MATHEMATICS DEPTH OF KNOWLEDGE EXAMPLE ITEMS

Example items that represent the applicable DOK levels across various Grade 8 Mathematics content domains are provided.

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Example Item 1

DOK Level 1:

Mathematics Grade 8 Content Domain: Numbers, Expressions, and Equations

Standard: MGSE8.NS.1. Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.

Which of these is an irrational number?

A. 4.25×10^{-2}

B. $0.\overline{73}$

C. $\sqrt{5}$

D. $\frac{456}{5}$

Correct Answer: C

Explanation of Correct Answer: The correct answer is choice (C) $\sqrt{5}$. The square root of a number that is not a perfect square is irrational. Choice (A) is incorrect because it is a terminating decimal in scientific notation, which is rational. Choice (B) is incorrect because it is a repeating decimal, which is rational. Choice (D) is incorrect because it is a fraction whose decimal expansion terminates, which is rational.

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Example Item 2

DOK Level 2:

Mathematics Grade 8 Content Domain: Algebra and Functions

Standard: MGSE8.EE.7. Solve linear equations in one variable. b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

Solve.

$7x - 3(4 + x) = 28$

A. $x = 4$
B. $x = 5$
C. $x = 7$
D. $x = 10$

Correct Answer: D

Explanation of Correct Answer: The correct answer is choice (D) $x = 10$. Applying the distributive property gives the equation $7x - 12 - 3x = 28$. Grouping like terms gives the equation $4x = 40$. Dividing both sides of the equation by 4 gives the solution $x = 10$. Choice (A) is incorrect because it is the result of subtracting 12 from the right side instead of adding. Choice (B) is incorrect because it is the result of failing to distribute the –3 to the x term in the parentheses. Choice (C) is incorrect because it is the result of ignoring the term –12 when grouping like terms, so that the variable terms are set equal to 28 instead of 40.

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Example Item 3

DOK Level 3:

Mathematics Grade 8 Content Domain: Algebra and Functions

Standard: MGSE8.EE.8. Analyze and solve pairs of simultaneous linear equations (systems of linear equations). b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example*, $3x + 2y = 5$ *and* $3x + 2y = 6$ *have no solution because* $3x + 2y$ *cannot simultaneously be* 5 *and* 6.

Look at the system of equations.

$$y = x + 4$$
$$2y = 2x + 8$$

Which statement about this system of equations is true and why?

A. It has no solution because the lines are parallel when graphed.
B. It has no solution because the equations are the same line when graphed.
C. It has infinitely many solutions because the lines are parallel when graphed.
D. It has infinitely many solutions because the equations are the same line when graphed.

Correct Answer: D

Explanation of Correct Answer: The correct answer is choice (D) It has infinitely many solutions because the equations are the same line when graphed. The second equation is written as $y = x + 4$ in slope-intercept form, so it has the same slope, 1, and intercept, 4, as the first equation. Therefore, the equations are the same line and there are infinitely many solutions, represented by the points on the line. Choice (A) is incorrect because it assumes the lines are parallel rather than the same line. Choice (B) is incorrect because it misinterpreted coincident lines as having no common solutions. Choice (C) is incorrect because it assumes the lines are parallel and that parallel lines have infinitely many solutions.

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MATHEMATICS ADDITIONAL SAMPLE ITEMS

This section has two parts. The first part is a set of 10 sample items for the Mathematics portion of the EOG assessment. The second part contains a table that shows for each item the standard assessed, the DOK level, the correct answer (key), and a rationale/explanation about the key and distractors. The sample items can be utilized as a mini-test to familiarize students with the item formats found on the assessment.

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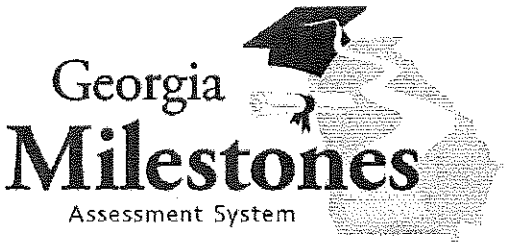

Mathematics Formula Sheet

You can find mathematics formula sheets on the Georgia Milestones webpage at http://www.gadoe.org/Curriculum-Instruction-and-Assessment/Assessment/Pages/Georgia-Milestones-Assessment-System.aspx.

