFS.912.G-MG.1.2  |
| **Benchmark**  | Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).  |
| **Also Assesses**  | MAFS.912.G-MG.1.1  |
| **Item Types**  | Selected Response (Multiple Choice), Gridded Response, and Short Answer |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification**  | Students will calculate density by calculating the volume or area of a figure or, if provided with the density, be able to find a measure over a specified interval (e.g., when given a population density, students can calculate population over a specified area).  |
| **Content Limits**  | Solids will be limited to right prisms, right-circular cylinders, right pyramids, and right-circular cones. Two-dimensional figures will be limited to circles, triangles, squares, rectangles, parallelograms, and trapezoids.  |
| **Stimulus Attributes**  | Items must be set in a real-world context. Items may require that students use a geometric shape to describe an object (e.g. modeling a tree trunk or a human torso as a cylinder).  |
| **Response Attributes**  | None Specified |
| **Sample Items**  | 1. A small city is in the shape of a circle with a radius of 6 miles. Only 75% of the city is zoned for residential use. If 240,000 people live in the city, what is the average population density per square mile of the residential zoned area?

 1. 1592 people per square mile
2. 2122 people per square mile
3. 2829 people per square mile
4. 8493 people per square mile

**Correct Answer: C** |

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| **Reporting Category**  | Geometry  |
| **Standard**  | Modeling with Geometry  |
| **Benchmark Number**  | MAFS.912.G-MG.1.3  |
| **Benchmark**  | Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios)  |
| **Also Assesses**  | MAFS.912.G-MG.1.1  |
| **Item Types**  | Selected Response (Multiple Choice), Gridded Response, and Short Answer |
| **Cognitive Complexity Level** | High |
| **Benchmark Clarification**  | Students will be able to create a visual representation of a real world design problem and solve using a geometric model such as a table of values, equation, graph, or geometric formula. Further, students will be able to interpret the results in the context of the real world problem and make conclusions based on the geometric model. |
| **Content Limits**  | None Specified |
| **Stimulus Attributes**  | Items must be set in a real-world context.  |
| **Response Attributes**  | None Specified  |

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| **Sample Items**  | 1. A soup company has redesigned the label for its signature canned soup. The label is to wrap around a 4 inch tall cylindrical can and have an area of 38 square inches.

4 inLabelDetermine the area of tin needed to make the entire can (including the circular bases). Round your answer to the nearest tenth.**Correct Answer: 52.4 square inches****Rubric****2: Student correctly identifies the radius of 1.51, diameter of 3.02, or area of the base of 7.18 AND calculates the correct area of tin.****1: Student correctly identifies the radius of 1.51, diameter of 3.02, or area of the base of 7.18 but does not calculate the correct area of tin.****0: The student does not correctly identify the radius of 1.51, diameter of 3.02, or area of the base of 7.18 and does not calculate the correct area of tin.** |

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| **Reporting Category** | Statistics and Probability |
| **Standard** | Interpreting Categorical and Quantitative Data |
| **Benchmark Number** | MAFS.912.S-ID.1.2 |
| **Benchmark** | Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. |
| **Also Assesses** | MAFS.912.S-ID.1.1 |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, and Short Answer |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will use descriptive statistics to describe a data set and to compare and contrast two or more data sets in terms of the shape, center, and/or spread.  |
| **Content Limits** | Students will not be asked to calculate standard deviation without the use of technology. Items that require measures of center or spread to be calculated without technology will be limited to no more than 12 data points within each data set. |
| **Stimulus Attributes** | Items may be set in a real-world or mathematical context, however, emphasis should be placed on real world situations.Data may be presented in a table of values, histogram, or box and whisker plot. |
| **Response Attributes** | None specified.  |

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| **Sample Items** | 1. A company surveyed their employees asking them the length of the commute they had to drive one way from their home to the office. The results are displayed in the histogram below:

ch2_31Which statement describes the histogram appropriately?1. The histogram is skewed to the right (positively skewed).
2. The histogram is skewed to the left (negatively skewed).
3. The histogram is a normal distribution.
4. The histogram is bimodal.

**Correct Answer: A**1. A teacher compared the performance of the boys in her class to the girls in her class through the results of a chapter test. The results are displayed in the following table:

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| Boys | Girls |
| 90 | 94 |
| 84 | 92 |
| 92 | 84 |
| 79 | 78 |
| 74 | 88 |
| 81 | 91 |
| 86 | 90 |
| 98 | 89 |
| 70 | 98 |
| 88 | 100 |

Using interquartile range, she found the boys’ results had a larger spread than the girls’ results. How much larger is the boys’ interquartile range than the girls’ interquartile range?**Correct Answer: 5** |
| **Reporting Category** | Statistics and Probability |
| **Standard** | Interpreting Categorical and Quantitative Data |
| **Benchmark Number** | MAFS.912.S-ID.1.3 |
| **Benchmark** | Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). |
| **Also Assesses** | MAFS.912.S-ID.1.1MAFS.912.S-ID.1.2 |
| **Item Types** | Selected Response (Multiple Choice) and Short Answer |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will identify outliers, the possible reasons for them and what effect they have on the mean, median, mode and range of data. |
| **Content Limits** | Items may include identifying outliers from a set of data in a graph such as a histogram or box-and-whisker plot. Items may also include what effect adding a higher or lower value have on a particular mean, median, mode or range.Items that require measures of center or spread to be calculated without technology will be limited to no more than 12 data points within each data set. |
| **Stimulus Attributes** | Items may be set in a real-world or mathematical context, however, emphasis should be placed on real world situations.Data may be presented in a table of values, histogram, or box and whisker plot. |
| **Response Attributes** | None Specified |

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| **Sample Item** | 1. The relative health of real estate in an area is often measured by the median house price as a measure of center. Which of the following best explains why the median is used?
2. High priced homes which act as outliers have little impact on the median, therefore, the median is the best measure of center.
3. Median is best used on large numbers such as house prices.
4. Because the median represents the middle number, it is the best measure to identify the middle price that houses are being sold at.
5. Median is the numerical average of all house prices, therefore, the median is the best measure of center.

**Correct Answer: A** |

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| **Reporting Category** | Statistics and Probability |
| **Standard** | Interpreting Categorical and Quantitative Data |
| **Benchmark Number** | MAFS.912.S-ID.1.4 |
| **Benchmark** | Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve. |
| **Also Assesses**  | N/A |
| **Item Types** | Selected Response (Multiple Choice), Gridded Response, and Short Answer |
| **Cognitive Complexity Level** | Moderate |
| **Benchmark Clarification** | Students will identify the properties of a normal distribution, find area under the standard normal distribution, find probabilities of a variable under a normal distribution, and find specific data values for given percentages using the standard normal distribution. Students may use technology or tables to find areas under the normal curve. |
| **Content Limits** | Items that ask for probabilities must be normally distributed. |
| **Stimulus Attributes** | Items must be set in real-world context. Items may include finding area under a curve between z-scores, finding z-scores with given probability or finding specific data values with given probability. Items may include students analyzing graphs with z-sores, data values or probabilities.  |
| **Response Attributes** | Items should specify whether probabilities are expected to be given in decimal or percentage form.  |

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| **Sample Items** | 1. For men aged between 18 and 24 years, serum cholesterol levels (in mg/100mL) have a mean of 178.1 and a standard deviation of 40.7 (based on data from the National Health Survey). What is the z-score corresponding to a male, aged 18-24 years, who has a serum cholesterol level of 259.0 mg/100mL?
2. -1.99
3. 1.99
4. 6.36
5. 80.9

**Correct Answer: B** |