



pennsylvania
DEPARTMENT OF EDUCATION

The Pennsylvania System of School Assessment

Mathematics Item and Scoring Sampler



2016–2017
Grade 8

Pennsylvania Department of Education Bureau of Curriculum, Assessment and Instruction—September 2016

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INTRODUCTION

General Introduction

The Pennsylvania Department of Education provides districts and schools with tools to assist in delivering focused instructional programs aligned with the Pennsylvania Core Standards (PCS). These tools include Academic Standards, Assessment Anchor documents, assessment handbooks, and content-based item and scoring samplers. This Item and Scoring Sampler is a useful tool for Pennsylvania educators in preparing local instructional programs. It can also be useful in preparing students for the statewide assessment.

Pennsylvania Core Standards (PCS)

This sampler contains examples of test questions that are aligned to the new Pennsylvania Core Standards-based 2013 PSSA Assessment Anchors and Eligible Content. The Mathematics, Reading, and Writing PSSA transitioned to PCS-based operational Mathematics and English Language Arts assessments starting with the spring 2015 PSSA administration.

The 2013 PCS-aligned Assessment Anchor and Eligible Content documents are posted on this portal:

- www.education.pa.gov [Hover over “K–12,” select “Assessment and Accountability,” and select “Pennsylvania System of School Assessment (PSSA).” Then select “Assessment Anchors” from the “Other Materials” list on the right side of the screen.]

What Is Included

This sampler contains test questions (items) that have been written to align to the Assessment Anchors that are based on the Pennsylvania Core Standards (PCS). The test questions provide an idea of the types of items that will appear on an operational, PCS-based PSSA. Each sample test question has been through a rigorous review process to ensure alignment with the Assessment Anchors.

Purpose and Uses

The items in this sampler may be used as examples for creating assessment items at the classroom level, and they may also be copied and used as part of a local instructional program.¹ Classroom teachers may find it beneficial to have students respond to the open-ended item in this sampler. Educators can then use the sampler as a guide to score the responses either independently or together with colleagues within a school or district.

Item Format and Scoring Guidelines

The multiple-choice (MC) items have four answer choices. Each correct response to an MC item is worth one point.

Each open-ended (OE) item is designed to take approximately ten to fifteen minutes to complete. During the administration of the PSSA, students are given additional time as necessary to complete the test items. Each OE item in mathematics is scored using an item-specific scoring guideline based on a 0–4-point scale. In this sampler, every item-specific scoring guideline is combined with examples of student responses that represent each score point to form a practical, item-specific scoring guide.

This sampler also includes the *General Description of Scoring Guidelines for Mathematics Open-Ended Questions* that students will have access to during a PSSA mathematics administration. The general description of scoring guidelines can be distributed to students for use during local assessments and can also be used by educators when scoring local assessments.¹

¹ The permission to copy and/or use these materials does not extend to commercial purposes.

Item Alignment

All PSSA items are aligned to statements and specifications included in the *Assessment Anchors and Eligible Content Aligned to the Pennsylvania Core Standards*. The mathematics content, process skills, directives, and action statements included in the PSSA mathematics questions align with the Assessment Anchor Content Standards. The Eligible Content statements represent the limits of the content of the mathematics questions.

Testing Time and Mode of Testing Delivery for the PSSA

The PSSA is delivered in traditional paper-and-pencil format as well as in an online format. The estimated time to respond to a test question is the same for both methods of test delivery. During an official testing administration, students are given additional time as necessary to complete the test questions. The following table shows the estimated response time for each item type.

Mathematics Item Type	MC	OE
Estimated Response Time (minutes)	2	10 to 15

Mathematics Reporting Categories

The Assessment Anchors are organized into four classifications as listed below.

• A = Numbers and Operations	• C = Geometry
• B = Algebraic Concepts	• D = Data Analysis and Probability

These four classifications are used throughout the grade levels. In addition to these classifications, there are five Reporting Categories for each grade level. The first letter of each Reporting Category represents the classification; the second letter represents the Domain as stated in the Common Core State Standards for Mathematics. Listed below are the Reporting Categories for Grade 8.

- A-N = The Number System
- B-E = Expressions and Equations
- B-F = Functions
- C-G = Geometry
- D-S = Statistics and Probability

Examples of multiple-choice and open-ended items assessing these categories are included in this booklet.

General Description of Scoring Guidelines for Mathematics Open-Ended Questions

4 – The response demonstrates a *thorough* understanding of the mathematical concepts and procedures required by the task.

The response provides correct answer(s) with clear and complete mathematical procedures shown and a correct explanation, as required by the task. Response may contain a minor “blemish” or omission in work or explanation that does not detract from demonstrating a *thorough* understanding.

3 – The response demonstrates a *general* understanding of the mathematical concepts and procedures required by the task.

The response and explanation (as required by the task) are mostly complete and correct. The response may have minor errors or omissions that do not detract from demonstrating a *general* understanding.

2 – The response demonstrates a *partial* understanding of the mathematical concepts and procedures required by the task.

The response is somewhat correct with *partial* understanding of the required mathematical concepts and/or procedures demonstrated and/or explained. The response may contain some work that is incomplete or unclear.

1 – The response demonstrates a *minimal* understanding of the mathematical concepts and procedures required by the task.

0 – The response has no correct answer and *insufficient* evidence to demonstrate any understanding of the mathematical concepts and procedures required by the task for that grade level.

Response may show only information copied from the question.

Special Categories within zero reported separately:

- BLK (blank).....Blank, entirely erased, or written refusal to respond
- OTOff task
- LOEResponse in a language other than English
- ILIllegible

Item and Scoring Sampler Format

This sampler includes the test directions and scoring guidelines that appear in the PSSA Mathematics assessments. Each multiple-choice item is followed by a table that includes the alignment, the answer key, the depth of knowledge (DOK) level, the percentage² of students who chose each answer option, and a brief answer option analysis or rationale. The open-ended item is followed by a table that includes the item alignment, DOK level, and mean student score. Additionally, each of the included item-specific scoring guidelines is combined with sample student responses representing each score point to form a practical, item-specific scoring guide. The *General Description of Scoring Guidelines for Mathematics Open-Ended Questions* used to develop the item-specific scoring guidelines should be used if any additional item-specific scoring guidelines are created for use within local instructional programs.

