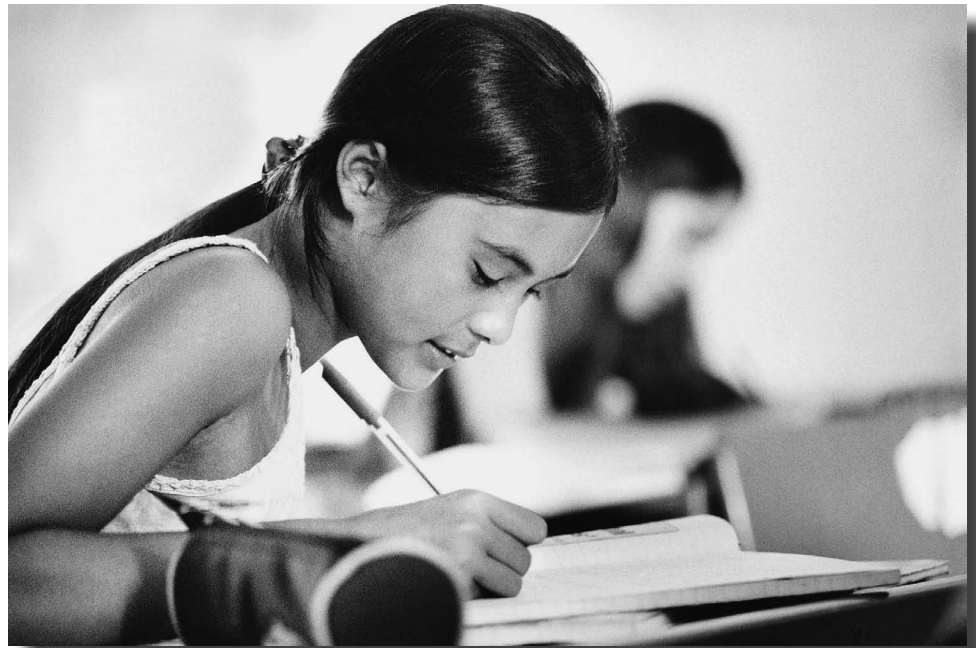pennsylvania
DEPARTMENT OF EDUCATION

The Pennsylvania System of School Assessment

Mathematics
Item and Scoring Sampler

2022–2023
Grade 6

INTRODUCTION

General Introduction

The Pennsylvania Department of Education (PDE) 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 Anchors and Eligible Content (AAEC) 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 by providing samples of test item types and scored student responses. The item sampler is not designed to be used as a pretest, a curriculum, or any other benchmark for operational testing.

This Item and Scoring Sampler is available in Braille format. For more information regarding Braille, call (717) 901-2238.

Pennsylvania Core Standards (PCS)

This sampler contains examples of test questions designed to assess the Pennsylvania Assessment Anchors and Eligible Content aligned to the PCS. 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 PCS-aligned Assessment Anchors and Eligible Content documents are posted on this portal:

➢ *www.education.pa.gov* [Hover over "Data and Reporting," select "Assessment and Accountability," and select "PSSA-PA System of School Assessment." Then select "Assessment Anchors/Eligible Content" on the right side of the screen.]

What Is Included

This sampler contains test questions, or test "items," that have been written to align to the Assessment Anchors that are based on the PCS. The sample test questions model the types of items that may appear on an operational PSSA. Each sample test question has been through a rigorous review process to ensure alignment with the Assessment Anchors prior to being piloted in an embedded field test within a PSSA assessment and then used operationally on a PSSA assessment. Answer keys, scoring guidelines, and any related stimulus material are also included. Additionally, sample student responses are provided with each open-ended item to demonstrate the range of responses that students provided in response to these items.

Purpose and Uses

The items in this sampler may be used[1] as examples for creating assessment items at the classroom level. Classroom teachers may find it beneficial to have students respond to the open-ended (OE) item in this sampler. Educators may then use the sampler as a guide to score the responses either independently or together with colleagues within a school or district. This sampler also includes the *General Description of Scoring Guidelines for Mathematics Open-Ended Items* that students will have access to during a PSSA mathematics administration. The general description of scoring guidelines may be distributed to students for use during local assessments and may also be used by educators when scoring local assessments.

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 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.

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.

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

Testing Time and Mode of Testing Delivery for the PSSA

The PSSA is delivered in a 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. 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

During an official test administration, students are given as much additional time as is necessary to complete the test questions.

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 6.

- A-N = The Number System

- A-R = Ratios and Proportional Relationships

- B-E = Expressions and Equations

- C-G = Geometry

- D-S = Statistics and Probability

Examples of MC and OE items assessing these categories are included in this sampler.

Item and Scoring Sampler Format

This sampler includes the test directions and scoring guidelines that appear in the PSSA Mathematics assessments. Each MC item is followed by a table that includes the item alignment, the answer key, the depth of knowledge (DOK) level, the percentage[2] of students who chose each answer option, and a brief answer-option analysis or rationale. The OE item is followed by a table that includes the item alignment, the DOK level, and the 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 Items* 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. The student responses in this item and scoring sampler are actual student responses; however, the handwriting has been changed to protect the students' identities and to make the item and scoring sampler accessible to as many people as possible.

Example Multiple-Choice Item Information Table

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

Example Open-Ended Item Information Table

Alignment	Assigned AAEC	**Depth of Knowledge**	Assigned DOK	**Mean Score**	Average Score

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2 All *p*-value percentages listed in the item information tables have been rounded.

General Description of Scoring Guidelines for Mathematics Open-Ended Items

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. The 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.

The response may show only information copied from the question.