Look under "EOG Resources."

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Item 1

Sofia read that there are approximately 2×10^{11} stars in the Milky Way Galaxy. She also read that there are approximately 3×10^{22} stars in the entire universe.

How many times larger is the number of stars in the universe than the number of stars in the Milky Way Galaxy?

A. 1.5×10^{2}
B. 1.5×10^{11}
C. 6×10^{11}
D. 6×10^{33}

Item 2

The graph of a line passes through the points (0, 6) and (6, 0).

Which of these is the equation of this line?

A. $y = -6x$
B. $y = 6x$
C. $y = x + 6$
D. $y = -x + 6$

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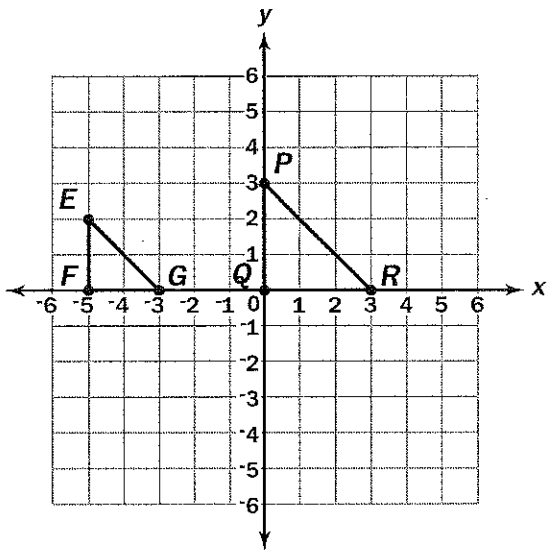
Item 3

Look at triangles *PQR* and *EFG*.



Which of these explains why triangles *PQR* and *EFG* are similar?

A. Triangle *EFG* is a result of dilating triangle *PQR* using a scale factor of $\frac{3}{2}$, with the origin as the center, and reflecting it across the *y*-axis.

B. Triangle *EFG* is a result of dilating triangle *PQR* using a scale factor of $\frac{2}{3}$, with the origin as the center, and reflecting it across the *y*-axis.

C. Triangle *EFG* is a result of dilating triangle *PQR* using a scale factor of $\frac{2}{3}$, with the origin as the center, and translating it 5 units to the left.

D. Triangle *EFG* is a result of dilating triangle *PQR* using a scale factor of $\frac{3}{2}$, with the origin as the center, and translating it 5 units to the left.

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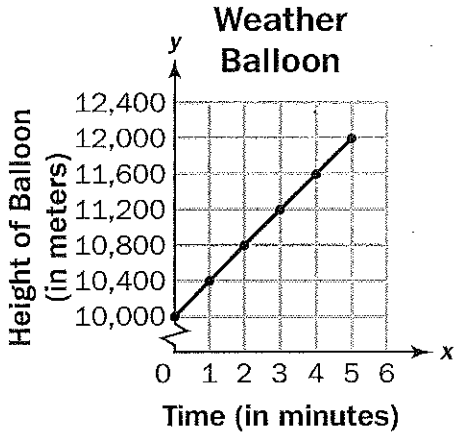
Item 4

A weather balloon is released from a height of 10,000 meters. It rises at a constant rate. The graph shows how the balloon's height changes over time.



What is the rate of change of the balloon's height, in meters per minute?