Example Multiple-Choice Item Information Table

Item Information		Option Annotations					
Alignment	Assigned AAEC	Brief answer option analysis or rationale					
Answer Key	Correct Answer						
Depth of Knowledge	Assigned DOK						
<i>p</i>-values							
A	B					C	D
Percentage of students who selected each option							

Example Open-Ended Item Information Table

Alignment	Assigned AAEC	Depth of Knowledge	Assigned DOK	Mean Score	
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² All *p*-value percentages listed in the item information tables have been rounded.

Grade 8 Formula Sheet

Formulas that you may need to work questions on this test are found below.

You may refer back to this page at any time during the mathematics test.

You may use calculator π or the number 3.14.

2016
Grade 8

Exponential Properties

$$a^m \cdot a^n = a^{m+n}$$

$$(a^m)^n = a^{m \cdot n}$$

$$\frac{a^m}{a^n} = a^{m-n}$$

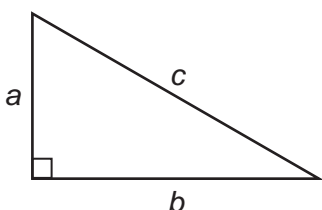
$$a^{-1} = \frac{1}{a}$$

Algebraic Equations

Slope: $m = \frac{y_2 - y_1}{x_2 - x_1}$

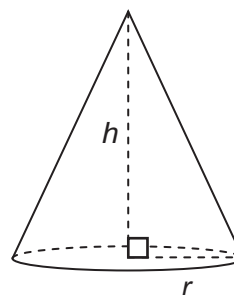
Slope-Intercept Form: $y = mx + b$

Pythagorean Theorem



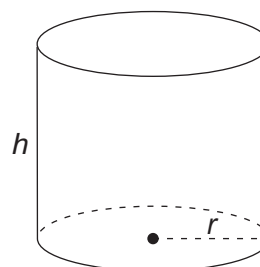
$$a^2 + b^2 = c^2$$

Cone



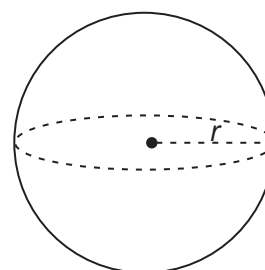
$$V = \frac{1}{3} \pi r^2 h$$

Cylinder



$$V = \pi r^2 h$$

Sphere



$$V = \frac{4}{3} \pi r^3$$

MATHEMATICS TEST DIRECTIONS

On the following pages are the mathematics questions.

- You may not use a calculator for question 1. You may use a calculator for all other questions on this test.

Directions for Multiple-Choice Questions:

Some questions will ask you to select an answer from among four choices.

For the multiple-choice questions:

- First solve the problem on scratch paper.
- Choose the correct answer and record your choice in the answer booklet.
- If none of the choices matches your answer, go back and check your work for possible errors.
- Only one of the answers provided is the correct response.

Directions for Open-Ended Questions:

Some questions will require you to write your response.

For the open-ended questions:

- These questions have more than one part. Be sure to read the directions carefully.
- You cannot receive the highest score for an open-ended question without completing all tasks in the question. For example, if the question asks you to show your work or explain your reasoning, be sure to show your work or explain your reasoning in the space provided.
- If the question does **not** ask you to show your work or explain your reasoning, you may use the space provided, but only those parts of your response that the question specifically asks for will be scored.
- Write your response in the appropriate location within the response box in the answer booklet. Some answers may require graphing, plotting, labeling, drawing, or shading. If you use scratch paper, be sure to transfer your final response and any needed work or reasoning to the answer booklet.

Question 1 in this sampler is to be solved without the use of a calculator.

MULTIPLE-CHOICE ITEMS

1. Simplify: $7^{-8} \times 7^{-4}$

A. $\frac{1}{7^{12}}$

B. $\frac{1}{7^4}$

C. 7^{12}

D. 7^{32}

Item Information				Option Annotations
Alignment		B-E.1.1.1		A. correct B. ignores the negative in the second exponent C. thinks 2 negatives make it positive D. multiplies the exponents
Answer Key		A		
Depth of Knowledge		1		
<i>p</i> -values				
A	B	C	D	
41%	12%	29%	18%	

A calculator is permitted for use in solving questions 2–17 in this sampler.

2. Which equation shows how to find the product of 1,000,000 and 1,000,000 using scientific notation?
- A. $1,000,000 \times 1,000,000 = (1 \times 10^6) \times (1 \times 10^6) = 1 \times 10^{(6 + 6)} = 1 \times 10^{12}$
 - B. $1,000,000 \times 1,000,000 = (1 \times 10^6) \times (1 \times 10^6) = 1 \times 10^{(6 \times 6)} = 1 \times 10^{36}$
 - C. $1,000,000 \times 1,000,000 = (1 \times 10^7) \times (1 \times 10^7) = 1 \times 10^{(7 + 7)} = 1 \times 10^{14}$
 - D. $1,000,000 \times 1,000,000 = (1 \times 10^7) \times (1 \times 10^7) = 1 \times 10^{(7 \times 7)} = 1 \times 10^{49}$

Item Information				Option Annotations
Alignment		B-E.1.1.4		A. correct B. multiplies the exponents C. incorrectly uses 7, because of 7 digits D. incorrectly uses 7, because of 7 digits, and multiplies the exponents
Answer Key		A		
Depth of Knowledge		1		
<i>p</i> -values				
A	B	C	D	
75%	13%	7%	5%	

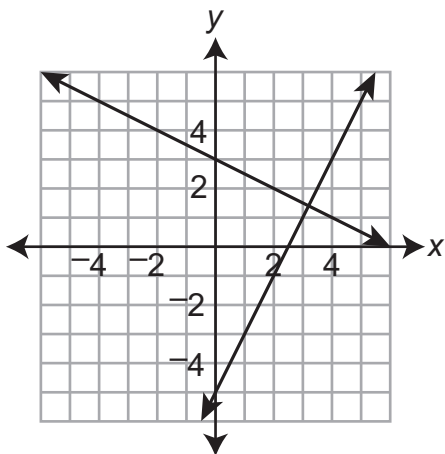
3. Mr. Carter is mapping the boundaries of a park on a coordinate grid. The park’s headquarters are located at the origin. The equations shown below represent two boundaries of the park.

$$y = 2x - 5$$

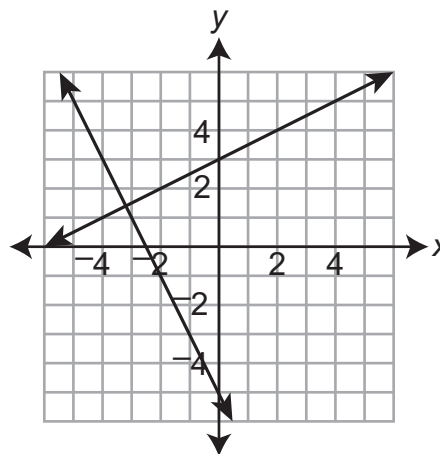
$$2x + 4y = 12$$

The park’s entrance is located at the intersection of these two boundaries. Which coordinate grid correctly shows the two boundaries and the park’s entrance?

