



**pennsylvania**  
DEPARTMENT OF EDUCATION

# The Pennsylvania System of School Assessment

## Mathematics Item and Scoring Sampler



**2021\***  
**Grade 6**

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\* This is a revised version of the 2017 Item and Scoring Sampler.

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## 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 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 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 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 items (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](http://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 (items) that have been written to be aligned with the Assessment Anchors, which are aligned to the 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.

Typically an item and scoring sampler is released every year to provide students and educators with a resource to assist in delivering focused instructional programs aligned to the PCS. However, due to the cancellation of standardized testing in 2019–2020, the 2021 Item and Scoring Sampler is a revised version of the previously released 2017 Item and Scoring Sampler. This revised version ensures that students and educators have an enhanced item and scoring sampler to use during instruction and/or preparation of students to take the PSSA Exam.

## **Purpose and Uses**

The items in this sampler may be used<sup>1</sup> 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. Classroom teachers may find it beneficial to have students respond to the open-ended (OE) 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 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 may be distributed to students for use during local assessments and may also be used by educators when scoring local assessments.<sup>1</sup>

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<sup>1</sup> 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.

<b>Mathematics Item Type</b>	<b>MC</b>	<b>OE</b>
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 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.

## 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).....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

## 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 alignment, the answer key, the depth of knowledge (DOK) level, the percentage<sup>2</sup> 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, 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**

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

**Example Open-Ended Item Information Table**

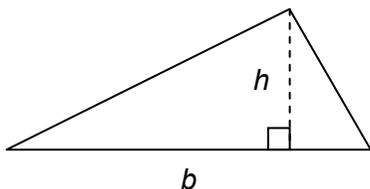
<b>Alignment</b>	Assigned AAEC	<b>Depth of Knowledge</b>	Assigned DOK	<b>Mean Score</b>	
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<sup>2</sup> All p-value percentages listed in the item information tables have been rounded.

Formulas that you may need on this test are found below.  
 You may refer back to this page at any time during the mathematics test.

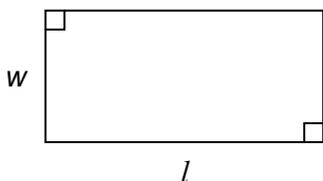
2021  
 Grade 6

**Triangle**



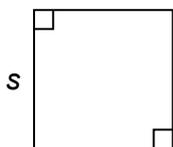
$$A = \frac{1}{2}bh$$

**Rectangle**



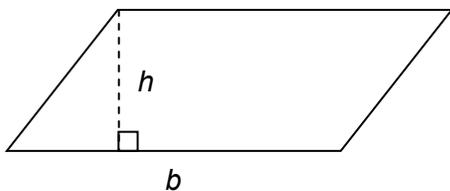
$$A = lw$$

**Square**



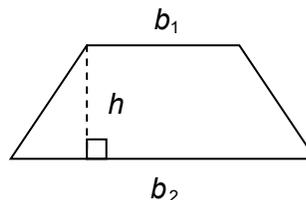
$$A = s^2$$

**Parallelogram**



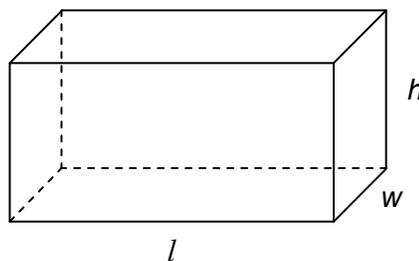
$$A = bh$$

**Trapezoid**



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

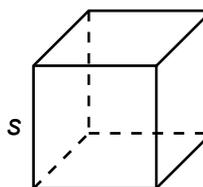
**Rectangular Prism**



$$V = lwh$$

$$SA = 2lw + 2lh + 2wh$$

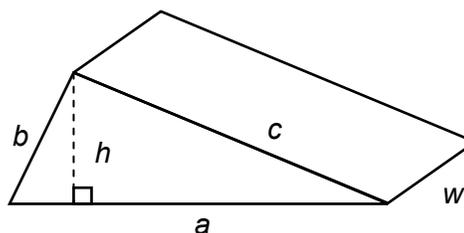
**Cube**



$$V = s \cdot s \cdot s$$

$$SA = 6s^2$$

**Triangular Prism**



$$SA = ah + aw + bw + cw$$

## 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:  $2(2.036) - 2.268$
- A. 1.768
  - B. 1.804
  - C. 2.216
  - D. 2.232

Item Information	
Alignment	A-N.2.1.1
Answer Key	B
Depth of Knowledge	1
p-value A	14%
p-value B	64% (correct answer)
p-value C	9%
p-value D	13%
Option Annotations	<p>A. multiplies the 2 by only the whole-number part of 2.036 to get 4.036</p> <p>B. Correct: multiplies the 2 by 2.036 to get 4.072 and then subtracts 2.268</p> <p>C. subtracts high digit minus low digit in <math>4.072 - 2.268</math></p> <p>D. multiplies the 2 by only the whole-number part of 2.036 to get 4.036, and subtracts high digit minus low digit in <math>4.036 - 2.268</math></p>

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

2. Grace has  $15\frac{3}{4}$  cups of plant food.
- She divides the plant food equally into 3 bags.
  - She uses all the plant food in 1 of the bags to feed her potted flowers.
  - She feeds each potted flower  $\frac{3}{4}$  cup of plant food.