Special Categories within zero reported separately:

BLK (blank).............Is blank, is entirely erased, or gives a written refusal to respond

OT...........................Is off-task

LOE........................Is in a language other than English

IL.............................Is illegible

Grade 6 Formula Sheet
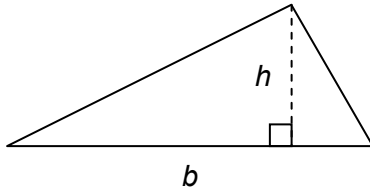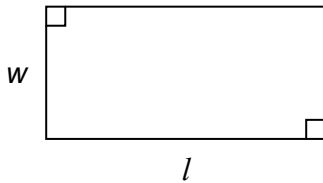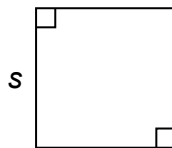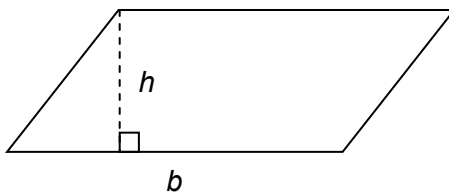
Triangle

$$A = \frac{1}{2}\,bh$$

Trapezoid

$$A = \frac{1}{2}\,h(b_1 + b_2)$$

Rectangle

$$A = lw$$
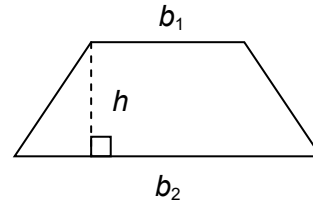
Rectangular Prism

$$V = lwh \qquad SA = 2lw + 2lh + 2wh$$

Square

$$A = s^2$$

Cube

$$V = s \cdot s \cdot s \qquad SA = 6s^2$$

Parallelogram

$$A = bh$$
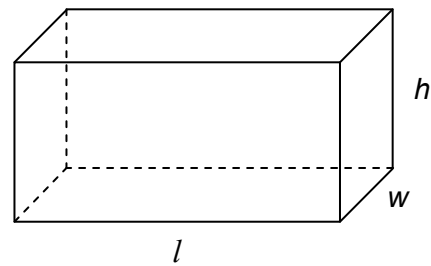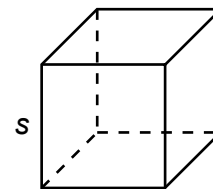
Triangular Prism
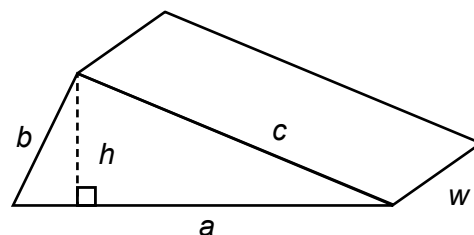
$$SA = ah + aw + bw + cw$$

MATHEMATICS TEST DIRECTIONS

On the following pages are the mathematics questions.

- You may <u>not</u> 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 <u>without</u> the use of a calculator.

MULTIPLE-CHOICE ITEMS

1. Simplify: $\dfrac{3 \bullet 27.25}{0.25}$

   A. 81

   B. 121

   C. 243

   D. 327

Item Information	
Alignment	A-N.2.1.1
Answer Key	D
Depth of Knowledge	1
p-value A	25%
p-value B	14%
p-value C	13%
p-value D	48% (correct answer)
Option Annotations	A. cancels the 0.25 from 27.25 and then multiplies 3 • 27 B. finds the sum of the quotients 3 ÷ 0.25 and 27.25 ÷ 0.25 C. multiplies 3 • 27 • 3 • 0.25 and then divides the result (60.75) by 0.25 D. Correct: multiplies 3 • 27.25 and then divides the result (81.75) by 0.25

A calculator is permitted for use in solving questions 2–16 in this sampler.

2. A family traveled by car to visit a relative.

    • The family traveled 114 miles on the route they used going to the relative's home.

    • The family used a different route returning from the relative's home and traveled 156 miles.

    • The car used a total of 12 gallons of gas.

    On average, how many miles did the family travel for each gallon of gas the car used?

    A. 16.4

    B. 19

    C. 22.5

    D. 26

Item Information	
Alignment	A-R.1.1
Answer Key	C
Depth of Knowledge	2
p-value A	12%
p-value B	9%
p-value C	71% (correct answer)
p-value D	8%
Option Annotations	A. multiplies 12 by the quotient 156 ÷ 114 B. divides 114 by half of 12 C. Correct: divides the total distance (114 + 156) by the number of gallons (12) D. divides 156 by half of 12

3. Jamal and Lucy each build model airplanes.

- Jamal had 10 model airplanes. After building some model airplanes last month, he had 18 model airplanes.

- Lucy also had some model airplanes. Last month, she built 12 model airplanes. After that, she had 20 model airplanes.

Which statement describes the ratio of the number of model airplanes Jamal built last month to the number of model airplanes Lucy built last month?

A. For every model airplane Jamal built, Lucy built 5 model airplanes.

B. For every 2 model airplanes Jamal built, Lucy built 3 model airplanes.

C. For every 2 model airplanes Jamal built, Lucy built 5 model airplanes.

D. For every 7 model airplanes Jamal built, Lucy built 3 model airplanes.

Item Information	
Alignment	A-R.1.1.1 B-E.2.1.3
Answer Key	B
Depth of Knowledge	2
p-value A	10%
p-value B	58% (correct answer)
p-value C	22%
p-value D	10%
Option Annotations	A. determines the correct ratio (8 to 12) but "reduces" it using subtraction B. Correct: compares the number of model airplanes Jamal built last month (18 – 10) to the number of model airplanes Lucy built last month (12) and simplifies the ratio 8 to 12 by dividing each number by 4 C. compares the number of model airplanes Jamal built to the total number of airplanes built OR compares the number of model airplanes Jamal built to the total number of airplanes Lucy had D. compares (18 + 10) to 12 instead of (18 – 10) to 12

4. Mike buys 4 packs of baseball cards for a total of $8. Each pack contains 10 baseball cards. How much does Mike pay for each baseball card?