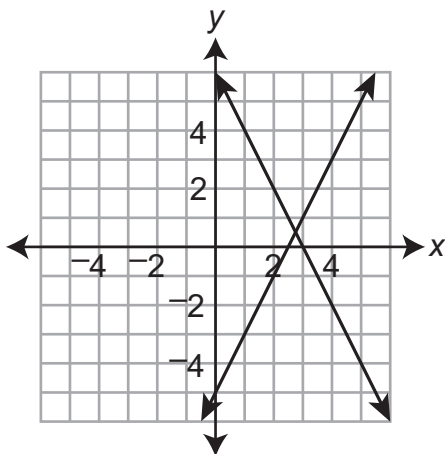
A.



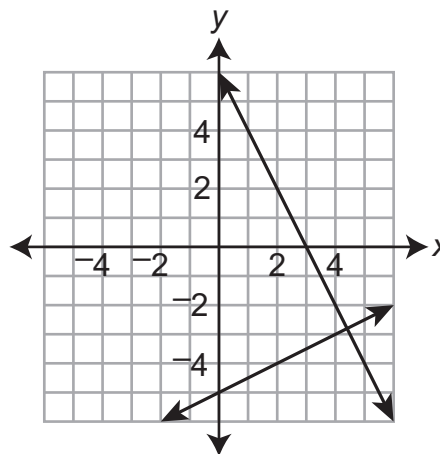
B.



C.



D.



Item Information				Option Annotations
Alignment	B-E.3.1.4			A. correct B. uses a negative slope for the first equation and a positive slope for the second equation C. uses the correct first equation but reverses the intercepts for the second equation D. uses the reciprocal of the slope for the first equation and reverses the intercepts for the second equation
Answer Key	A			
Depth of Knowledge	1			
p-values				
A	B	C	D	
46%	19%	22%	13%	

4. A cleaning company charges x dollars per hour to clean floors and y dollars per hour to clean the rest of a house.
- When the company spends 2 hours to clean floors and 3 hours to clean the rest of a house, the total charge is \$84.
 - When the company spends 1 hour to clean floors and 4 hours to clean the rest of a house, the total charge is \$87.

Which ordered pair represents the hourly charges to clean floors and to clean the rest of the house?

- A. (12, 20)
- B. (15, 18)
- C. (18, 15)
- D. (20, 12)

Item Information				Option Annotations
Alignment		B-E.3.1.5		A. tries these values in the first example; $2 \times 12 + 3 \times 20 = 84$ B. correct C. reverses the solution D. reverses the meaning of each value in the ordered pair and tries the values in the first example
Answer Key		B		
Depth of Knowledge		2		
p-values				
A	B	C	D	
19%	55%	15%	11%	

5. Marianna has been adding \$30 to her savings account every month. Which model could represent the money in Marianna’s savings account (y) after x months?

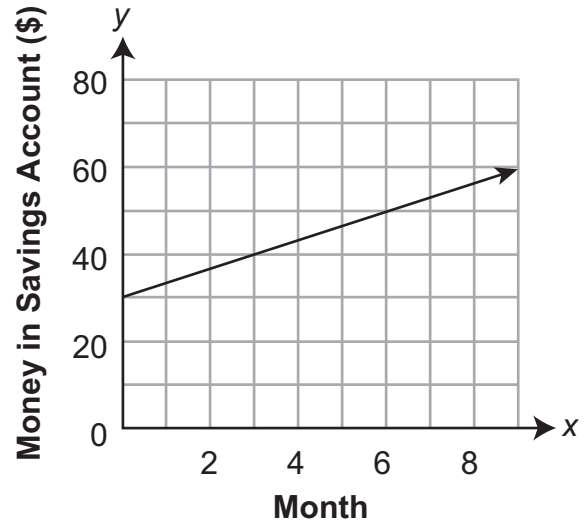
A. $y = 10x + 30$

B. $y = 10 - 30x$

C. **Marianna’s Savings Account**

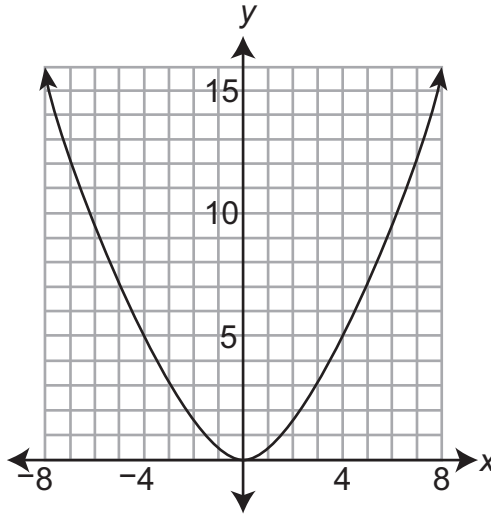
Month (x)	Money in Savings Account (y)
3	\$100
5	\$160
7	\$220

D. **Marianna’s Savings Account**



Item Information				Option Annotations	
Alignment		B-F.1.1		A. sees 30 is represented, but not as slope B. sees 30 and ignores the negative part of the slope C. correct D. identifies slope as 30/1 instead of 10/3	
Answer Key		C			
Depth of Knowledge		2			
p-values					
A	B	C	D		
28%	9%	48%	15%		

6. The graph below represents a function.



Which single transformation could be applied to the graph so that it no longer represents a function?

- A. reflection across the x -axis
- B. reflection across the y -axis
- C. rotation of 90° clockwise about the origin
- D. translation 5 units to the left

Item Information		Option Annotations	
Alignment	B-F.1.1.1 C-G.1.1.1	A. thinks a function must have some positive y -values B. confuses this with a reflection across $y = x$ C. correct D. thinks all functions must go through the origin	
Answer Key	C		
Depth of Knowledge	2		
<i>p</i>-values			
A	B		C
14%	22%	48%	16%

7. Two linear functions of x are shown below.

Function 1
 $y = 30x + 19$

Function 2

x	y
-12	-311
-8	-211
-3	-86
1	14

Which statement about the functions is true?