How many potted flowers does Grace feed?

- A.  $4\frac{1}{2}$
- B. 5
- C.  $5\frac{1}{2}$
- D. 7

Item Information	
Alignment	A-N.1.1
Answer Key	D
Depth of Knowledge	2
p-value A	19%
p-value B	18%
p-value C	17%
p-value D	46% (correct answer)
Option Annotations	<p>A. divides <math>15\frac{3}{4}</math> by 3 to get <math>5\frac{1}{4}</math>, and then subtracts <math>\frac{3}{4}</math> from <math>5\frac{1}{4}</math></p> <p>B. subtracts <math>\frac{3}{4}</math> from <math>15\frac{3}{4}</math> to get 15, and then divides 15 by 3</p> <p>C. divides <math>15\frac{3}{4}</math> by 3 to get <math>5\frac{1}{4}</math>, retains the whole number (5), and then subtracts <math>\frac{1}{4}</math> from <math>\frac{3}{4}</math></p> <p>D. Correct: divides <math>15\frac{3}{4}</math> by 3 to get <math>5\frac{1}{4}</math>, and then divides <math>5\frac{1}{4}</math> by <math>\frac{3}{4}</math></p>

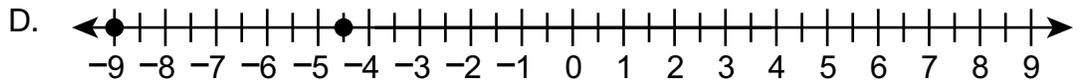
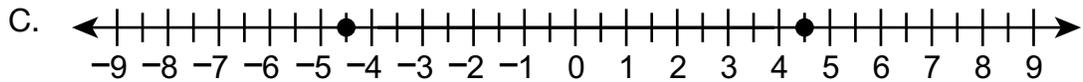
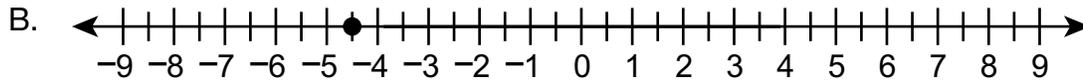
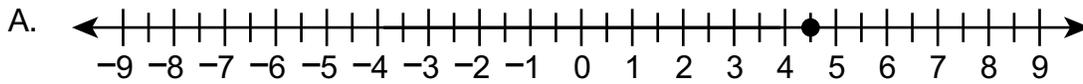
3. Ivan packed 56 apples and 72 pears into boxes. He packed both apples and pears into each box. He put the same number of apples into every box and the same number of pears into every box. He sold each box for \$19.95. What is the **greatest** amount of money Ivan could earn selling all the boxes of fruit?
- A. \$39.90
  - B. \$79.80
  - C. \$159.60
  - D. \$179.55

Item Information	
Alignment	A-N.2.2.1 A-N.2.1.1
Answer Key	C
Depth of Knowledge	2
p-value A	11%
p-value B	19%
p-value C	52% (correct answer)
p-value D	18%
Option Annotations	A. uses 2 as the GCF and multiplies \$19.95 by 2 B. uses 4 as the GCF and multiplies \$19.95 by 4 C. Correct: determines the common factors of 56 and 72 (1, 2, 4, 8), identifies 8 as the GCF, and multiplies 8 by \$19.95 D. factors 56 as $9 \times 6$ , uses 9 as the GCF, and multiplies \$19.95 by 9

4. Which statement about the opposite of a number is correct?
- A. The opposite of 5 is  $\frac{1}{5}$ .
  - B. The opposite of 0 is 0.
  - C. The opposite of  $-5$  is 0.
  - D. The opposite of  $-5$  is 1.

Item Information	
Alignment	A-N.3.1.2
Answer Key	B
Depth of Knowledge	1
p-value A	19%
p-value B	66% (correct answer)
p-value C	8%
p-value D	7%
Option Annotations	<p>A. knows <math>5 \cdot \frac{1}{5} = 1</math>, so thinks <math>\frac{1}{5}</math> is the opposite (i.e., confuses with the multiplicative inverse)</p> <p>B. Correct: recognizes 0 as its own opposite since <math>0(-1) = 0</math></p> <p>C. knows <math>-5(0) = 0</math>, so thinks 0 is the opposite (i.e., confuses with the multiplicative property of 0)</p> <p>D. knows <math>-5(1) = -5</math>, so thinks 1 is the opposite (i.e., confuses with the identity property of multiplication)</p>

5. Which number line shows a point graphed at **every** location that represents a number with an absolute value of 4.5?



Item Information	
Alignment	A-N.3.2.2
Answer Key	C
Depth of Knowledge	1
p-value A	31%
p-value B	7%
p-value C	58% (correct answer)
p-value D	4%
Option Annotations	<p>A. omits <math>-4.5</math></p> <p>B. omits <math>4.5</math> (may think absolute value is equivalent to “the opposite of”)</p> <p>C. Correct: identifies the two points that are each 4.5 units away from 0—one negative (to the left) and one positive (to the right)</p> <p>D. uses <math>-4.5</math>, but includes an additional 4.5 in the negative direction</p>

6. Elliot plants lettuce and onions in his garden. He always plants the same ratio of lettuce plants to onion plants, as shown in the table below.

