The Pennsylvania System of School Assessment

Mathematics
Item and Scoring Sampler

2022–2023
Grade 7

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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 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 7.

- 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
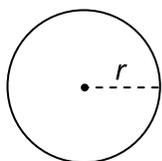
Grade 7 Formula Sheet

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.
You may use calculator π or the number 3.14 as an approximation of π.
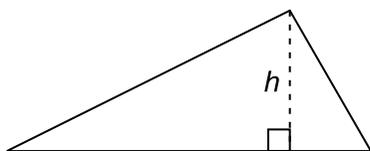
2022
Grade 7

Simple Interest

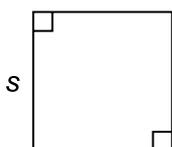$I = Prt$

Circle

$C = 2\pi r$ $A = \pi r^2$

Triangle

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

Square

$A = s^2$

Rectangle

$A = lw$ $P = 2l + 2w$

Parallelogram

$A = bh$
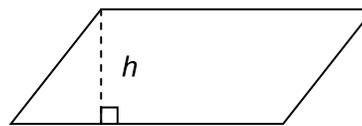
Trapezoid
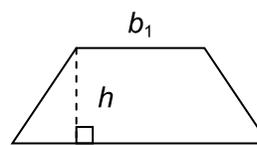
$A = \dfrac{1}{2}h(b_1 + b_2)$

Rectangular Prism
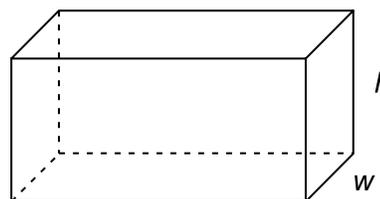
$V = lwh$ $SA = 2lw + 2lh + 2wh$

Polygonal Prism
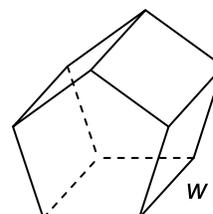
$V = Bw$, where B = area of the base
$SA = Pw + 2B$, where P = perimeter of base

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. Add: $7\frac{5}{6} + 4\frac{1}{3} + 1\frac{3}{5}$

A. $12\frac{3}{10}$

B. $12\frac{9}{14}$

C. $13\frac{23}{30}$

D. $13\frac{5}{6}$

Item Information	
Alignment	A-N.1.1.1
Answer Key	C
Depth of Knowledge	1
p-value A	7%
p-value B	35%
p-value C	49% (correct answer)
p-value D	9%

Item Information

Option Annotations	
	A. finds a correct common denominator but does not apply conversions to the numerators and simplifies $\frac{9}{30}$ to $\frac{3}{10}$

B. adds the whole parts (7 + 4 + 1), the numerators (5 + 1 + 3), and the denominators (6 + 3 + 5) separately

C. Correct: converts $7\frac{5}{6}$ to an improper fraction $\left(7\frac{5}{6} = \frac{7 \times 6 + 5}{6} = \frac{47}{6}\right)$, converts $4\frac{1}{3}$ to an improper fraction $\left(4\frac{1}{3} = \frac{4 \times 3 + 1}{3} = \frac{13}{3}\right)$, converts $1\frac{3}{5}$ to an improper fraction $\left(1\frac{3}{5} = \frac{1 \times 5 + 3}{5} = \frac{8}{5}\right)$; finds equivalent fractions using a common denominator of 30 $\left(\frac{47 \times 5}{6 \times 5} = \frac{235}{30}, \frac{13 \times 10}{3 \times 10} = \frac{130}{30}, \text{ and } \frac{8 \times 6}{5 \times 6} = \frac{48}{30}\right)$, adds the numerators (235 + 130 + 48 = 413), and then converts $\frac{413}{30}$ to a mixed number by dividing 413 by 30, using the quotient as the whole part and the remainder as the numerator OR finds equivalent fractions using a common denominator of 30 $\left(7\frac{5 \times 5}{6 \times 5} = 7\frac{25}{30}, 4\frac{1 \times 10}{3 \times 10} = 4\frac{10}{30}, \text{ and } 1\frac{3 \times 6}{5 \times 6} = 1\frac{18}{30}\right)$, adds the whole parts and the numerators separately (7 + 4 + 1 = 12, 25 + 10 + 18 = 53), and then simplifies $12\frac{53}{30}$ $\left(12\frac{53}{30} = 12 + \frac{30}{30} + \frac{23}{30} = 12 + 1 + \frac{23}{30} = 13\frac{23}{30}\right)$