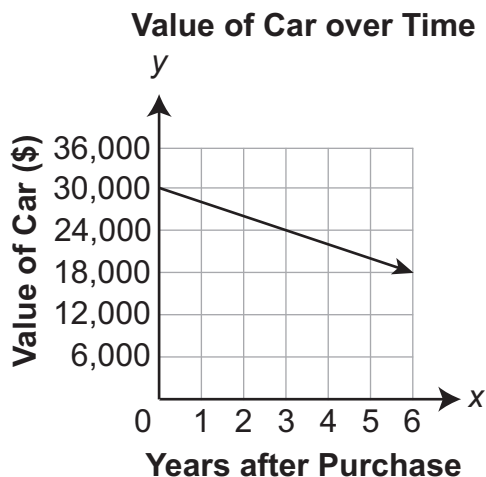
- A. Function 2 can be described by the equation $y = 35x - 109$.
- B. Function 2 can be described by the equation $y = 100x - 11$.
- C. The y -intercept of function 1 is less than the y -intercept of function 2.
- D. The rate of change of function 1 is greater than the rate of change of function 2.

Item Information		Option Annotations	
Alignment	B-F.1.1.2 B-F.1.1.3	A. sees $35x + 109$ works for first pair in table, but writes as $35x - 109$ B. uses difference of first two y -values as slope C. misidentifies y -intercept of function 2 D. correct	
Answer Key	D		
Depth of Knowledge	2		
<i>p</i>-values			
A	B	C	D
10%	12%	30%	48%

8. Luis is building a new deck and needs to have a slab of concrete poured. He knows the contractor charges an initial cost of \$75 plus an additional \$2.50 per square foot of concrete. Which equation can be used to determine the cost (y), in dollars, to pour a concrete slab with an area of x square feet?
- A. $y = 2.5x + 75$
 - B. $y = 7.5x + 2.5$
 - C. $y = 75x + 2.5$
 - D. $y = 77.5x$

Item Information				Option Annotations
Alignment		B-F.2.1.1		A. correct B. converts 75 to 7.5 and uses it as the rate C. reverses the rate and initial cost D. adds 75 and 2.5 and assumes that is the rate per square foot
Answer Key		A		
Depth of Knowledge		2		
<i>p-values</i>				
A	B	C	D	
70%	8%	17%	5%	

9. The graph below shows the relationship between the number of years after a car is purchased and the car's value.



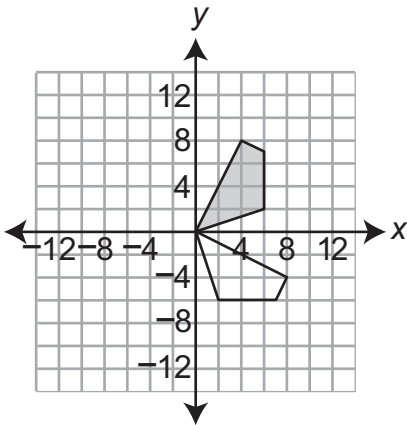
Which statement correctly describes the relationship shown in the graph?

- A. The car's initial value is \$2,000, and the car's value increases \$30,000 each year.
- B. The car's initial value is \$18,000, and the car's value increases \$2,000 each year.
- C. The car's initial value is \$30,000, and the car's value decreases \$2,000 each year.
- D. The car's initial value is \$30,000, and the car's value decreases \$12,000 each year.

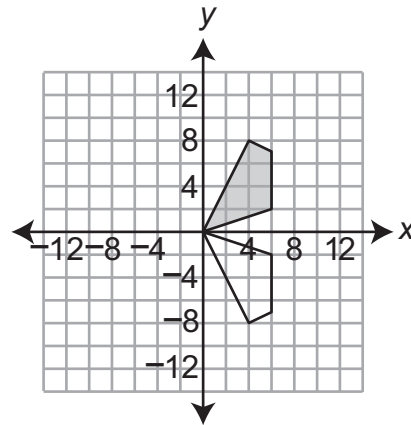
Item Information				Option Annotations
Alignment		B-F.2.1.2		A. reverses meaning for slope and y-intercept and misreads direction of slope in graph B. reads graph from right to left C. correct D. uses change in value at end of 6 years as rate of change
Answer Key		C		
Depth of Knowledge		2		
p-values				
A	B	C	D	
3%	5%	79%	13%	

10. Which coordinate plane shows that the shaded polygon is the image of the unshaded polygon after a 90° counterclockwise rotation about the origin?

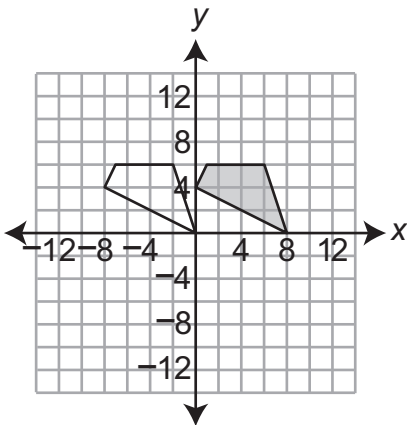
A.



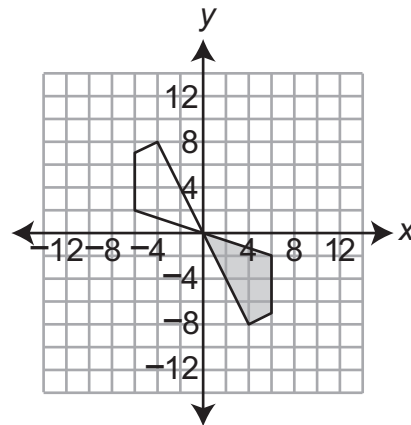
B.



C.

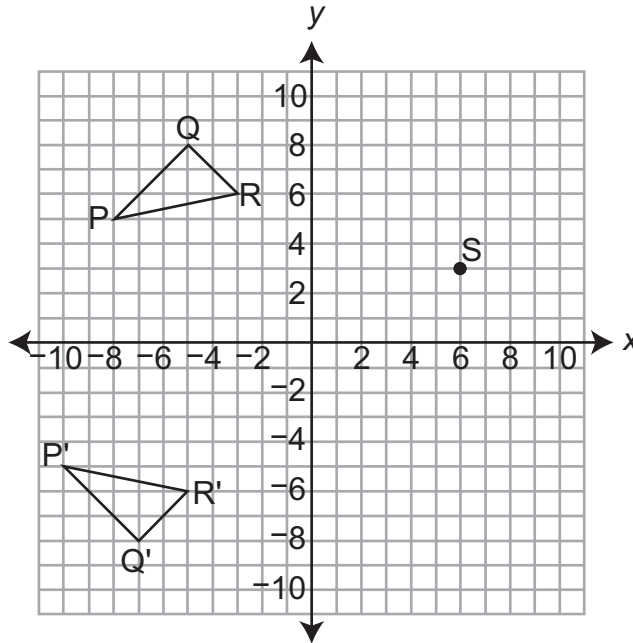


D.