Elliot's Plants

Lettuce Plants	Onion Plants
1	?
4	12
6	18
8	24

Based on the information in the table, how many onion plants would Elliot plant for 1 lettuce plant?

- A. 3
- B. 4
- C. 6
- D. 9

Item Information	
Alignment	A-R.1.1.3 A-R.1.1.2
Answer Key	A
Depth of Knowledge	2
p-value A	75% (correct answer)
p-value B	4%
p-value C	18%
p-value D	3%
Option Annotations	<p>A. Correct: identifies the ratio of lettuce plants to onion plants as 1:3 and applies this ratio by multiplying the number of lettuce plants (1) by 3 to determine the number of onion plants</p> <p>B. identifies the ratio of lettuce plants to onion plants as 1:3 but misapplies the ratio by adding 3 to the number of lettuce plants (1)</p> <p>C. starting from the bottom, uses “subtract 6” as the pattern in the onion column</p> <p>D. using the first two rows, solves <math>4 - \square = 1</math> to set up <math>12 - 3</math></p>

7. Which expression has the **least** value?

- A.  $4^1 + 12$
- B.  $4^3$
- C.  $25 - 4^2$
- D.  $4^4 - 160$

Item Information	
Alignment	B-E.1.1.1
Answer Key	C
Depth of Knowledge	1
p-value A	9%
p-value B	10%
p-value C	68% (correct answer)
p-value D	13%
Option Annotations	<p>A. selects the expression with the lowest-value exponent</p> <p>B. selects the expression with a single term</p> <p>C. Correct: applies the exponents to determine the value of each expression (<math>4 + 12 = 16</math>, <math>4 \cdot 4 \cdot 4 = 64</math>, <math>25 - 4 \cdot 4 = 9</math>, <math>4 \cdot 4 \cdot 4 \cdot 4 - 160 = 96</math>) and selects the expression with the least value</p> <p>D. selects the expression that shows the subtraction of the greatest number</p>

8. An algebraic expression is described below.

six more than the product of four times the difference between  $x$  and 3

What is the value of the expression when  $x = 8$ ?

- A. 14
- B. 26
- C. 35
- D. 50

Item Information	
Alignment	B-E.1.1.2 B-E.1.1.3 B-E.1.1.4
Answer Key	B
Depth of Knowledge	2
p-value A	13%
p-value B	61% (correct answer)
p-value C	18%
p-value D	8%
Option Annotations	<p>A. writes the expression as <math>6 + x \cdot (4 - 3)</math>, switching the <math>x</math> and the 4, and then substitutes 8 in for <math>x</math> to get <math>6 + 8 \cdot (4 - 3) = 6 + 8 \cdot 1 = 6 + 8 = 14</math></p> <p>B. Correct: writes the expression as <math>6 + 4 \cdot (x - 3)</math> and then substitutes 8 in for <math>x</math> to get <math>6 + 4 \cdot (8 - 3) = 6 + 4 \cdot 5 = 6 + 20 = 26</math></p> <p>C. writes the expression as <math>6 + 4 \cdot x - 3</math>, omitting the grouping symbols, and then substitutes 8 in for <math>x</math> to get <math>6 + 4 \cdot 8 - 3 = 6 + 32 - 3 = 38 - 3 = 35</math></p> <p>D. writes the expression as <math>6 + 4 \cdot (x - 3)</math>, substitutes 8 in for <math>x</math>, subtracts 3 from 8 first to get <math>6 + 4 \cdot 5</math>, but then adds 6 and 4 before multiplying by 5</p>

9. Marty read  $x$  books. Jackie read 28 books, which is 6 books more than the number of books Marty read. The equation below can be used to find the number of books Marty read.

$$x + 6 = 28$$

Ron read 3 times as many books as Marty. How many books did Ron read?

- A. 22
- B. 34
- C. 66
- D. 78

Item Information	
Alignment	B-E.2
Answer Key	C
Depth of Knowledge	2
p-value A	32%
p-value B	7%
p-value C	56% (correct answer)
p-value D	5%
Option Annotations	<p>A. subtracts 6 from both sides of the equation to get <math>x = 22</math>, which is the number of books Marty read</p> <p>B. attempts to solve for <math>x</math> by adding 6 to 28 to get <math>x = 34</math> and then does not multiply by 3</p> <p>C. Correct: subtracts 6 from both sides of the equation to get <math>x = 22</math> and then multiplies 22 by 3</p> <p>D. writes Ron's expression as <math>3 \times 28 - 6</math> (i.e., omits grouping symbols)</p>

10. A gray whale swims 161 kilometers in 24 hours. The equation below can be used to find the rate ( $r$ ), in kilometers per hour (kph), at which the gray whale swims.

$$r \times 24 = 161$$

Rounded to the nearest tenth, what is the rate at which the gray whale swims?