A. 400
B. 2,000
C. 2,400
D. 10,400

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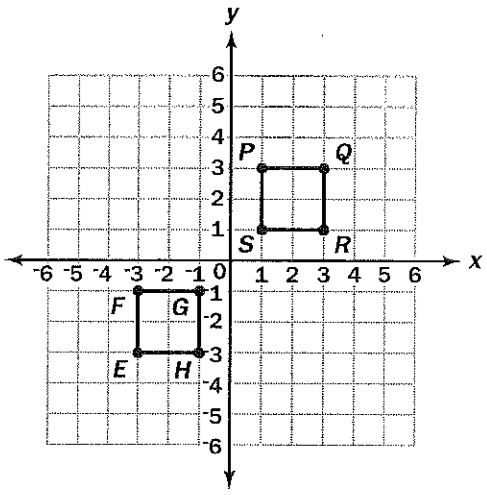
Item 5

Square *PQRS* is congruent to square *EFGH*.



Which series of transformations to square *PQRS* will result in square *EFGH*?

A. translation down by 3 units followed by reflection across the *y*-axis
B. reflection across the *y*-axis followed by translation down by 5 units
C. reflection across the *x*-axis followed by 45° clockwise rotation about the origin
D. translation to the left by 4 units followed by 90° counterclockwise rotation about the origin

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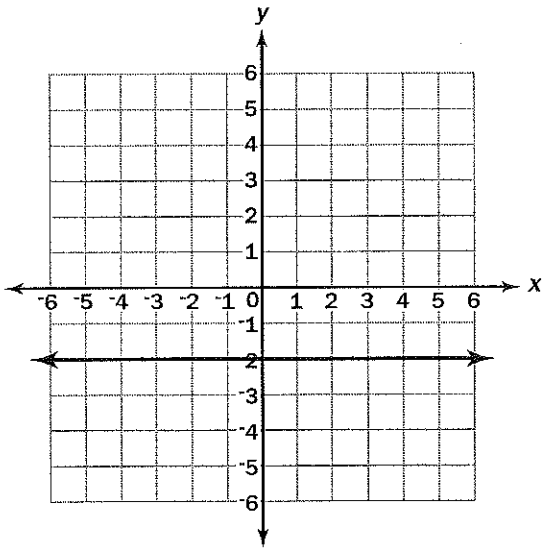
Item 6

Greg wants to compare two different relations. He drew a graph for one relation and created a table of values for the other relation.



x	y
2	2
2	0
2	–2
2	–4

Which statement about this graph and the values in this table is true?

A. Both do not represent functions because they do not pass through the origin.

B. Both represent functions because they are graphically represented as straight lines.

C. The graph represents a function because it is a horizontal line, but the values in the table do not represent a function because there are multiple values for *y* for a single value of *x*.

D. The graph does not represent a function because it is not a vertical line, but the values in the table represent a function because there are multiple values for *y* for a single value of *x*.

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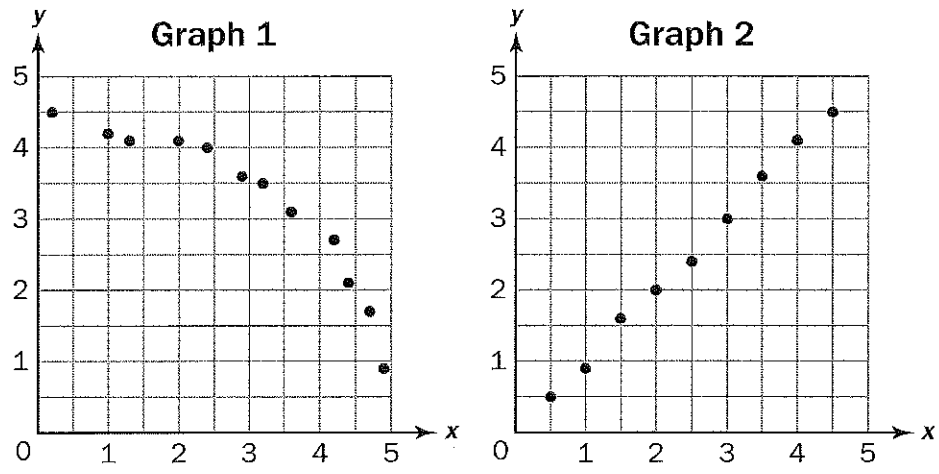
Item 7

Harry constructed two scatter plots to represent the relationship between *x* and *y* in two experiments.