Item Information				Option Annotations	
Alignment		C-G.1.1.1		A. correct B. uses reflection across x-axis C. uses a translation, but thinks 90 degrees because of shifting from one quadrant to another D. uses 180-degree rotation	
Answer Key		A			
Depth of Knowledge		2			
p-values					
A	B	C	D		
49%	20%	7%	24%		

11. In the figure shown below, triangle PQR is transformed to create triangle P'Q'R'.



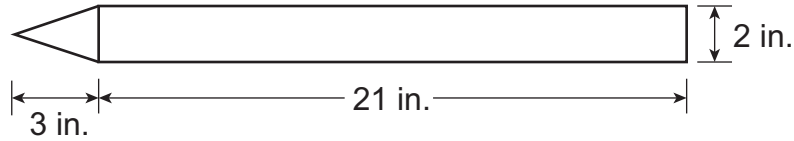
Point S will be transformed the same way as triangle PQR. Which sentence could describe how point S will be transformed?

- A. Point S will be translated to (6, 0) and then rotated to (0, 6).
- B. Point S will be translated to (6, 0) and then rotated to (0, -6).
- C. Point S will be translated to (4, 3) and then reflected to (-4, 3).
- D. Point S will be translated to (4, 3) and then reflected to (4, -3).

Item Information				Option Annotations
Alignment		C-G.1.1.2 C-G.1.1.3		A. picks an option that includes the axes B. thinks the two triangles are rotations of one another C. reflects the point across the wrong axis D. correct
Answer Key		D		
Depth of Knowledge		2		
p-values				
A	B	C	D	
15%	20%	22%	43%	

12. A balloon in the shape of a crayon is shown below.

Crayon Balloon



The crayon balloon is made up of a cone and a cylinder. What is the volume, in cubic inches, of the crayon balloon?

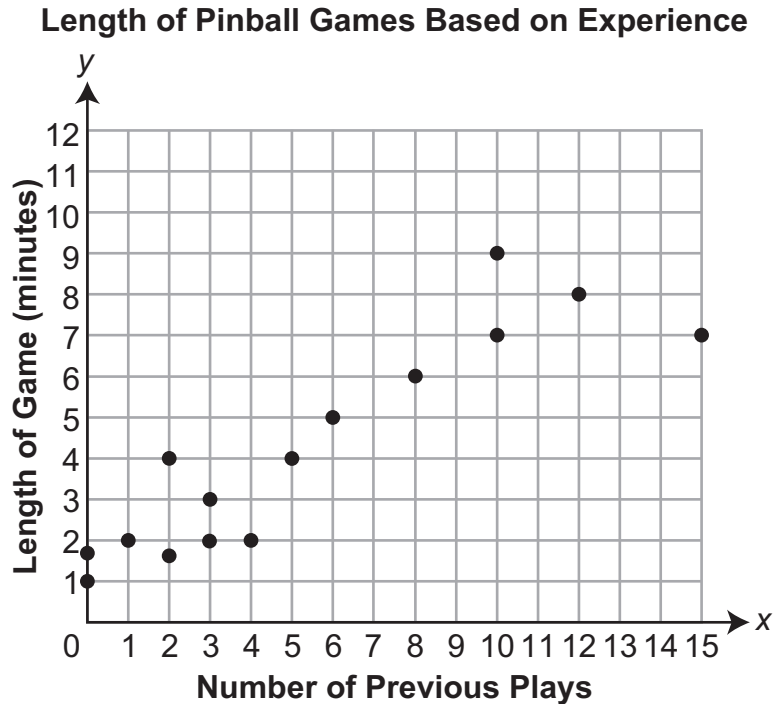
- A. 69.12
- B. 75.40
- C. 138.23
- D. 276.46

Item Information				Option Annotations
Alignment		C-G.3.1.1		A. correct B. uses formula for volume of a cylinder instead of a cone C. calculates 1 squared as 1 times 2 D. uses 2 inches as the radius
Answer Key		A		
Depth of Knowledge		2		
<i>p</i> -values				
A	B	C	D	
49%	19%	18%	14%	

13. Part of a sculpture is a stone sphere with a volume of 36π cubic feet. What is the radius, in feet, of the stone sphere?
- A. 3
 - B. 6
 - C. 9
 - D. 12

Item Information				Option Annotations			
Alignment		C-G.3.1.1		A. correct B. finds square root of 36 C. finds value of r cubed and then divides by 3 D. divides 36 by 3			
Answer Key		A					
Depth of Knowledge		2					
<i>p</i> -values							
A	B	C	D				
40%	26%	15%	19%				

14. Christy created the scatter plot shown below.

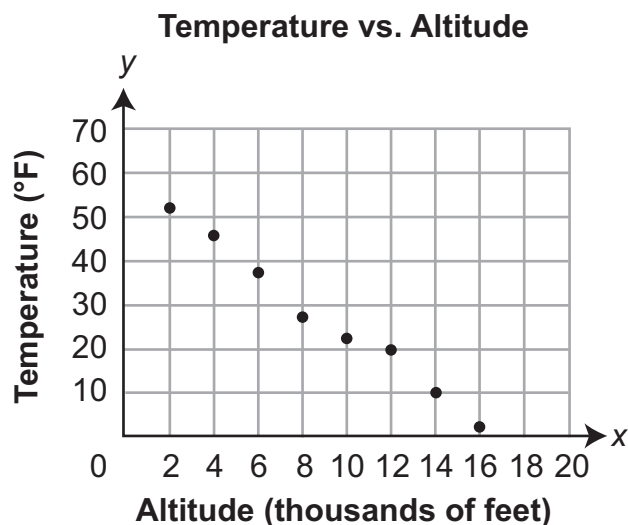


Christy finds that the line of best fit for the data has the equation $y = 0.51x + 1.48$. Which statement **best** explains how removing the point (15, 7) would affect the slope of the line of best fit?