D. uses 6 as the common denominator, correctly converts $\frac{1}{3}$ to $\frac{2}{6}$, but incorrectly converts $\frac{3}{5}$ to $\frac{4}{6}$ before correctly converting $12\frac{11}{6}$ to $13\frac{5}{6}$

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

2. Mandy is walking in the woods. She completes 70% of her walk in $3\frac{1}{2}$ hours. She continues walking at that same rate. How much time, in hours, will Mandy's entire walk take?

A. $3\frac{4}{5}$

B. 5

C. 6

D. $6\frac{1}{2}$

Item Information	
Alignment	A-R.1.1.1
Answer Key	B
Depth of Knowledge	2
p-value A	20%
p-value B	56% (correct answer)
p-value C	12%
p-value D	12%
Option Annotations	A. adds $\frac{3}{10}$ (for 30%) to $3\frac{1}{2}$ B. Correct: converts $3\frac{1}{2}$ to an improper fraction $\left(3\frac{1}{2} = \frac{3 \times 2 + 1}{2} = \frac{7}{2}\right)$, converts 70% to $\frac{7}{10}$, and then divides $\frac{7}{2}$ by $\frac{7}{10}$ by inverting $\frac{7}{10}$ and multiplying $\frac{7}{2}$ by $\frac{10}{7}$ to get $\frac{10}{2}$, which simplifies to 5 C. multiplies $\frac{7}{2}$ and $\frac{7}{10}$, rounds the answer to 2.5, and adds it to 3.5 D. adds 3 (for 30%) to $3\frac{1}{2}$

3. The table below shows the relationship between the amount of electricity used by a customer in different months and the cost shown on the customer's electric bill.

Monthly Electric Bills for a Customer

Month	Amount of Electricity Used (kilowatt-hours)	Cost of Electricity Used ($)
1	290	27.55
2	350	33.25
3	460	43.70
4	500	47.50

Based on the information shown in the table, which inequality could be used to determine all the numbers of kilowatt-hours (x) of electricity a customer could use in a month for the cost to be less than $65.00?

A. $0.095x < 65.00$

B. $0.095x > 65.00$

C. $0.92x < 65.00$

D. $0.92x > 65.00$

Item Information	
Alignment	A-R.1.1.3 B-E.2.2.2
Answer Key	A
Depth of Knowledge	2
p-value A	43% (correct answer)
p-value B	22%
p-value C	24%
p-value D	11%
Option Annotations	A. Correct: determines the rate by dividing the cost of electricity by the amount used for any given month (e.g., 33.25 ÷ 350 = 0.095), uses the rate (0.095) for the coefficient of x, and uses the "less than" symbol (<) for the comparison B. reverses the direction of the inequality C. divides the month 3 kilowatt-hours (460) by the month 4 kilowatt-hours (500) OR divides the month 3 cost ($43.70) by the month 4 cost ($47.50) D. divides the month 3 kilowatt-hours (460) by the month 4 kilowatt-hours (500) and reverses the direction of the inequality OR divides the month 3 cost ($43.70) by the month 4 cost ($47.50) and reverses the direction of the inequality

4. The table below shows the numbers of pages Lenny can read in certain amounts of time.

Lenny's Reading Rate

| Time (minutes)	Pages Read
60	108
90	162
135	243

Based on the table, which equation can be used to determine the number of pages (p) Lenny can read in t minutes?