- A. 3.8 kph
- B. 3.9 kph
- C. 6.7 kph
- D. 6.8 kph

Item Information	
Alignment	B-E.2.1.3
Answer Key	C
Depth of Knowledge	2
p-value A	5%
p-value B	5%
p-value C	81% (correct answer)
p-value D	9%
Option Annotations	<ul style="list-style-type: none"> <li>A. multiplies 161 by 24 and moves the decimal</li> <li>B. multiplies 161 by 24, moves the decimal, and rounds up</li> <li>C. Correct: divides 161 by 24 to get 6.708333 . . . and rounds down</li> <li>D. correctly divides 161 by 24 but rounds up</li> </ul>

11. The table below shows the relationship between the number of tables and the number of chairs in each of three meeting rooms of an office building.

Number of Tables (t)	Number of Chairs (c)
3	24
5	40
9	72

Which equation describes the relationship between the number of tables and the number of chairs in each meeting room?

- A.  $c = 3t$
- B.  $c = 8t$
- C.  $c = 21t$
- D.  $c = 24t$

Item Information	
Alignment	B-E.3.1.1 B-E.3.1.2
Answer Key	B
Depth of Knowledge	2
p-value A	13%
p-value B	72% (correct answer)
p-value C	7%
p-value D	8%
Option Annotations	A. uses 3 from the first table pair B. Correct: determines that the number of chairs is always 8 times the number of tables C. uses $24 - 3$ from the first table pair D. uses 24 from the first table pair

12. A store is having a sale. All items are discounted 20% off the original price. Which table shows the relationship between the original price and the discount?

A. 20% Off Sale

Original Price	Discount
\$9.95	\$0.20
\$19.95	\$0.40
\$29.95	\$0.60
\$39.95	\$0.80

B. 20% Off Sale

Original Price	Discount
\$9.95	\$1.99
\$19.95	\$3.99
\$29.95	\$5.99
\$39.95	\$7.99

C. 20% Off Sale

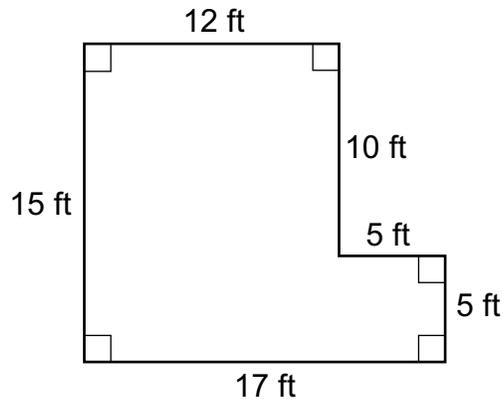
Original Price	Discount
\$29.50	\$0.59
\$32.00	\$0.64
\$38.75	\$0.78
\$42.50	\$0.85

D. 20% Off Sale

Original Price	Discount
\$29.50	\$2.75
\$32.00	\$3.00
\$38.75	\$3.65
\$42.50	\$4.05

Item Information	
Alignment	B-E.3.1.2 A-R.1.1.5
Answer Key	B
Depth of Knowledge	2
p-value A	16%
p-value B	60% (correct answer)
p-value C	9%
p-value D	15%
Option Annotations	A. equates 20% with 0.20 and uses a pattern of “add \$0.20” in the Discount column B. Correct: uses $20\% = 0.20$ and multiplies each value in the Original Price column by 0.20 C. multiplies by 0.02 D. moves the decimal to the left 1 place, subtracts 0.20, and rounds down to the nearest nickel (if necessary)

13. A figure is shown below.

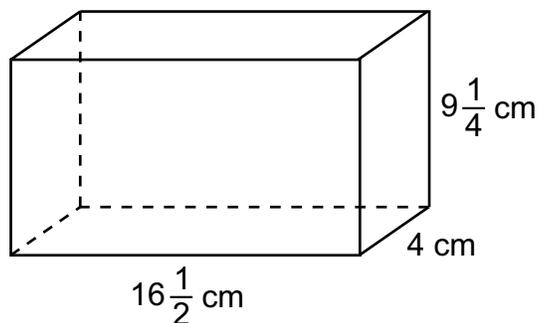


What is the area of the figure?

- A. 205 sq ft
- B. 230 sq ft
- C. 265 sq ft
- D. 280 sq ft

Item Information	
Alignment	C-G.1.1.2
Answer Key	A
Depth of Knowledge	2
p-value A	53% (correct answer)
p-value B	12%
p-value C	22%
p-value D	13%
Option Annotations	<p>A. Correct: separates the figure into a 15-by-12 rectangle and a 5-by-5 square, determines the partial areas to be <math>15 \cdot 12 = 180</math> and <math>5 \cdot 5 = 25</math>, and then adds the partial areas OR separates the figure into a 12-by-10 rectangle and a 17-by-5 rectangle, determines the partial areas to be <math>12 \cdot 10 = 120</math> and <math>17 \cdot 5 = 85</math>, and then adds the partial areas OR determines the area of the “greater” rectangle to be <math>15 \cdot 17 = 255</math> and then subtracts the area of the upper-right 10-by-5 rectangle</p> <p>B. determines the area of the 17-by-15 rectangle and subtracts <math>5 \times 5</math> (instead of subtracting <math>5 \times 10</math>)</p> <p>C. divides the figure into two rectangles with a horizontal line, but adds <math>17 \times 5</math> and <math>15 \times 12</math> (instead of adding <math>10 \times 12</math>)</p> <p>D. determines the area of the 17-by-15 rectangle and adds <math>5 \times 5</math> (instead of subtracting <math>5 \times 10</math>)</p>

14. A rectangular prism is pictured below.



What is the volume of the rectangular prism?