Which statement BEST compares the two graphs?

A. Graph 1 shows a linear positive association, and Graph 2 shows a nonlinear negative association.

B. Graph 1 shows a linear negative association, and Graph 2 shows a nonlinear positive association.

C. Graph 1 shows a nonlinear positive association, and Graph 2 shows a linear negative association.

D. Graph 1 shows a nonlinear negative association, and Graph 2 shows a linear positive association.

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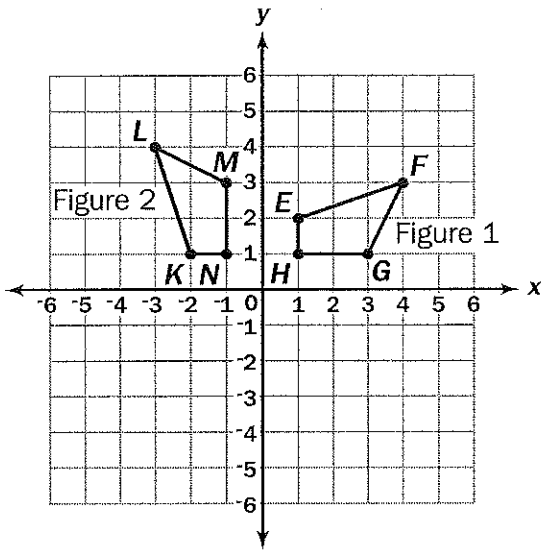
Item 8

Figure 1 is rotated counterclockwise by 90° about the origin to obtain Figure 2.



Which statement about the angles in Figure 1 and Figure 2 is true?

A. $m\angle G = m\angle K$
B. $m\angle H = m\angle L$
C. $m\angle G = m\angle M$
D. $m\angle H = m\angle K$

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Item 9

How many solutions does the equation $2(p + 5) = 4 - 10p$ have? Explain how you found your answer. Write your answer on the lines.

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Item 10

The United States has an approximate population of 3×10^8 people. Each person in the United States consumes an average of about 14,000 grams of rice per year.

Brazil has an approximate population of 2×10^8 people. Each person in Brazil consumes an average of about 5×10^4 grams of rice per year.

Part A: About how much rice does the United States consume each year?

_____ grams

Part B: About how much rice does Brazil consume each year?

_____ grams

Part C: Which country consumes more rice each year, and how many times more rice does it consume than the other country? Show or explain your work and write your answer on the lines.

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MATHEMATICS ADDITIONAL SAMPLE ITEM KEYS

Item	Standard/ Element	DOK Level	Correct Answer	Explanation
1	MGSE8.EE.3	2	B	The correct answer is choice (B) 1.5×10^{11}. To divide numbers in scientific notation, divide the coefficients and subtract the exponents of the common base. $\frac{3}{2} = 1.5$ and $22 - 11 = 11$, so the quotient is 1.5×10^{11}. Choice (A) is incorrect because it is the result of dividing the exponents instead of subtracting. Choice (C) is incorrect because it is the result of multiplying 3×2 instead of dividing. Choice (D) is incorrect because it is the product of the two quantities.
2	MGSE8.EE.6	2	D	The correct answer is choice (D) $y = -x + 6$. The slope of the line is the ratio of the change in y-values to the change in x-values: $\frac{(0-6)}{(6-0)} = -1$. The y-intercept is the y-coordinate when $x = 0$, which is 6. So, the equation of the line is $y = -x + 6$. Choices (A) and (B) are incorrect because the y-intercept is confused with the slope. Choice (C) is incorrect because the slope has the incorrect sign.

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Item	Standard/ Element	DOK Level	Correct Answer	Explanation
3	MGSE8.G.4	2	C	The correct answer is choice (C) Triangle *EFG* is a result of dilating triangle *PQR* using a scale factor of $\frac{2}{3}$, with the origin as the center, and translating it 5 units to the left. $\frac{EF}{PQ} = \frac{FG}{QR} = \frac{EG}{PR} = \frac{2}{3}$, so *EFG* is the result of dilating *PQR* using a scale factor of $\frac{2}{3}$. The vertices of *EFG* are 5 units to the left of the corresponding vertices in the dilated triangle, so *EFG* is the result of translating the dilated triangle 5 units to the left. Choice (A) is incorrect because it confuses translation and reflection and uses the reciprocal of the scale factor. Choice (B) is incorrect because it confuses translation and reflection. Choice (D) is incorrect because it uses the reciprocal of the scale factor.