A. $p = 1.5t$

B. $p = 1.8t$

C. $t = 1.5p$

D. $t = 1.8p$

Item Information

Alignment	A-R.1.1.4
Answer Key	B
Depth of Knowledge	2
p-value A	12%
p-value B	53% (correct answer)
p-value C	10%
p-value D	25%
Option Annotations	A. determines the rate either by dividing the second output by the first output ($162 \div 108 = 1.5$) OR by dividing the second input by the first input ($90 \div 60 = 1.5$)
	B. Correct: determines the rate by dividing the number of pages read by the time, in minutes, for any given row of the table (e.g., $162 \div 90 = 1.8$) and recognizes that the rate (1.8) should be multiplied by the amount of time (t), with the product being equal to the number of pages read (p)
	C. reverses t and p and determines the rate either by dividing the second output by the first output ($162 \div 108 = 1.5$) OR by dividing the second input by the first input ($90 \div 60 = 1.5$)
	D. reverses t and p

5. Erin completes an exercise program at a fitness center. The graph shown below represents the percentage of her exercise program (y) Erin has completed when she has exercised for x minutes.

Erin's Exercise Program
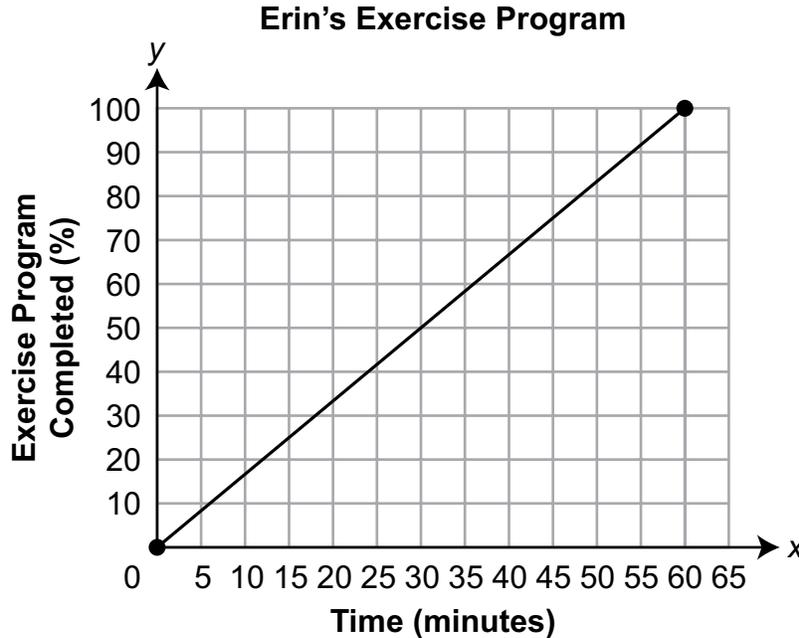
Based on the graph, what does the value of the y-coordinate represent when $x = 15$?

A. Erin has completed 9% of her exercise program.

B. Erin has completed 25% of her exercise program.

C. Erin has completed 9 minutes of her exercise program.

D. Erin has completed 25 minutes of her exercise program.

Item Information

Alignment	A-R.1.1.5
Answer Key	B
Depth of Knowledge	2
p-value A	10%
p-value B	70% (correct answer)
p-value C	9%
p-value D	11%
Option Annotations	A. identifies the *x*-coordinate when $y = 15$ but uses the units for the *y*-axis B. Correct: determines the rate by setting up and simplifying the fraction as "rise" over "run" $\left(\frac{100 - 0}{60 - 0} = \frac{100}{60} = \frac{5}{3}\right)$, multiplies the rate by 15 to determine the *y*-value $\left(\frac{5}{3} \bullet 15 = 25\right)$, and interprets the *y*-value as the percentage completed C. identifies the meaning of the *x*-coordinate when $y = 15$ D. identifies the correct *y*-value but pairs it with the units for the *x*-axis

6. A stone with a triangular face is used in a water fountain. Lennox made a scale drawing of the triangular face. He labels the vertices of his triangle as P, Q, and R. The sides of triangle PQR are described below.

- Side PQ is 12 inches long.

- Side QR is 25% longer than side PQ.

- Side PR is $\frac{2}{3}$ the length of side QR.

Each inch of Lennox's scale drawing represents $\frac{1}{2}$ foot of the actual triangular face. What is the perimeter, in feet, of the actual triangular face of the stone?