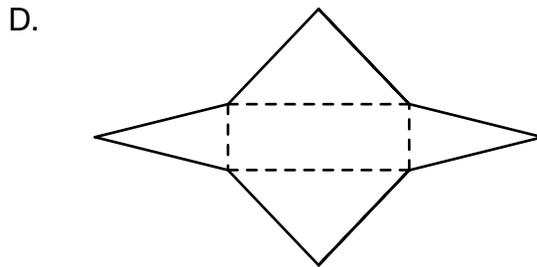
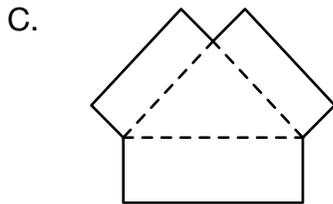
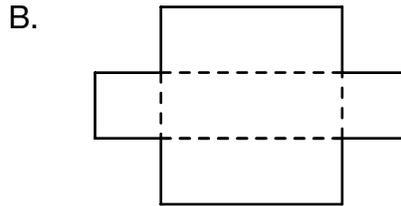
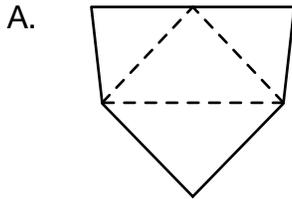
- A.  $89\frac{1}{4} \text{ cm}^3$
- B.  $203\frac{1}{2} \text{ cm}^3$
- C.  $576\frac{1}{8} \text{ cm}^3$
- D.  $610\frac{1}{2} \text{ cm}^3$

Item Information	
Alignment	C-G.1.1.3
Answer Key	D
Depth of Knowledge	1
p-value A	8%
p-value B	8%
p-value C	12%
p-value D	72% (correct answer)
Option Annotations	<p>A. adds edge lengths and then multiplies the sum by 3</p> <p>B. multiplies edge lengths and then divides the product by 3</p> <p>C. adds the product of whole numbers to the product of fractions</p> <p>D. Correct: uses the volume formula for a rectangular prism (<math>V = lwh</math>) to multiply <math>16\frac{1}{2}</math> by 4 by <math>9\frac{1}{4}</math></p>

15. A three-dimensional figure is pictured below.



Which net could form the three-dimensional figure when folded along the dashed line segments?



Item Information	
Alignment	C-G.1.1.5
Answer Key	D
Depth of Knowledge	2
p-value A	18%
p-value B	3%
p-value C	5%
p-value D	74% (correct answer)
Option Annotations	<p>A. selects a net with all triangular faces</p> <p>B. selects a net with a rectangular base, but the lateral faces are not triangular</p> <p>C. selects a net with rectangular and triangular faces but reverses the locations of rectangles and triangles</p> <p>D. Correct: identifies that the base is a rectangle and each lateral face is a triangle and selects a net composed of a rectangle surrounded by four triangles</p>

16. A band has an album with 9 songs on it. The lengths of the songs, in seconds, are listed below.

181 134 155 201 265 94 326 298 326

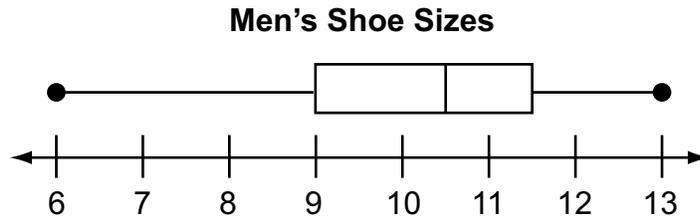
What is the **median** song length, in seconds, of the 9 songs on the band’s album?

- A. 201
- B. 220
- C. 265
- D. 326

Item Information	
Alignment	D-S.1.1.2
Answer Key	A
Depth of Knowledge	1
p-value A	71% (correct answer)
p-value B	6%
p-value C	18%
p-value D	5%
Option Annotations	<ul style="list-style-type: none"> <li>A. Correct: orders the list from least to greatest and identifies the middle value</li> <li>B. determines the mean of the data</li> <li>C. identifies the middle value in the unordered list</li> <li>D. determines the mode of the data</li> </ul>

## OPEN-ENDED QUESTION

17. Carlos surveyed 40 men about their shoe sizes. Carlos made the box-and-whisker plot below to display his results.



- A. What was the **median** shoe size of the 40 men Carlos surveyed? Explain how you found your answer.

Go to the next page to finish question 17.



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

Martin thinks more men have shoe sizes between 6 and 9 than between  $11\frac{1}{2}$  and 13 because the whisker from 6 to 9 is longer than the whisker from  $11\frac{1}{2}$  to 13.

- B.** Explain why Martin is **not** correct. As part of your explanation, find the number of men with shoe sizes in each interval and describe how you found those numbers.