    A. $0.05

    B. $0.20

    C. $3.20

    D. $5.00

Item Information	
Alignment	A-R.1.1.2
Answer Key	B
Depth of Knowledge	2
p-value A	17%
p-value B	54% (correct answer)
p-value C	18%
p-value D	11%
Option Annotations	A. reverses the order of the division when determining the amount paid for each pack and calculates (4 ÷ 8) ÷ 10 B. Correct: determines the amount paid for each pack by dividing the total amount by the number of packs ($8 ÷ 4) and then determines the amount paid for each card by dividing the amount per pack by the number of cards in each pack ($2 ÷ 10) OR determines the total number of cards purchased by multiplying the number of packs by the number of cards in each pack (4 • 10) and then determines the amount paid for each card by dividing the amount paid by the total number of cards ($8 ÷ 40) C. uses multiplication instead of division when determining the amount paid for each pack and calculates (8 • 4) ÷ 10 D. determines the total number of cards purchased but reverses the order of the division when determining the amount paid for each card (40 ÷ 8)

5. Mr. Li's yard is in the shape of a square. Each side has a length of 40 feet. Mr. Li uses 20% of the area of the yard for a garden. What is the area, in square feet, of the garden in Mr. Li's yard?

    A.   64

    B.   80

    C.   320

    D.   800

Item Information	
Alignment	A-R.1.1.5 C-G.1.1.1
Answer Key	C
Depth of Knowledge	2
p-value A	13%
p-value B	29%
p-value C	35% (correct answer)
p-value D	23%
Option Annotations	A. determines 20% of each side length (0.20 • 40 = 8) and then multiplies 8 by 8 B. divides the area of the yard (40 • 40) by 20 C. Correct: converts 20% to 0.20 before multiplying the area of the yard (40 • 40) by 0.20 D. divides the area of the yard (40 • 40) by 2

6. Which statement explains why $-2x + 4y = 7$ is **not** an expression?

    A.   An expression cannot have an equals sign.

    B.   An expression cannot have an operation symbol.

    C.   An expression cannot have any negative numbers.

    D.   An expression cannot have more than one variable.

Item Information	
Alignment	B-E.1.1
Answer Key	A
Depth of Knowledge	1
p-value A	53% (correct answer)
p-value B	10%
p-value C	20%
p-value D	17%
Option Annotations	A. Correct: recognizes that a comparison symbol (=) is used to compare two expressions B. thinks expressions can have only 1 term or can compare only 2 terms C. thinks expressions can have only positive numbers D. thinks expressions can have only 1 variable

7. Which expression is equivalent to $2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 3 \times 7 \times 7$?

  A. $2^2 \times 3^4 \times 7^2$

  B. $2^3 \times 3^4 \times 7^2$

  C. $3^2 \times 4^3 \times 2^7$

  D. $8^3 \times 81^4 \times 49^2$

Item Information	
Alignment	B-E.1.1.1
Answer Key	B
Depth of Knowledge	1
p-value A	6%
p-value B	89% (correct answer)
p-value C	3%
p-value D	2%
Option Annotations	A. uses 2 as the exponent of base 2 instead of 3 B. Correct: counts three 2s and rewrites $2 \times 2 \times 2$ as 2^3, counts four 3s and rewrites $3 \times 3 \times 3 \times 3$ as 3^4, and counts two 7s and rewrites 7×7 as 7^2 C. switches the bases and the exponents D. multiplies the bases while also including the exponents

8. Lynda builds a wooden box in the shape of a rectangular prism. The box has no cover. The box is 12 inches long, x inches wide, and 24 inches high. The expression below can be used to determine the surface area, in square inches, of the box.

$$48x + 12x + 2 \bullet 288$$

What is the coefficient of the term in the expression that represents the area of the bottom of the box?

A. 2

B. 12

C. 48

D. 288

Item Information	
Alignment	B-E.1.1.3 C-G.1
Answer Key	B
Depth of Knowledge	2
p-value A	18%
p-value B	33% (correct answer)
p-value C	26%
p-value D	23%
Option Annotations	A. identifies the smaller factor of the length-height product, which represents two faces of the prism B. Correct: identifies 12x as the term that represents the area of the bottom of the box since it is the only face that is not being doubled ("the top has no cover") and then identifies 12 as the coefficient of the variable x C. identifies the coefficient of the width-height product, which represents two faces of the prism D. identifies the larger factor of the length-height product, which represents two faces of the prism

9. An inequality is shown below.

$$x < 20$$

Which equation has a solution that satisfies the inequality?

A. $\frac{3}{4}x = 12$

B. $x = 3^3 - 7$

C. $21.2 = x - 12\frac{1}{2}$

D. $x = 2.2 \bullet 6 + 2^3$

Item Information	
Alignment	B-E.2.1
Answer Key	A
Depth of Knowledge	2
p-value A	47% (correct answer)
p-value B	24%
p-value C	15%
p-value D	14%
Option Annotations	A. Correct: multiplies both sides of the equation by the reciprocal of $\frac{3}{4}$ and determines that $x = 16$, which is less than 20 B. identifies an equation with a solution that is equal to 20 instead of less than 20 C. subtracts $12\frac{1}{2}$ from 21.2 instead of adding D. simplifies 2^3 as $2 \bullet 3$ and then adds the result to $2.2 \bullet 6$ $(13.2 + 6)$

10. A pizza was cut into equal slices. Ben ate 4 of the slices. The amount Ben ate was $\frac{2}{3}$ of the whole pizza. Which equation represents a way to find the total number of slices that were in the whole pizza?