- A. The slope of the line of best fit would decrease because the point lies below the original line of best fit.
- B. The slope of the line of best fit would decrease because the point lies above the original line of best fit.
- C. The slope of the line of best fit would increase because the point lies below the original line of best fit.
- D. The slope of the line of best fit would increase because the point lies above the original line of best fit.

Item Information				Option Annotations
Alignment	D-S.1.1.1			A. identifies where the point lies but thinks removing it would cause the line to move further down B. gets the correct relationship between the location of the point and the slope but the wrong location of the point C. correct D. gets the location of the line incorrect and thinks that removing a point above the line will cause the slope of the line to increase
Answer Key	C			
Depth of Knowledge	2			
p-values				
A	B	C	D	
20%	9%	56%	15%	

15. The scatter plot below shows the temperatures (y), in degrees Fahrenheit ($^{\circ}\text{F}$), that were recorded at different altitudes (x), in thousands of feet.



Which equation could represent the line of best fit for the temperatures, in degrees Fahrenheit, based on the altitudes, in thousands of feet?

- A. $y = -\frac{9}{4}x + 47$
- B. $y = -\frac{7}{2}x + 59$
- C. $y = -5x + 69$
- D. $y = -5x + 80$

Item Information				Option Annotations	
Alignment		D-S.1.1.2		A. chooses line that passes through data points (8, 29) and (12, 20) B. correct C. chooses line that passes through data points (6, 39) and (8, 29) D. chooses line that passes through data points (12, 20) and (14, 10)	
Answer Key		B			
Depth of Knowledge		2			
p-values					
A	B	C	D		
20%	46%	21%	13%		

16. Blake interviewed 24 students to see whether they collected sports cards and whether they participated in sports. The table below shows his data.

Sports-Card Collecting and Sports Participation

	Participates in Sports	Does Not Participate in Sports
Collects Sports Cards	6	3
Does Not Collect Sports Cards	x	7

How many of the students Blake interviewed participate in sports?

- A. 4
- B. 10
- C. 14
- D. 15

Item Information		Option Annotations	
Alignment	D-S.1.2.1	A. thinks both columns should be equal ($6 + x = 3 + 7$) B. finds how many do not participate in sports C. correct D. finds how many do not collect sports cards	
Answer Key	C		
Depth of Knowledge	2		
<i>p</i> -values			
A	B		C
16%	17%	63%	4%

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OPEN-ENDED QUESTION

17. Bill used a rain gauge to measure how much rain fell, in centimeters (cm), during a rainfall.

The rain fell at the same rate throughout the first 180 minutes of the rainfall.

- A. Complete the table below with the number of minutes it took for 9 centimeters of rain to fall and the number of centimeters of rain that fell through 150 minutes.

Rainfall

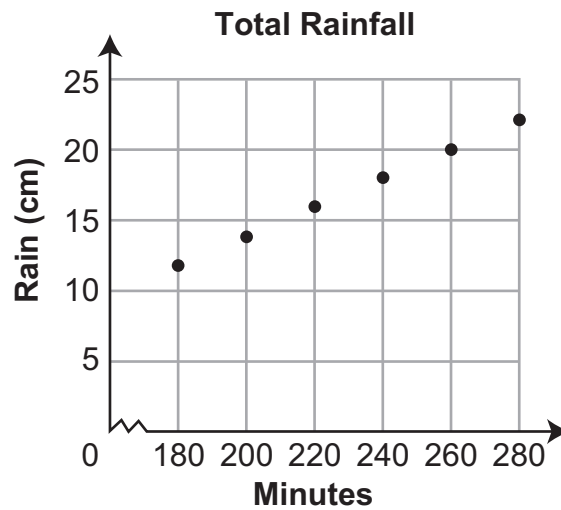
Time (minutes)	30	45	60	90	_____	150	180
Rain (cm)	2	3	4	6	9	_____	12

- B. Write an equation to describe the relationship between the time (t), in minutes, and the amount of rain (r), in centimeters.

Go to the next page to finish question 17.

17. *Continued.* Please refer to the previous page for task explanation.

The total amount of rain that fell from 180 minutes through 280 minutes is shown in the scatter plot below.



- C. Describe the change in the slope between the first 180 minutes and the following 100 minutes, and explain what it means in terms of the total amount of rainfall.

After 280 minutes, the slope of the graph is 0.

- D. Explain what a slope of 0 means in this situation.

Item-Specific Scoring Guideline

#17 Item Information

Alignment	B-E.2	Depth of Knowledge	2	Mean Score	1.73
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Assessment Anchor this item will be reported under:

M08.B-E.2—Understand the connections between proportional relationships, lines, and linear equations.

Specific Anchor Descriptor addressed by this item:

M08.B-E.2.1—Analyze and describe linear relationships between two variables, using slope.

Scoring Guide

Score	In this item, the student . . .
4	Demonstrates a thorough understanding of connections between proportional relationships, lines, and linear equations by correctly solving problems and clearly explaining procedures.
3	Demonstrates a general understanding of connections between proportional relationships, lines, and linear equations by correctly solving problems and clearly explaining procedures with only minor errors or omissions.
2	Demonstrates a partial understanding of connections between proportional relationships, lines, and linear equations by correctly performing a significant portion of the required task.
1	Demonstrates minimal understanding of connections between proportional relationships, lines, and linear equations.
0	The response has no correct answer and insufficient evidence to demonstrate any understanding of the mathematical concepts and procedures as required by the task. Response may show only information copied from the question.

Top-Scoring Student Response and Training Notes

Score	Description
4	Student earns 4 points.
3	Student earns 3.0–3.5 points.
2	Student earns 2.0–2.5 points.
1	Student earns 0.5–1.5 points. OR Student demonstrates minimal understanding of connections between proportional relationships, lines, and linear equations.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.

Top-Scoring Response

Part A (1 point):

$\frac{1}{2}$ point for each correct answer

What?								Why?
Rainfall								
Time (minutes)	30	45	60	90	<u>135</u>	150	180	
Rain (cm)	2	3	4	6	9	<u>10</u>	12	

Part B (1 point):

1 point for correct equation

What?	Why?
$t = 15r$ OR $r = \frac{1}{15}t$ OR equivalent	

Part C (1 point):

1 point for complete explanation

OR $\frac{1}{2}$ point for correct but incomplete explanation

What?	Why?
	Sample Explanation: The slope is steeper for the second part. This means it is raining more during that time.