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



## Item-Specific Scoring Guideline

### #17 Item Information

<b>Alignment</b>	D-S.1	<b>Depth of Knowledge</b>	2	<b>Mean Score</b>	1.05
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### Assessment Anchor this item will be reported under:

M06.D-S.1—Demonstrate understanding of statistical variability by summarizing and describing distributions.

### Specific Anchor Descriptor addressed by this item:

M06.D-S.1.1—Display, analyze, and summarize numerical data sets in relation to their context.

### Scoring Guide

Score	In this item, the student . . .
4	Demonstrates a thorough understanding of statistical variability by correctly solving problems and clearly explaining procedures.
3	Demonstrates a general understanding of statistical variability by correctly solving problems and clearly explaining procedures with only minor errors or omissions.
2	Demonstrates a partial understanding of statistical variability by correctly performing a significant portion of the required task.
1	Demonstrates minimal understanding of statistical variability.
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 statistical variability.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.

## Top-Scoring Response

### Part A (2 points):

1 point for correct answer

1 point for complete explanation

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

What?	Why?
(size) $10\frac{1}{2}$	<p><b>Sample Explanation:</b></p> <p>In a box-and-whisker plot, the line inside the box represents the median.</p>

### Part B (2 points):

1 point for correct answer

1 point for complete explanation

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

What?	Why?
10 (men)	<p><b>Sample Explanation:</b></p> <p>The first whisker represents the 1st quartile and the second whisker represents the 4th quartile. Each quartile represents <math>\frac{1}{4}</math> of the total number of men. Since there are 40 men surveyed, each quartile represents 10 men.</p>

STUDENT RESPONSE

Response Score: 4 points



PART A

Question 17  
Page 1 of 2

Item ID

?

←

↶

↷

↵

Line Guide

Calculator

Options

Carlos surveyed 40 men about their shoe sizes. Carlos made the box-and-whisker plot below to display his results.

**Men's Shoe Sizes**

**A.** What was the **median** shoe size of the 40 men Carlos surveyed? Explain how you found your answer.

The median shoe size for the 40 men Carlos surveyed is 10.5, because in a box-and-whisker plot you have a median, lower quartile, lower extreme, higher quartile, and higher extreme. The median is the very middle of the data. The lower and higher quartiles are always next to the median. These three terms are the box part. So the median is the center line inside the box.

Review/End Test

Pause

Flag

Options

Next

PART B

Question 17  
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Item ID

?



Calculator



Line Guide



Magnifying Glass



Eraser



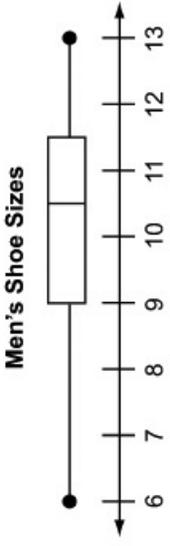
Pencil



Arrow

Carlos surveyed 40 men about their shoe sizes. Carlos made the box-and-whisker plot below to display his results.

**Men's Shoe Sizes**



Martin thinks more men have shoe sizes between 6 and 9 than between  $11\frac{1}{2}$  and 13 because the whisker from 6 to 9 is longer than the whisker from  $11\frac{1}{2}$  to 13.

**B.** Explain why Martin is **not** correct. As part of your explanation, find the number of men with shoe sizes in each interval and describe how you found those numbers.

Martin is not correct because a box-and-whisker plot is fit in 4 equal parts or 25%. So in each part there are 10 mans data.

The student has given the correct answer (in each part there are 10 mans data) and a complete explanation (Martin is not correct because a box-and-whisker plot is fit in 4 equal parts or 25%. So in each part there are 10 mans data). [2 points]

EQ

124 / 1000

Review/End Test

Pause

Flag

Options

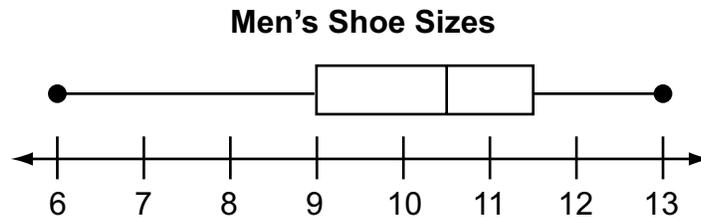
Back

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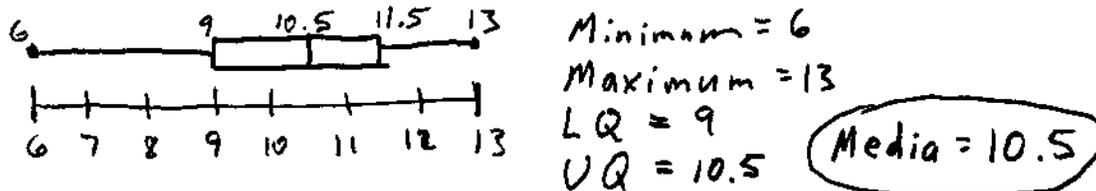
## STUDENT RESPONSE

## Response Score: 3 points

17. Carlos surveyed 40 men about their shoe sizes. Carlos made the box-and-whisker plot below to display his results.



- A. What was the **median** shoe size of the 40 men Carlos surveyed? Explain how you found your answer.