A. $\frac{2}{3} \bullet x = 4$

B. $4 \bullet x = \frac{2}{3}$

C. $\frac{2}{3} + x = 4$

D. $x = 4 \bullet \frac{2}{3}$

Item Information	
Alignment	B-E.2.1.3
Answer Key	A
Depth of Knowledge	2
p-value A	39% (correct answer)
p-value B	19%
p-value C	11%
p-value D	31%
Option Annotations	A. Correct: recognizes that the total number of slices should be multiplied by $\frac{2}{3}$ to show that $\frac{2}{3}$ of a whole pizza is 4 slices
	B. multiplies *x* by 4 instead of by $\frac{2}{3}$
	C. uses addition instead of multiplication
	D. multiplies 4 by $\frac{2}{3}$ instead of *x* by $\frac{2}{3}$

11. Mr. Kusick unpacks full boxes of textbooks to get ready for the school year. Each full box contains the same number of textbooks. The table below shows the numbers of textbooks that Mr. Kusick unpacks from different numbers of boxes.

Textbooks in Boxes

Number of Boxes	Number of Textbooks
1	8
3	24
6	48
8	64

Which statement about this relation is true?

A. The number of boxes is the dependent variable because it is the first column in the table.

B. The number of boxes is the dependent variable because it is the smaller number in each row.

C. The number of textbooks is the dependent variable because each number of textbooks is a multiple of the number of boxes in the same row.

D. The number of textbooks is the dependent variable because it is determined by the number of boxes Mr. Kusick unpacks.

Item Information	
Alignment	B-E.3
Answer Key	D
Depth of Knowledge	2
p-value A	11%
p-value B	12%
p-value C	35%
p-value D	42% (correct answer)
Option Annotations	A. considers that the order of the columns determines which variable is the dependent variable B. considers the dependent variable to always be the smaller set of values C. considers the dependent variable to always be a multiple of the independent variable D. Correct: recognizes that the number of textbooks is the dependent variable because the number of textbooks that have been unpacked is determined by (i.e., is "dependent" upon) the number of boxes that have been unpacked

12. Lara runs 2 miles each day. She uses the equation shown below to help determine some information about her running.
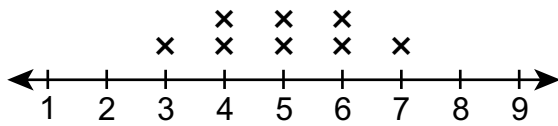
$$2x = y$$

What do the variables x and y **most likely** represent in Lara's equation?

A. The variable x represents the total number of miles Lara runs in y days.

B. The variable y represents the total number of miles Lara runs in x days.

C. The variable x represents Lara's rate, in miles per hour, and the variable y represents the total time, in hours, she runs each day.

D. The variable y represents Lara's rate, in miles per hour, and the variable x represents the total time, in hours, she runs each day.

Item Information	
Alignment	B-E.3.1
Answer Key	B
Depth of Knowledge	2
p-value A	28%
p-value B	45% (correct answer)
p-value C	19%
p-value D	8%
Option Annotations	A. switches the meanings of the variables B. Correct: recognizes that the total number of miles Lara runs is 2 times the number of days, so identifies x as the number of days since the x is being multiplied by 2 in the equation C. uses the equation $d = rt$ and describes it as $d = xy$ D. uses the equation $d = rt$ and describes it as $d = yx$

13. Which line plot shows a data distribution that has the same **range** and **interquartile range**?
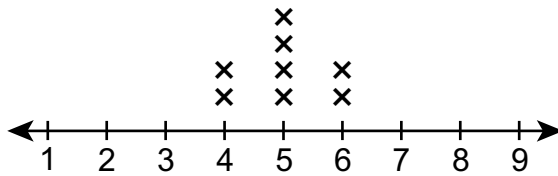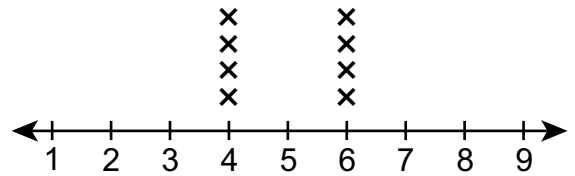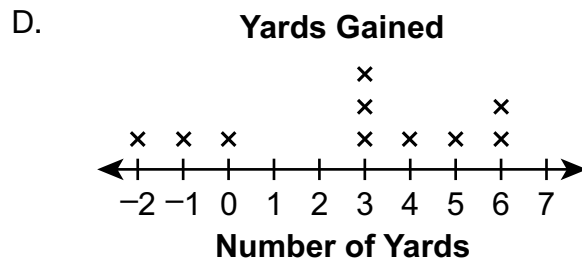
A.

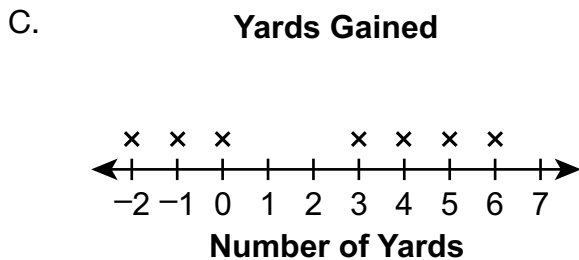| value	1	2	3	4	5	6	7	8	9
count			1	2	2	2	1		

B.

value	1	2	3	4	5	6	7	8	9
count		1	1	1	1	1	1	1	1

C.

value	1	2	3	4	5	6	7	8	9
count				2	3	2			

D.

value	1	2	3	4	5	6	7	8	9
count				4		4			

Item Information

Item Information	
Alignment	D-S.1
Answer Key	D
Depth of Knowledge	2
p-value A	24%
p-value B	20%
p-value C	22%
p-value D	34% (correct answer)
Option Annotations	A. considers that the range and interquartile range would be the same when a symmetric data set is somewhat spread out
	B. considers that the range and interquartile range would be the same when all the data points are unique
	C. considers that the range and interquartile range would be the same when a symmetric data set is clustered in the center
	D. Correct: recognizes that a data set that is distributed equally over only two unique values has the same range and interquartile range OR determines the range of the data set to be 2 by subtracting the minimum value from the maximum value (6 – 4) and determines the interquartile range to also be 2 by first identifying the first and third quartile values (the first quartile value is the average of the 2nd and 3rd smallest data points, $\frac{4 + 4}{2} = 4$; the third quartile value is the average of the 6th and 7th smallest data points, $\frac{6 + 6}{2} = 6$) and then subtracting the first quartile value from the third quartile value (6 – 4)

14. Carter is a quarterback for a football team. The list below shows the number of yards his team gained on his last 10 completed passes.

$$6 \quad 3 \quad 4 \quad -2 \quad -1 \quad 6 \quad 5 \quad 0 \quad 3 \quad 3$$

Which line plot also shows the number of yards Carter's team gained on his last 10 completed passes?