Part D (1 point):

1 point for complete explanation

What?	Why?
	Sample Explanation: A slope of 0 means it stopped raining.

STUDENT RESPONSE

Response Score: 4 points

17. Bill used a rain gauge to measure how much rain fell, in centimeters (cm), during a rainfall.

The rain fell at the same rate throughout the first 180 minutes of the rainfall.

- A. Complete the table below with the number of minutes it took for 9 centimeters of rain to fall and the number of centimeters of rain that fell through 150 minutes.

Rainfall

Time (minutes)	30	45	60	90	<u>135</u>	150	180
Rain (cm)	2	3	4	6	9	<u>10</u>	12

The student has given two correct answers.

- B. Write an equation to describe the relationship between the time (t), in minutes, and the amount of rain (r), in centimeters.

$$t = 15r$$

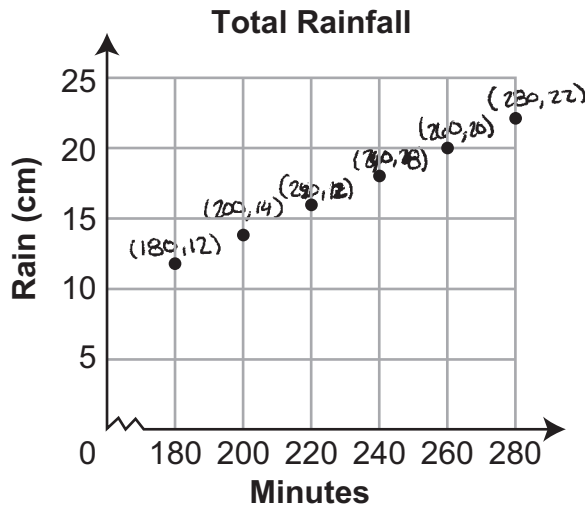
The student has given a correct equation.

Go to the next page to finish question 17.

17. *Continued.* Please refer to the previous page for task explanation.

The total amount of rain that fell from 180 minutes through 280 minutes is shown in the scatter plot below.

$$m = \frac{1}{10}$$



C. Describe the change in the slope between the first 180 minutes and the following 100 minutes, and explain what it means in terms of the total amount of rainfall.

In this scatter plot it takes 10 minutes to get a cm of rain compared to the previous 15 minutes. This means it is steadily increasing and will yield a larger amount of rain faster.

The student has given a complete description.

After 280 minutes, the slope of the graph is 0.

D. Explain what a slope of 0 means in this situation.

It means the rain has stopped.

The student has given a complete explanation.

STUDENT RESPONSE

Response Score: 3 points



PARTS A AND B

Question 17
Page 1 of 3

Item ID

?

Line Guide

Calculator

Eraser

Highlighter

Eraser

Highlighter

Bill used a rain gauge to measure how much rain fell, in centimeters (cm), during a rainfall.

The rain fell at the same rate throughout the first 180 minutes of the rainfall.

A. Complete the table below with the number of minutes it took for 9 centimeters of rain to fall and the number of centimeters of rain that fell through 150 minutes.

Time (minutes)	30	45	60	90	135	150	180
Rain (cm)	2	3	4	6	9	10	12

The student has given two correct answers.

The student has given a correct equation.

B. Write an equation to describe the relationship between the time (t), in minutes, and the amount of rain (r), in centimeters.

Eq
 $t = 15r$

The student has given a correct equation.

Review/End Test

Pause

Flag

Options

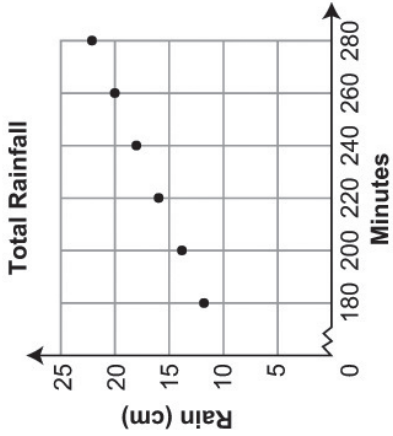
Next

PART C

Question 17
Page 2 of 3

Bill used a rain gauge to measure how much rain fell, in centimeters (cm), during a rainfall.

The total amount of rain that fell from 180 minutes through 280 minutes is shown in the scatter plot below.



C. Describe the change in the slope between the first 180 minutes and the following 100 minutes, and explain what it means in terms of the total amount of rainfall.

Eq

the slope is going at the same rate. For every 15 minutes it is 1 centimeter of rainfall.

The student has given an incorrect explanation.

89 / 1000

Item ID ?



Line Guide



Next

Back

Options







Flag



Pause

Review/End Test

PART D

Question 17
Page 3 of 3

Bill used a rain gauge to measure how much rain fell, in centimeters (cm), during a rainfall.

After 280 minutes, the slope of the graph is 0.

D. Explain what a slope of 0 means in this situation.

Eq

63 / 1000

The student has given a complete explanation.

Review/End Test

Pause

Flag

Options

Back

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STUDENT RESPONSE

Response Score: 2 points

17. Bill used a rain gauge to measure how much rain fell, in centimeters (cm), during a rainfall.

The rain fell at the same rate throughout the first 180 minutes of the rainfall.

- A. Complete the table below with the number of minutes it took for 9 centimeters of rain to fall and the number of centimeters of rain that fell through 150 minutes.

Rainfall

Time (minutes)	30	45	60	90	135	150	180
Rain (cm)	2	3	4	6	9	10	12

The student has given two correct answers.

- B. Write an equation to describe the relationship between the time (t), in minutes, and the amount of rain (r), in centimeters.

$$15r = T$$

$$\text{Time} = T$$

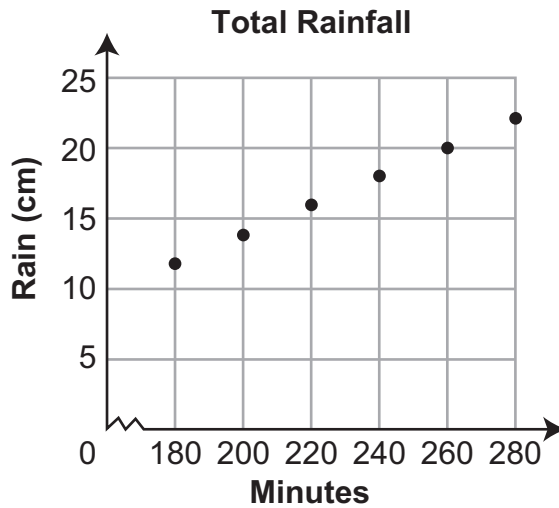
$$\text{Rain} =$$

The student has given a correct equation.