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Item	Standard/ Element	DOK Level	Correct Answer	Explanation
4	MGSE8.F.4	2	A	The correct answer is choice (A) 400. The rate of change of the balloon's height is equal to the slope of the line in the graph. The balloon rises 2,000 meters in 5 minutes, so the rate of change is $\frac{2,000}{5} = 400$. Choice (B) is incorrect because it is the change in height of the balloon. Choice (C) is incorrect because it calculates the rate of change by dividing 12,000 by 5. Choice (D) is incorrect because it is the height at 1 minute, which is not equal to the rate of change because the graph does not show a proportional relationship.
5	MGSE8.G.2	2	D	The correct answer is choice (D) translation to the left by 4 units followed by 90° counterclockwise rotation about the origin. Vertex *P* corresponds to vertex *E*, so *PQRS* must be translated 4 units to the left and then rotated 90° counterclockwise about the origin. Choices (A), (B), and (C) are incorrect because the images of *PQRS* will be oriented incorrectly and will not lie on *EFGH*.
6	MGSE8.F.4	2	C	The correct answer is choice (C) The graph represents a function because it is a horizontal line, but the values in the table do not represent a function because there are multiple values for *y* for a single value of *x*. A function has exactly one output for each input. The table does not represent a function because the input $x = 2$ has more than one value for *y* for one *x*-value. Choice (A) is incorrect because it assumes that the graphs of functions always pass through the origin. Choice (B) is incorrect because it assumes that all straight-line graphs represent functions. Choice (D) is incorrect because it confuses the definitions of functions and non-functions.

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Item	Standard/ Element	DOK Level	Correct Answer	Explanation
7	MGSE8.SP.1	2	D	The correct answer is choice (D) Graph 1 shows a nonlinear negative association, and Graph 2 shows a linear positive association. The points on Graph 1 can be best approximated with a curve, and *y*-values decrease as *x*-values increase. The points on Graph 2 can be best approximated with a line, and *y*-values increase as *x*-values increase. Choice (A) is incorrect because it confuses the descriptions of Graph 1 and Graph 2. Choice (B) is incorrect because it misidentifies the patterns in the graph. Choice (C) is incorrect because it confuses positive and negative association.
8	MGSE8.G.1	2	C	The correct answer is choice (C) $m\angle G = m\angle M$. A rotation is a rigid motion, so Figure 1 is congruent to Figure 2 and corresponding angles are congruent. Since angle *G* corresponds with angle *M*, the measures of the angles are equal. Choices (A), (B), and (D) are incorrect because they equate the measures of angles that are not congruent.
9	MGSE8.EE.7a	2	N/A	See scoring rubric and exemplar responses beginning on page 74.
10	MGSE8.EE.4	3	N/A	See scoring rubric and exemplar responses beginning on page 75.

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MATHEMATICS EXAMPLE SCORING RUBRICS AND EXEMPLAR RESPONSES

Item 9

Scoring Rubric

Points	Description
2	The response achieves the following: • The response demonstrates a complete understanding of identifying the number of solutions to a linear equation. • Give 2 points for two key elements that are complete and correct. Response is correct and complete. • Response shows application of a reasonable and relevant strategy. • Mathematical ideas are expressed coherently through clear, complete, logical, and fully developed responses using words, calculations, and/or symbols as appropriate.
1	The response achieves the following: • The response demonstrates a partial understanding of identifying the number of solutions to a linear equation. • Give 1 point for one correct key element; allow for correct parts based on a previous incorrect response(s). • Response shows application of a relevant strategy, though it may be only partially applied or remain unexplained. • Mathematical ideas are expressed only partially using words, calculations, and/or symbols as appropriate.
0	The response achieves the following: • The response demonstrates limited to no understanding of identifying the number of solutions to a linear equation. • Response shows no application of a strategy or application of an irrelevant strategy. • Mathematical ideas cannot be interpreted or lack sufficient evidence to support even a limited understanding.