A.
Yards Gained

Number of Yards

B.
Yards Gained

Number of Yards

C.
Yards Gained

Number of Yards

D.
Yards Gained

Number of Yards

Item Information	
Alignment	D-S.1.1.1
Answer Key	D
Depth of Knowledge	2
p-value A	8%
p-value B	8%
p-value C	6%
p-value D	78% (correct answer)
Option Annotations	A. does not plot the negative values B. plots the negative values as positive values C. does not plot repeated values D. Correct: extends the number line below 0 to include the negative numbers and uses one × for each number, including three ×s for 3 and two ×s for 6

15. The line plot below shows the weights, in pounds, of twelve bowling balls on a rack.

**Bowling Balls on Rack**

Bowling Ball Weight (pounds)
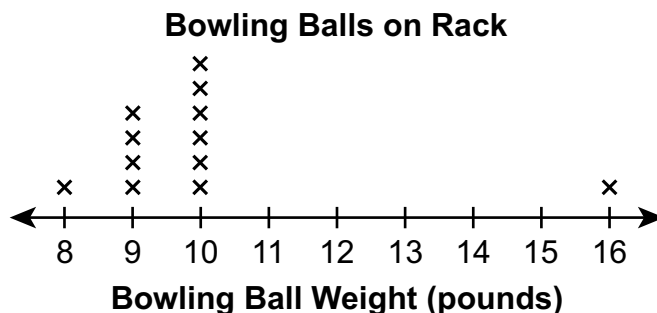
Which statement about the weights of these bowling balls is true?

A. The weights cluster from 8 pounds to 10 pounds, and 8 pounds is an outlier.

B. The weights cluster from 11 pounds to 15 pounds, and 8 pounds is an outlier.

C. The weights cluster from 8 pounds to 10 pounds, and 16 pounds is an outlier.

D. The weights cluster from 11 pounds to 15 pounds, and 16 pounds is an outlier.

Item Information	
Alignment	D-S.1.1.3
Answer Key	C
Depth of Knowledge	2
p-value A	15%
p-value B	5%
p-value C	73% (correct answer)
p-value D	7%
Option Annotations	A. concludes that 8 is an outlier since there is only one value at that weight
	B. confuses definitions of cluster and gap and concludes that 8 is an outlier since there is only one value at that weight
	C. Correct: identifies that 11 of the 12 data points are grouped (i.e., "clustered") together from 8 pounds to 10 pounds and identifies the 16-pound weight as an outlier since it is significantly greater than the other data values (i.e., it is more than 1.5 times the interquartile range above the third quartile value, since Q1 = 9, Q3 = 10, IQR = 10 − 9 = 1, 1.5 • 1 = 1.5, 9 + 1.5 = 10.5, and 16 > 10.5)
	D. confuses definitions of cluster and gap

OPEN-ENDED QUESTION

16. Devonte bought a kite that needs to be put together. When finished, the kite will look like the diagram shown below.
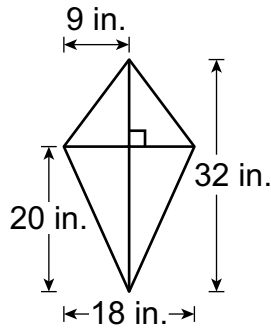
A. What is the area, in square inches, of the kite when it is put together?

The box that the kite came in is a rectangular prism with dimensions of $20\frac{1}{2}$ inches by $9\frac{1}{2}$ inches by 2 inches.

B. What is the surface area, in square inches, of the box? Show or explain all your work.

Go to the next page to finish question 16.

GO ON ⟩

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

Miriam bought a kite that is already put together. It is the same size as Devonte's kite. The box that Miriam's kite came in is a rectangular prism with dimensions of $32\frac{1}{2}$ inches by $18\frac{1}{2}$ inches by 1 inch. Miriam thinks that since both her kite and Devonte's kite are the same size, the volumes of the boxes they came in are the same.

C. Show or explain why Miriam is **not** correct. As part of your response, find the correct volume, in cubic inches, of each box.

Devonte's box: _____ cubic inches

Miriam's box: _____ cubic inches

After you have checked your work, close your answer booklet and test booklet so your teacher will know you are finished.

STOP

Item-Specific Scoring Guideline

#16 Item Information

Alignment	C-G.1.1.2 C-G.1.1.3 C-G.1.1.6	Depth of Knowledge	2	Mean Score	1.38

Assessment Anchor this item will be reported under:

M06.C-G.1—Solve real-world and mathematical problems involving area, surface area, and volume.

Specific Anchor Descriptor addressed by this item:

M06.C-G.1.1—Find area, surface area, and volume by applying formulas and using various strategies.