Go to the next page to finish question 17.

17. *Continued.* Please refer to the previous page for task explanation.

The total amount of rain that fell from 180 minutes through 280 minutes is shown in the scatter plot below.



C. Describe the change in the slope between the first 180 minutes and the following 100 minutes, and explain what it means in terms of the total amount of rainfall.

The change in slope is because instead of the minutes increasing by 10 they are increasing by 20. This would make the slope decrease

The student has given an incorrect explanation.

After 280 minutes, the slope of the graph is 0.

D. Explain what a slope of 0 means in this situation.

A slope of 0 means the line doesn't move.

The student has given an incorrect explanation.

STUDENT RESPONSE

Response Score: 1 point



PARTS A AND B

Question 17
Page 1 of 3

Item ID

?

The rain fell at the same rate throughout the first 180 minutes of the rainfall.

A. Complete the table below with the number of minutes it took for 9 centimeters of rain to fall and the number of centimeters of rain that fell through 150 minutes.

Time (minutes)	30	45	60	90	105	150	180
Rain (cm)	2	3	4	6	9	11	12

The student has given two incorrect answers.

B. Write an equation to describe the relationship between the time (t), in minutes, and the amount of rain (r), in centimeters.

Eq

$$t = r \cdot 10 + 15$$

The student has given an incorrect equation.

Next

Options

Flag

Pause

Review/End Test

PART C

Question 17
Page 2 of 3

Item ID

Line Guide

?

Bill used a rain gauge to measure how much rain fell, in centimeters (cm), during a rainfall.

The total amount of rain that fell from 180 minutes through 280 minutes is shown in the scatter plot below.

Minutes	Rain (cm)
180	12
190	14
200	16
210	18
220	20
230	22
240	24
250	25
260	24
270	22
280	20

C. Describe the change in the slope between the first 180 minutes and the following 100 minutes, and explain what it means in terms of the total amount of rainfall.

Eq

the slope goes strait up meaning the rainfall was concistant

The student has given an incorrect explanation.

60 / 1000

Review/End Test

Pause

Flag

Options

Back

Next

PART D

Question 17
Page 3 of 3

Bill used a rain gauge to measure how much rain fell, in centimeters (cm), during a rainfall.

After 280 minutes, the slope of the graph is 0.

D. Explain what a slope of 0 means in this situation.

the rain stopped falling

The student has given a complete explanation.

Eq

24 / 1000

Back

Review/End Test

Pause






Flag

Options

Line Guide

Item ID

?



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STUDENT RESPONSE

Response Score: 0 points

17. Bill used a rain gauge to measure how much rain fell, in centimeters (cm), during a rainfall.

The rain fell at the same rate throughout the first 180 minutes of the rainfall.

- A. Complete the table below with the number of minutes it took for 9 centimeters of rain to fall and the number of centimeters of rain that fell through 150 minutes.

Rainfall

Time (minutes)	30	45	60	90	<u>120</u>	150	180
Rain (cm)	2	3	4	6	9	<u>11</u>	12

The student has given two incorrect answers.

- B. Write an equation to describe the relationship between the time (t), in minutes, and the amount of rain (r), in centimeters.

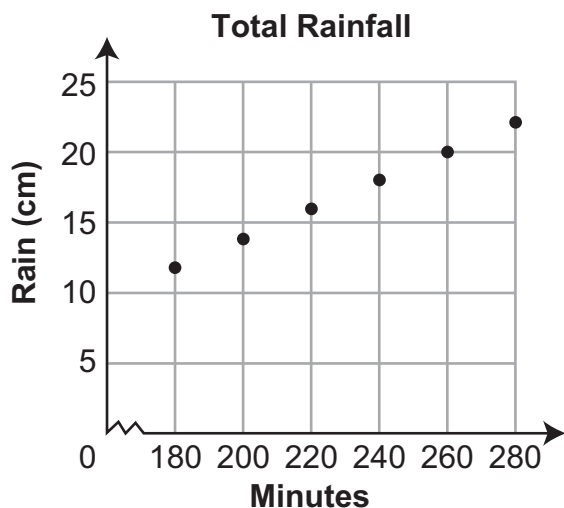
for every every 30 min theres 2cm of rain

The student has not given a correct equation.

Go to the next page to finish question 17.

17. *Continued.* Please refer to the previous page for task explanation.

The total amount of rain that fell from 180 minutes through 280 minutes is shown in the scatter plot below.



C. Describe the change in the slope between the first 180 minutes and the following 100 minutes, and explain what it means in terms of the total amount of rainfall.

the amount of rain went up alot

The student has given an incorrect explanation.

After 280 minutes, the slope of the graph is 0.

D. Explain what a slope of 0 means in this situation.

its not going up any more

The student has given an incorrect explanation.

MATHEMATICS—SUMMARY DATA

MULTIPLE-CHOICE

Sample Number	Alignment	Answer Key	Depth of Knowledge	p-values			
				A	B	C	D
1	B-E.1.1.1	A	1	41%	12%	29%	18%
2	B-E.1.1.4	A	1	75%	13%	7%	5%
3	B-E.3.1.4	A	1	46%	19%	22%	13%
4	B-E.3.1.5	B	2	19%	55%	15%	11%
5	B-F.1.1	C	2	28%	9%	48%	15%
6	B-F.1.1.1 C-G.1.1.1	C	2	14%	22%	48%	16%
7	B-F.1.1.2 B-F.1.1.3	D	2	10%	12%	30%	48%
8	B-F.2.1.1	A	2	70%	8%	17%	5%
9	B-F.2.1.2	C	2	3%	5%	79%	13%
10	C-G.1.1.1	A	2	49%	20%	7%	24%
11	C-G.1.1.2 C-G.1.1.3	D	2	15%	20%	22%	43%
12	C-G.3.1.1	A	2	49%	19%	18%	14%
13	C-G.3.1.1	A	2	40%	26%	15%	19%
14	D-S.1.1.1	C	2	20%	9%	56%	15%
15	D-S.1.1.2	B	2	20%	46%	21%	13%
16	D-S.1.2.1	C	2	16%	17%	63%	4%

OPEN-ENDED

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
17	B-E.2	4	2	1.73

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PSSA Grade 8 Mathematics Item and Scoring Sampler

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