A. $8\frac{1}{2}$

B. $18\frac{1}{2}$

C. 34

D. 74

Item Information	
Alignment	A-R.1.1.6
	C-G.1.1.1
Answer Key	B
Depth of Knowledge	2
p-value A	21%
p-value B	44% (correct answer)
p-value C	20%
p-value D	15%

Item Information		
Option Annotations	A.	finds 25% of PQ rather than 125% of PQ
	B.	Correct: determines the length of side QR by multiplying the length of side PQ by 0.25 and then adding this to the length of side PQ $(0.25 \cdot 12 + 12 = 3 + 12 = 15$ inches), determines the length of side PR by multiplying the length of side QR by $\frac{2}{3}$ $\left(\frac{2}{3} \cdot 15 = 10 \text{ inches}\right)$, determines the perimeter of the scale drawing by adding the three side lengths $(12 + 15 + 10 = 37$ inches), and then converts the scale drawing perimeter to the actual perimeter by multiplying the scale drawing perimeter by $\frac{1}{2}$ and changing the units from inches to feet $\left(\frac{1}{2} \cdot 37 = 18\frac{1}{2} \text{ feet}\right)$ OR converts the length of PQ to the actual length by multiplying the length of PQ by $\frac{1}{2}$ and changing the units from inches to feet $\left(\frac{1}{2} \cdot 12 = 6 \text{ feet}\right)$, determines the actual length of side QR by multiplying the actual length of side PQ by 0.25 and then adding this to the actual length of side PQ $\left(0.25 \cdot 6 + 6 = 1\frac{1}{2} + 6 = 7\frac{1}{2} \text{ feet}\right)$, determines the actual length of side PR by multiplying the actual length of side QR by $\frac{2}{3}$ $\left(\frac{2}{3} \cdot 7\frac{1}{2} = 5 \text{ feet}\right)$, and then determines the perimeter by adding the three side lengths $\left(6 + 7\frac{1}{2} + 5 = 18\frac{1}{2} \text{ feet}\right)$
	C.	finds 25% of PQ and incorrectly applies the scale by dividing by $\frac{1}{2}$
	D.	incorrectly applies the scale by dividing by $\frac{1}{2}$ rather than multiplying by $\frac{1}{2}$

7. Which expression is equivalent to 24(807)?

A. 20(8) + 4(8) + 20(7) + 4(7)

B. 20(80) + 4(80) + 20(7) + 4(7)

C. 20(800) + 4(800) + 20(7) + 4(7)

D. 20(800) + 4(800) + 20(70) + 4(70)

Item Information	
Alignment	B-E.1.1
Answer Key	C
Depth of Knowledge	1
p-value A	8%
p-value B	13%
p-value C	71% (correct answer)
p-value D	8%
Option Annotations	A. uses the digits and not the place values B. uses 80 instead of 800 C. Correct: identifies 24 = 20 + 4, identifies 807 = 800 + 7, and then multiplies each term of 20 + 4 by each term of 800 + 7 before adding the products D. uses 70 instead of 7

8. Simplify: $x(2.25 + 1.25 + 0.75)$

    A. $2.25x + 1$

    B. $2.25x + 2$

    C. $3.25x$

    D. $4.25x$

Item Information	
Alignment	B-E.1.1.1
Answer Key	D
Depth of Knowledge	1
p-value A	4%
p-value B	9%
p-value C	4%
p-value D	83% (correct answer)
Option Annotations	A. does not distribute and adds 1.25 to 0.75 and gets 1 B. does not distribute C. does not carry when adding 0.75 + 1.25 D. Correct: adds the three values within the grouping symbols and then multiplies the sum by x OR distributes the x to each term within the grouping symbols and then combines like terms by adding the coefficients

9. A square pyramid is cut into two pieces with a single straight cut. The cut passes through the vertex of the pyramid and is perpendicular to the base. What shape is created by the cross section of the cut?