Item-Specific Scoring Guide

Score	In this item, the student . . .
4	Demonstrates a thorough understanding of solving real-world and mathematical problems involving area, surface area, and volume by correctly solving problems and clearly explaining procedures.
3	Demonstrates a general understanding of solving real-world and mathematical problems involving area, surface area, and volume by correctly solving problems and clearly explaining procedures with only minor errors or omissions.
2	Demonstrates a partial understanding of solving real-world and mathematical problems involving area, surface area, and volume by correctly performing a significant portion of the required task.
1	Demonstrates minimal understanding of solving real-world and mathematical problems involving area, surface area, and volume.
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. The 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 solving real-world and mathematical problems involving area, surface area, and volume.
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):

1 point for correct answer

What?	Why?
288 (square inches)	

Part B (1 point):

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

$\frac{1}{2}$ point for correct and complete support

What?	Why?
509.5 (square inches)	**Sample Work:** $$2\left(20\frac{1}{2} \bullet 9\frac{1}{2}\right) = 389\frac{1}{2}$$ $$2\left(20\frac{1}{2} \bullet 2\right) = 82$$ $$2\left(9\frac{1}{2} \bullet 2\right) = 38$$ $$389\frac{1}{2} + 82 + 38 = 509\frac{1}{2}$$ **OR** **Sample Explanation:** The area of one of the sides is $20\frac{1}{2}\left(9\frac{1}{2}\right) = 194\frac{3}{4}$. The area of one of the other sides is $20\frac{1}{2} \times 2 = 41$, and another side is $9\frac{1}{2} \times 2 = 19$. These 3 sides add up to $254\frac{3}{4}$, and this is half the surface area, so $254\frac{3}{4} \times 2$ is the entire surface area, which is $509\frac{1}{2}$ square inches. **OR equivalent**

Part C (2 points):

$\frac{1}{2}$ point for <u>each</u> correct answer

1 point for correct and complete support

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

What?	Why?
Devonte's box: 389.5 (cubic inches) Miriam's box: 601.25 (cubic inches)	**Sample Work:** $20.5 \times 9.5 \times 2 = 389.5$ cubic inches (Devonte) $32.5 \times 18.5 \times 1 = 601.25$ cubic inches (Miriam) **OR** **Sample Explanation:** The volume of the boxes depends on the dimensions of the box, not the contents in the box. One box will have more empty space around the materials that make up the kite. **OR equivalent**

STUDENT RESPONSE

Response Score: 4 points

PARTS A and B

Question 16
Page 1 of 2

Devonte bought a kite that needs to be put together. When finished, the kite will look like the diagram shown below.
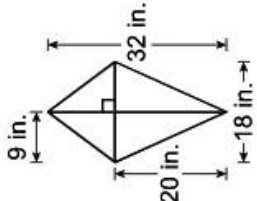
9 in.

32 in.

20 in.

←18 in.→

A. What is the area, in square inches, of the kite when it is put together?

$288\ in^2$

The student provided the correct answer ($288\ in^2$). While support is not required for Part A, the student likely found the areas of all four triangles, using the area of a triangle formula [$A = \frac{1}{2}bh$], then added the four areas together. [1 point]

$2\left(20\frac{1}{2} \times 2\right) = 82$ → 82

$2\left(9\frac{1}{2} \times 2\right) = 38$ → 38

$2\left(20\frac{1}{2}\ 9\frac{1}{2}\right) = 389\frac{1}{2}$ → $+ 389\frac{1}{2}$

$509\frac{1}{2}\ in^2$

The student provided the correct answer $\left(509\frac{1}{2}\ in^2\right)$ with correct and complete support. To find the surface area [$SA = 2lw + 2lh + 2wh$] of the whole box, the student multiplied [$2\left(20\frac{1}{2} \times 2\right) = 82$, AND $2\left(9\frac{1}{2} \times 2\right) = 38$, AND $2\left(20\frac{1}{2}\ 9\frac{1}{2}\right) = 389\frac{1}{2}$] and then added the 82, 38, and $389\frac{1}{2}$ to arrive at the correct answer of $509\frac{1}{2}\ in^2$. The missing multiplication sign in the work for Devonte's box is a blemish, and no deduction was taken. [1 point]

PART C

Question 16
Page 2 of 2

Devonte bought a kite that needs to be put together. When finished, the kite will look like the diagram shown below.

Miriam bought a kite that is already put together. It is the same size as Devonte's kite. The box that Miriam's kite came in is a rectangular prism with dimensions of $32\frac{1}{2}$ inches by $18\frac{1}{2}$ inches by 1 inch. Miriam thinks that since both her kite and Devonte's kite are the same size, the volumes of the boxes they came in are the same.

C. Show or explain why Miriam is **not** correct. As part of your response, find the correct volume, in cubic inches, of each box.

$D = 20\frac{1}{2} \times 9\frac{1}{2} \times 2 = 389\frac{1}{2}$

$M = 18\frac{1}{2}\ \ 32\frac{1}{2} \times 1 = 601\frac{1}{4}$

31 / 1000

Devonte's box: $389\frac{1}{2}$ cubic inches   Miriam's box: $601\frac{1}{4}$ cubic inches

The student provided the correct answer for each box's volume $\left(\text{Devonte's box: } 389\frac{1}{2} \text{ cubic inches,}\right.$ Miriam's box: $601\frac{1}{4}$ cubic inches$\left.\right)$. The student also provided correct and complete support for the work shown $\left(D = 20\frac{1}{2} \times 9\frac{1}{2} \times 2 = 389\frac{1}{2} \text{ AND } M = 18\frac{1}{2}\ 32\frac{1}{2} \times 1 = 601\frac{1}{4}\right)$. The missing multiplication sign in the work for Miriam's box is a blemish, and no deduction was taken. [2 points]

STUDENT RESPONSE

Response Score: 3 points

16. Devonte bought a kite that needs to be put together. When finished, the kite will look like the diagram shown below.
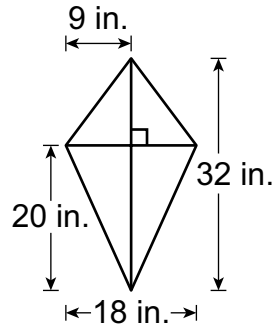
A. What is the area, in square inches, of the kite when it is put together?