The median shoe size of the 40 men Carlos surveyed was 10.5. The dots at the ends of the line are the minimum and maximum, which are 6 and 13. The end lines of the box on the line are the lower quartile and the upper quartile, which are 9 and 11.5. Therefore, the middle line is the median. When I was looking for the median, I was looking for the middle line in the box. which was 10.5.

The student has given the correct answer (10.5) and a complete explanation (*When I was looking for the median, I was looking for the middle line in the box.*) [2 points]

Go to the next page to finish question 17.

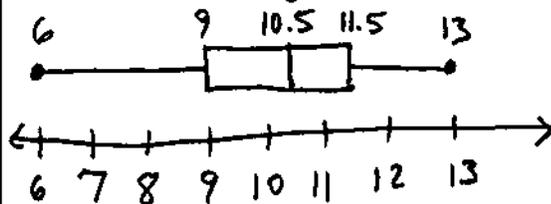


17. *Continued.* Please refer to the previous page for task explanation.

Martin thinks more men have shoe sizes between 6 and 9 than between  $11\frac{1}{2}$  and 13 because the whisker from 6 to 9 is longer than the whisker from  $11\frac{1}{2}$  to 13.

B. Explain why Martin is **not** correct. As part of your explanation, find the number of men with shoe sizes in each interval and describe how you found those numbers.

Martin's theory about that there are more men who have shoe sizes between 6 and 9 than between  $11\frac{1}{2}$  and 13 is incorrect. Just because the whisker is longer, does not mean there are more shoe sizes. The shoe sizes between  $11\frac{1}{2}$  and 13 are the same amount. This is because the 6 represents the minimum since it is the endpoint on the left side of the line, the left line of the box represents the lower quartile, which is 9. Therefore, the number of shoe sizes from 6 to 9 are 25% of the total amount of shoe sizes. From the maximum, 13, or the endpoint on the right side of the line to the upper quartile,  $11\frac{1}{2}$ , or the right line of the box, is also 25% of the total amount of shoe sizes because it is a quartile. The median of the middle line of the box is 10.5. The only reason why the whisker is longer from 6 to 9 than  $11\frac{1}{2}$  to 13, is because the range of 6 to 9 is bigger than the range of  $11\frac{1}{2}$  to 13.



Minimum = 6  
 Maximum = 13  
 LQ = 9  
 UQ = 11.5  
 Median = 10.5

The student has not given the answer of 10 men, but the explanation that each of the quartiles represents 25% is correct and complete.

[1 point]

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



STUDENT RESPONSE

Response Score: 2 points



PART A

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Item ID

Line Guide

Carlos surveyed 40 men about their shoe sizes. Carlos made the box-and-whisker plot below to display his results.

**Men's Shoe Sizes**

**A.** What was the **median** shoe size of the 40 men Carlos surveyed? Explain how you found your answer.

---

The median is 10.5 because in the plot the line in the box is at 10.5.

The student has given the correct answer (10.5) and a complete explanation (in the plot the line in the box is at 10.5). [2 points]

70 / 1000

Options

Flag

Pause

Review/End Test

PART B

Question 17  
Page 2 of 2

Item ID

?







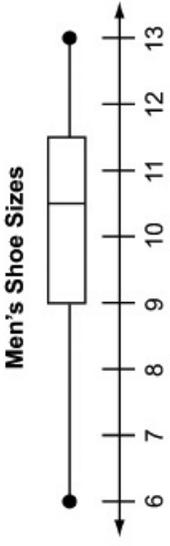






Carlos surveyed 40 men about their shoe sizes. Carlos made the box-and-whisker plot below to display his results.

**Men's Shoe Sizes**



Martin thinks more men have shoe sizes between 6 and 9 than between  $11\frac{1}{2}$  and 13 because the whisker from 6 to 9 is longer than the whisker from  $11\frac{1}{2}$  to 13.

**B.** Explain why Martin is **not** correct. As part of your explanation, find the number of men with shoe sizes in each interval and describe how you found those numbers.

EQ

Martin is not correct because the box doesn't start until after 9, and doesn't end until  $11\frac{1}{2}$ .

The student has not given the answer of 10 men, and the explanation provided (*because the box doesn't start until after 9, and doesn't end until  $11\frac{1}{2}$* ) is incorrect and does not explain that each quartile is 25% of the total number of men. [0 points]

93 / 1000

Review/End Test

Pause

Flag

Options

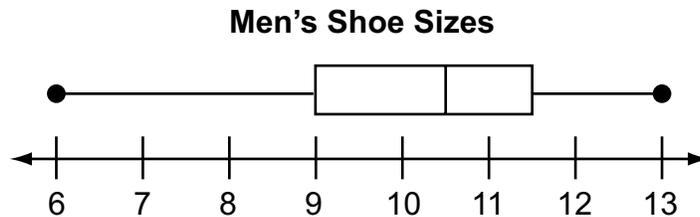
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## STUDENT RESPONSE

## Response Score: 1 point

17. Carlos surveyed 40 men about their shoe sizes. Carlos made the box-and-whisker plot below to display his results.



- A. What was the **median** shoe size of the 40 men Carlos surveyed? Explain how you found your answer.