Exemplar Response

Points Awarded	Sample Response
2	One solution AND When I solved for p, I got $p = -\frac{1}{2}$.

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Points Awarded	Sample Response
1	One solution OR When I solved for p, I got $p = -\frac{1}{2}$. OR A valid conclusion based on an error in the explanation, which implies the equation was solved incorrectly, OR similar.
0	No correct responses

Item 10

Scoring Rubric

Points	Description
4	The response achieves the following: • Response demonstrates a complete understanding of performing operations with numbers expressed in scientific notation. • Give 4 points if student response indicates the correct yearly rice consumption for both countries AND that Brazil consumes 2.4 times more rice each year than the United States. Response is correct and complete. • Response shows application of a reasonable and relevant strategy. • Mathematical ideas are expressed coherently through clear, complete, logical, and fully developed responses using words, calculations, and/or symbols as appropriate.
3	The response achieves the following: • Response demonstrates a near complete understanding of how to perform operations with numbers expressed in scientific notation. • Give 3 points if student response indicates the correct yearly rice consumption for both countries AND that Brazil consumes more rice each year than the United States, but with a calculation error in Part C. Response is nearly completely correct. • Response shows application of a reasonable and relevant strategy. • Mathematical ideas are expressed coherently through clear, complete, logical, and fully developed responses using words, calculations, and/or symbols as appropriate.

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Points	Description
2	The response achieves the following: • Response demonstrates some understanding of how to perform operations with numbers expressed in scientific notation. • Give 2 points if student response indicates the correct yearly rice consumption for both countries OR indicates the correct yearly consumption for one of the countries and a correct process for finding how many times more rice one country consumes than the other country based on the incorrect consumption determined in Part A or Part B. Response is only partially correct. • Response shows application of a relevant strategy, though it may be only partially applied or remain unexplained. • Mathematical ideas are expressed only partially using words, calculations, and/or symbols as appropriate.
1	The response achieves the following: • Response demonstrates minimal understanding of how to perform operations with numbers expressed in scientific notation. • Give 1 point if student response indicates the correct yearly rice consumption for the United States OR the correct yearly rice consumption for Brazil. Response is only partially correct. • Response shows application of a relevant strategy, though it may be only partially applied or remain unexplained. • Mathematical ideas are expressed only partially using words, calculations, and/or symbols as appropriate.
0	The response achieves the following: • Response demonstrates no understanding of how to perform operations with numbers expressed in scientific notation. • The student is unable to calculate the total rice consumption for either country or to determine how many times more rice Brazil consumes than the United States. • Response shows no application of a strategy or application of an irrelevant strategy. • Mathematical ideas cannot be interpreted or lack sufficient evidence to support even a limited understanding.

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Exemplar Response

Points Awarded	Sample Response
4	Part A: 4.2×10^{12} grams AND Part B: 1×10^{13} grams AND Part C: $\frac{1 \times 10^{13}}{4.2 \times 10^{12}} \approx 0.24 \times 10^{1} = 2.4$ Brazil consumes about 2.4 times as much rice as the United States.
3	Part A: 4.2×10^{12} grams AND Part B: 1×10^{13} grams AND Part C: $\frac{1 \times 10^{13}}{4.2 \times 10^{12}} \approx 0.24$ Brazil consumes 0.24 times as much rice as the United States.
2	Part A: 4.2×10^{13} grams AND Part B: 1×10^{13} grams AND Part C: $\frac{4.2 \times 10^{13}}{1 \times 10^{13}} = 4.2$ Brazil consumes 4 times as much rice as the United States.
1	Part A: 4.2×10^{12} grams OR Part B: 1×10^{13} grams
0	Response is irrelevant, inappropriate, or not provided.

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