$$\frac{1}{2}bh$$

$$\frac{1}{2}18 \times 12 = 108$$

$$\frac{1}{2}18 \times 20 = 180$$

$$\begin{array}{r}108\\180\\\hline 288\end{array}$$

$$\boxed{288\ in^2}$$

The student provided the correct answer (*288 in²*). The work shown is correct, though not necessary for credit. The student wrote out the formula for finding the area of a triangle $\left(\frac{1}{2}bh\right)$. The student then calculated the area of the top half of the kite, which is a triangle $\left(\frac{1}{2}\ 18 \times 12 = 108\right)$, with the base = 18 and the height = 12 (to find the height of the top triangle, take the full 32 in. height of the kite and subtract the 20 in. height of the bottom triangle). The student then calculated the area of the bottom half of the kite, also a triangle $\left(\frac{1}{2}\ 18 \times 20 = 180\right)$, with the base = 18 and the height = 20. The student then added these two areas together to calculate the total area of the kite (*108 + 180 = 288*). [1 point]

B. What is the surface area, in square inches, of the box? Show or explain all your work.

$$14,883\ in^2$$

$$82 + 389\frac{1}{2} + 38$$

The student provided an incorrect answer (*14,883 in²*) with incomplete support. The student had a correct expression $\left(82 + 389\frac{1}{2} + 38\right)$ that has the correct areas of the sides [82 is a result of multiplying $2\left(20\frac{1}{2} \times 2\right)$, $389\frac{1}{2}$ is the result of multiplying $2\left(20\frac{1}{2} \times 9\frac{1}{2}\right)$, and 38 is the result of multiplying $2\left(9\frac{1}{2} \times 2\right)$]. These are all of the pairs of sides of the box. However, no work or explanation was provided for calculating these areas of the sides of the box. Complete and correct work or explanation is required for full credit of $\frac{1}{2}$ point for the support. [0 points]

Go to the next page to finish question 16.

GO ON ▷

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

Miriam bought a kite that is already put together. It is the same size as Devonte's kite. The box that Miriam's kite came in is a rectangular prism with dimensions of $32\frac{1}{2}$ inches by $18\frac{1}{2}$ inches by 1 inch. Miriam thinks that since both her kite and Devonte's kite are the same size, the volumes of the boxes they came in are the same.

C. Show or explain why Miriam is **not** correct. As part of your response, find the correct volume, in cubic inches, of each box.

Miriam is not correct because
Devonte's box has a different. Devonte's
size
volume is 389½ and Miriam is
volume is 601¼

The student provided the correct answer for each box's volume $\left(\text{Devonte's box: } 389\frac{1}{2} \text{ cubic inches, Miriam's box: } 601\frac{1}{4} \text{ cubic inches}\right)$. The student also provided correct and complete support in the explanation (*Miriam is not correct because Devonte's box has a different size*). [2 points]

Devonte's box: 389 ½ cubic inches

Miriam's box: 601 ¼ cubic inches

After you have checked your work, close your answer booklet and test booklet so your teacher will know you are finished.

STOP
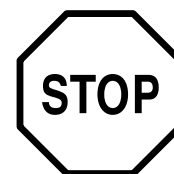
STUDENT RESPONSE

Response Score: 2 points
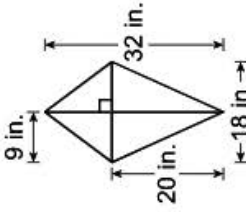
PARTS A and B

Question 16
Page 1 of 2

Devonte bought a kite that needs to be put together. When finished, the kite will look like the diagram shown below.

32 in.
9 in.
20 in.
18 in.

A. What is the area, in square inches, of the kite when it is put together?

576 square inches

The student provided an incorrect answer (*576 square inches*). No support (work or explanation) is required, so it is unclear where an error was made. The student may have calculated the area by multiplying the height (32) by the width (18) but did not divide by two. [0 points]

by 2 inches.

B. What is the surface area, in square inches, of the box? Show or explain all your work.

194 because if you are doing the surface it would be $20\frac{1}{2}$ and $9\frac{1}{2}$ timed togther.

The student provided an incorrect answer (*194*) with incomplete and incorrect support. The student provided an incomplete explanation (*it would be $20\frac{1}{2}$ and $9\frac{1}{2}$ timed together*). This explanation explains how to find only one of the six sides of the box. Additionally, $20\frac{1}{2} \times 9\frac{1}{2}$ does not equal 194; the student truncated the answer of $194\frac{3}{4}$ to 194. All six sides must be calculated and added together to get the surface area of the box. [0 points]

PART C

Question 16
Page 2 of 2

Devonte bought a kite that needs to be put together. When finished, the kite will look like the diagram shown below.

32 in.

9 in.

18 in.

20 in.

Miriam bought a kite that is already put together. It is the same size as Devonte's kite. The box that Miriam's kite came in is a rectangular prism with dimensions of $32\frac{1}{2}$ inches by $18\frac{1}{2}$ inches by 1 inch. Miriam thinks that since both her kite and Devonte's kite are the same size, the volumes of the boxes they came in are the same.

C. Show or explain why Miriam is **not** correct. As part of your response, find the correct volume, in cubic inches, of each box.

Miriam is not correct because the boxes are all diffrent lengths.

65 / 1000

Devonte's box: [$389\frac{1}{2}$] cubic inches   Miriam's box: [$601\frac{1}{4}$] cubic inches

The student provided the correct answer for each box's volume (Devonte's box: $389\frac{1}{2}$ cubic inches, Miriam's box: $601\frac{1}{4}$ cubic inches). The student also provided correct and complete support in the explanation (*Miriam is not correct because the boxes are all diffrent lengths*). [2 points]
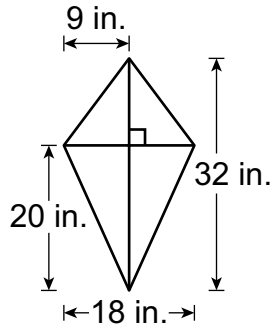
STUDENT RESPONSE

Response Score: 1 point

16. Devonte bought a kite that needs to be put together. When finished, the kite will look like the diagram shown below.

A. What is the area, in square inches, of the kite when it is put together?

$$32 \div 18 = 1.7 \text{ in.}$$

The student provided an incorrect answer (*1.7 in.*). The student divided the overall length by the overall width. [0 points]

The box that the kite came in is a rectangular prism with dimensions of $20\frac{1}{2}$ inches by $9\frac{1}{2}$ inches by 2 inches.