~~9~~ ~~9½~~ 10 10½ ~~11~~ ~~11½~~

$10\frac{1}{2}$  is the median  
because If you put the numbers  
from least to greatest and check off  
left to right you will get the answer.

The student has given the correct answer ( $10\frac{1}{2}$ ) and an incorrect explanation that does not explain that the median in a box-and-whisker plot is the line inside the box. [1 point]

Go to the next page to finish question 17.



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

Martin thinks more men have shoe sizes between 6 and 9 than between  $11\frac{1}{2}$  and 13 because the whisker from 6 to 9 is longer than the whisker from  $11\frac{1}{2}$  to 13.

- B. Explain why Martin is **not** correct. As part of your explanation, find the number of men with shoe sizes in each interval and describe how you found those numbers.

Martin is not correct because just because the whisker is longer doesn't mean that there are more shoe sizes. There could be only 5 people who have shoe sizes from 6-9 and 35 men with shoe sizes from  $11\frac{1}{2}$  to 13. Only one person for each shoe size 6-9 and 3 or 4 each for the  $11\frac{1}{2}$  to 13 shoe sizes.

The student has given an incorrect answer and an incorrect explanation. The student provides random numbers for each of the quartiles and does not explain that each quartile is 25% of the total number of men.  
[0 points]

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



STUDENT RESPONSE

Response Score: 0 points



PART A

Question 17  
Page 1 of 2

Item ID

Carlos surveyed 40 men about their shoe sizes. Carlos made the box-and-whisker plot below to display his results.

**Men's Shoe Sizes**

**A.** What was the **median** shoe size of the 40 men Carlos surveyed? Explain how you found your answer.

The median shoe size of the 40 men Carlos surveyed was 9.5. I found my answer by first counting how many shoe sizes there were, there were 8. So then I knew that I was going to have an uneven number. Next I placed my fingers on the page until I got down to the two numbers that were in the middle. With those two numbers I added 9 and 10 to get 19. Finally I divided 19 by 2 to get the median number of 9.5.

407 / 1000

The student has given an incorrect answer (9.5) and an incorrect explanation that does not explain that the median in a box-and-whisker plot is the line inside the box. [0 points]

Next

Review/End Test

Pause

Flag

Options

PART B

Question 17  
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Item ID

?







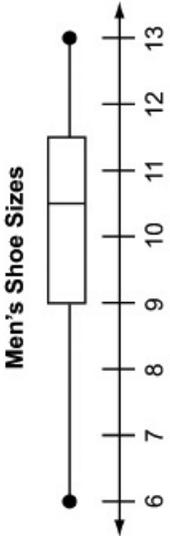






Carlos surveyed 40 men about their shoe sizes. Carlos made the box-and-whisker plot below to display his results.

**Men's Shoe Sizes**



Martin thinks more men have shoe sizes between 6 and 9 than between  $11\frac{1}{2}$  and 13 because the whisker from 6 to 9 is longer than the whisker from  $11\frac{1}{2}$  to 13.

**B.** Explain why Martin is **not** correct. As part of your explanation, find the number of men with shoe sizes in each interval and describe how you found those numbers.

Eq.

Martin is not correct for thinking that. He is not correct because every single number has the same amount of people with a shoe size. For example there are 8 intervals. So 8 shoe sizes goes into 40 people equally. When I say that I mean that every shoe size will have the same amount of people with that same shoe size. That is why Martin is not correct for thinking that.

The student has given an incorrect answer that shows a misunderstanding of intervals (every single number has the same amount of people with a shoe size. For example there are 8 intervals) and an incorrect explanation that does not explain that each quartile is 25% of the total number of men. There is insufficient evidence that the student understands how to correctly interpret a box-and-whisker plot. [0 points]

373 / 1000

Review/End Test

Pause

Flag

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**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	B	1	14%	64%	9%	13%
2	A-N.1.1	D	2	19%	18%	17%	46%
3	A-N.2.2.1 A-N.2.1.1	C	2	11%	19%	52%	18%
4	A-N.3.1.2	B	1	19%	66%	8%	7%
5	A-N.3.2.2	C	1	31%	7%	58%	4%
6	A-R.1.1.3 A-R.1.1.2	A	2	75%	4%	18%	3%
7	B-E.1.1.1	C	1	9%	10%	68%	13%
8	B-E.1.1.2 B-E.1.1.3 B-E.1.1.4	B	2	13%	61%	18%	8%
9	B-E.2	C	2	32%	7%	56%	5%
10	B-E.2.1.3	C	2	5%	5%	81%	9%
11	B-E.3.1.1 B-E.3.1.2	B	2	13%	72%	7%	8%
12	B-E.3.1.2 A-R.1.1.5	B	2	16%	60%	9%	15%
13	C-G.1.1.2	A	2	53%	12%	22%	13%
14	C-G.1.1.3	D	1	8%	8%	12%	72%
15	C-G.1.1.5	D	2	18%	3%	5%	74%
16	D-S.1.1.2	A	1	71%	6%	18%	5%

**Open-Ended**

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
17	D-S.1	4	2	1.05



## **PSSA Grade 6 Mathematics Item and Scoring Sampler**

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