   A. an isosceles triangle

   B. a rectangle that is not a square

   C. a scalene right triangle

   D. a square

Item Information	
Alignment	C-G.1.1.4
Answer Key	A
Depth of Knowledge	2
p-value A	43% (correct answer)
p-value B	15%
p-value C	26%
p-value D	16%
Option Annotations	A. Correct: recognizes that the cut would pass through the base and either through two lateral faces or through two lateral edges of the pyramid, resulting in a triangle, recognizes that the cut through the two lateral faces (or through the two lateral edges) would result in equal side lengths and identifies a triangle with two equal sides as an isosceles triangle B. identifies the shape of the new base and not the cross section C. identifies the shape of the two triangular faces that were cut and not the cross section D. thinks about a cut parallel to the base and not perpendicular to the base

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10. The figure below shows three intersecting lines.
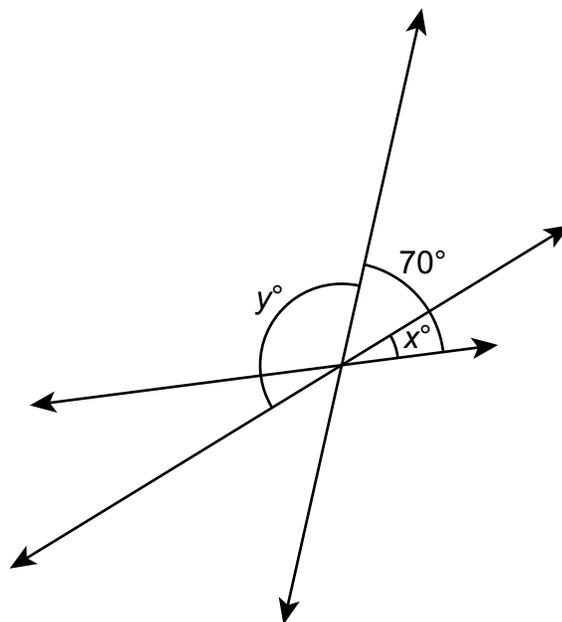

Which statement **best** describes all the possible measures for the angle labeled *y*°?

A. The measure of the angle is *x*°, and it is between 0° and 70°.

B. The measure of the angle is *x*°, and it is between 110° and 180°.

C. The measure of the angle is 110° + *x*°, and it is between 0° and 70°.

D. The measure of the angle is 110° + *x*°, and it is between 110° and 180°.

Item Information	
Alignment	C-G.2.1
Answer Key	D
Depth of Knowledge	2
p-value A	22%
p-value B	23%
p-value C	20%
p-value D	35% (correct answer)
Option Annotations	A. thinks the angles labeled $x°$ and $y°$ must be the same
	B. does not realize that the angle labeled $x°$ must be between 0° and 70°
	C. selects the correct expression but uses the inequality describing all possible values for x
	D. Correct: identifies that the lower portion of the angle labeled $y°$ has a measure of $x°$ since it is opposite the angle labeled $x°$, identifies that the upper portion of the angle labeled $y°$ has a measure of $y° - x°$, recognizes that the upper portion of the angle labeled $y°$ and the angle labeled 70° are supplementary and sets up the equation $70° + y° - x° = 180°$, determines the measure of the angle labeled $y°$ by solving the equation for $y°$ to get $110° + x°$, recognizes that the angle labeled $x°$ must be between 0° and 70° (since it is part of the angle labeled 70°), and uses this information to determine that the measure of the angle labeled $y°$ must be between 110° and 180° ($110° + 0° = 110°$, $110° + 70° = 180°$)

11. A rectangle is shown below.
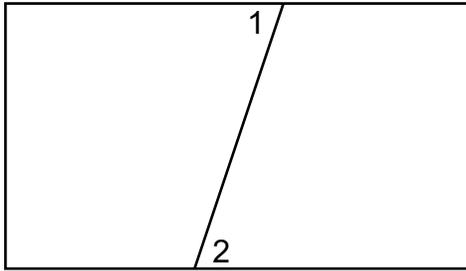
Which term describes the relationship between angle 1 and angle 2?