B. What is the surface area, in square inches, of the box? Show or explain all your work.

$$20\frac{1}{2} + 9\frac{1}{2} + 2 = \boxed{32} \quad \text{SA}$$

The student provided an incorrect answer (*32*) with incorrect support. The student added the three provided dimensions of the box $\left(20\frac{1}{2} + 9\frac{1}{2} + 2\right)$. All six sides must be calculated and added together to get the surface area of the box. [0 points]

Go to the next page to finish question 16.   GO ON

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

Miriam bought a kite that is already put together. It is the same size as Devonte's kite. The box that Miriam's kite came in is a rectangular prism with dimensions of $32\frac{1}{2}$ inches by $18\frac{1}{2}$ inches by 1 inch. Miriam thinks that since both her kite and Devonte's kite are the same size, the volumes of the boxes they came in are the same.

C. Show or explain why Miriam is **not** correct. As part of your response, find the correct volume, in cubic inches, of each box.

Miriam is not correct, because one of their
kites could weight more and have a different
volume even if they both have
the same area or size.

The student provided the correct answer for each box's volume (Devonte's box: $389\frac{2}{4}$ cubic inches, Miriam's box: $601\frac{1}{4}$ cubic inches) with incorrect support (*one of their kites could weight more and have a different volume*). A correct explanation would discuss the difference in the sizes or volumes of the boxes. [1 point]

Devonte's box: $389\frac{2}{4}$ cubic inches

Miriam's box: $601\frac{1}{4}$ cubic inches

After you have checked your work, close your answer booklet and test booklet so your teacher will know you are finished.

STOP
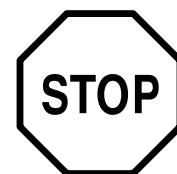
STUDENT RESPONSE

Response Score: 0 points

PARTS A and B

Question 16
Page 1 of 2

Item ID

Devonte bought a kite that needs to be put together. When finished, the kite will look like the diagram shown below.

9 in.

32 in

20 in.

18 in. →

A. What is the area, in square inches, of the kite when it is put together?

The area is
79 in

The student provided an incorrect answer (*79 in*). No support (work or explanation) is required, so it is unclear where an error was made. The student may have added the four given lengths from the diagram. [0 points]

The box that the kite came in is a rectangular prism with dimensions of $20\frac{1}{2}$ inches by $9\frac{1}{2}$ inches by 2 inches.

B. What is the surface area, in square inches, of the box? Show or explain all your work.

$9\frac{1}{2} \times 20\frac{1}{2} = 194\frac{3}{4}$ in.

The student provided an incorrect answer $\left(194\frac{3}{4}\ in.\right)$ with incomplete support. The student provided incomplete work $\left(9\frac{1}{2} \times 20\frac{1}{2}\right)$. This work shows how to find the surface area of only one of the six sides of the box. All six sides must be calculated and added together to get the surface area of the box. [0 points]

Review/End Test | Pause | Flag | Options | Next

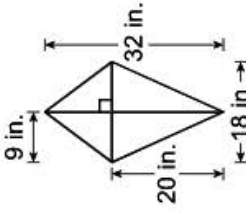# PART C

Devonte bought a kite that needs to be put together. When finished, the kite will look like the diagram shown below.

Miriam bought a kite that is already put together. It is the same size as Devonte's kite. The box that Miriam's kite came in is a rectangular prism with dimensions of $32\frac{1}{2}$ inches by $18\frac{1}{2}$ inches by 1 inch. Miriam thinks that since both her kite and Devonte's kite are the same size, the volumes of the boxes they came in are the same.

C. Show or explain why Miriam is **not** correct. As part of your response, find the correct volume, in cubic inches, of each box.

Miriam is not correct because she did not multiply.

51 / 1000

Devonte's box: [____] cubic inches   Miriam's box: [____] cubic inches

The student did not provide any answers for the volume in cubic inches of either box. The explanation provided (*because she did not multiply*) is incorrect. [0 points]

MATHEMATICS—SUMMARY DATA

Multiple-Choice

Sample Number	Alignment	Answer Key	Depth of Knowledge	*p*-value A	*p*-value B	*p*-value C	*p*-value D
1	A-N.2.1.1	D	1	25%	14%	13%	**48%**
2	A-R.1.1	C	2	12%	9%	**71%**	8%
3	A-R.1.1.1 B-E.2.1.3	B	2	10%	**58%**	22%	10%
4	A-R.1.1.2	B	2	17%	**54%**	18%	11%
5	A-R.1.1.5 C-G.1.1.1	C	2	13%	29%	**35%**	23%
6	B-E.1.1	A	1	**53%**	10%	20%	17%
7	B-E.1.1.1	B	1	6%	**89%**	3%	2%
8	B-E.1.1.3 C-G.1	B	2	18%	**33%**	26%	23%
9	B-E.2.1	A	2	**47%**	24%	15%	14%
10	B-E.2.1.3	A	2	**39%**	19%	11%	31%
11	B-E.3	D	2	11%	12%	35%	**42%**
12	B-E.3.1	B	2	28%	**45%**	19%	8%
13	D-S.1	D	2	24%	20%	22%	**34%**
14	D-S.1.1.1	D	2	8%	8%	6%	**78%**
15	D-S.1.1.3	C	2	15%	5%	**73%**	7%

Open-Ended

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
16	C-G.1.1.2 C-G.1.1.3 C-G.1.1.6	4	2	1.38

PSSA Grade 6 Mathematics
Item and Scoring Sampler