A.   alternate exterior angles

B.   corresponding angles

C.   alternate interior angles

D.   vertical angles

Item Information	
Alignment	C-G.2.1.2
Answer Key	C
Depth of Knowledge	1
p-value A	18%
p-value B	23%
p-value C	40% (correct answer)
p-value D	19%
Option Annotations	A. incorrectly identifies the pair of angles B. incorrectly identifies the pair of angles C. Correct: recognizes that opposite sides of a rectangle are parallel, identifies the slanted line segment as a transversal, identifies the two labeled angles as "alternate" since they appear on opposite sides (i.e., "alternate" sides) of the transversal, and identifies the two labeled angles as "interior" since they appear between the two parallel sides of the rectangle (i.e., they appear in the "interior" of the rectangle) D. incorrectly identifies the pair of angles

12. A design for a Do-Not-Disturb sign is made up of a rectangle with a circle cut out.
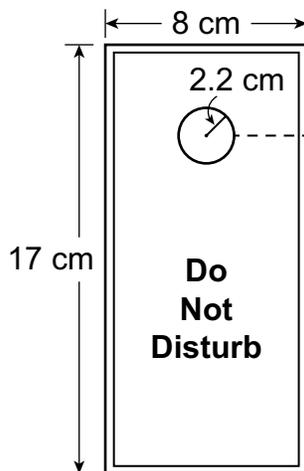
Paper is used to make the sign. Which measurement is **closest** to the area of the paper surface of the Do-Not-Disturb sign once the circle has been cut out?

A. 121 cm^2

B. 122 cm^2

C. 129 cm^2

D. 136 cm^2

Item Information	
Alignment	C-G.2.2
Answer Key	A
Depth of Knowledge	2
p-value A	38% (correct answer)
p-value B	14%
p-value C	14%
p-value D	34%
Option Annotations	A. Correct: determines the area of the rectangle by multiplying the side lengths ($17 \cdot 8 = 136 \text{ cm}^2$), determines the approximate area of the small circle by multiplying the square of the radius by π and rounding to the nearest whole number ($2.2^2 \cdot \pi \approx 15 \text{ cm}^2$), and then subtracts the approximate area of the circle from the area of the rectangle ($136 - 15 = 121 \text{ cm}^2$) B. subtracts the circumference of the circle from the area of the rectangle C. does not square the radius D. determines the area of the rectangle only

13. A town has a population of 7,500. The mayor asked two different employees to conduct a survey to determine whether residents of the town are in favor of the construction of a new baseball stadium.

- Denise surveyed 150 randomly selected residents at a recent baseball game.
- Tamira surveyed 150 randomly selected residents living in different sections of town.

The table below shows the results of the two surveys.

New Baseball Stadium

	In Favor	**Opposed**	**No Opinion**
Denise's Survey	125	20	5
Tamira's Survey	30	105	15

Which statement identifies the more reliable survey and provides a valid conclusion based on that survey?

A. Denise's survey is more reliable than Tamira's survey, and approximately 6,250 residents of the town would likely be in favor of the construction of a new baseball stadium.

B. Denise's survey is more reliable than Tamira's survey, and approximately 1,250 residents of the town would likely be opposed to the construction of a new baseball stadium.

C. Tamira's survey is more reliable than Denise's survey, and approximately 1,500 residents of the town would likely be in favor of the construction of a new baseball stadium.

D. Tamira's survey is more reliable than Denise's survey, and approximately 6,000 residents of the town would likely be opposed to the construction of a new baseball stadium.

Item Information	
Alignment	D-S.1.1.2
Answer Key	C
Depth of Knowledge	2
p-value A	26%
p-value B	21%
p-value C	33% (correct answer)
p-value D	20%
Option Annotations	A. selects the less reliable survey but makes a valid prediction based on that survey B. selects the less reliable survey and adds the "no opinion" to the opposed C. Correct: identifies Tamira's survey as the more reliable survey since Tamira collected data from people all across town and not just people who attend a baseball game, determines the percentage of people who would likely be in favor of a new stadium by dividing the number in favor by the total number of people surveyed (30 ÷ 150 = 0.2), and then multiplies the percentage by the population (0.2 • 7,500 = 1,500) D. selects the more reliable survey but adds the "no opinion" to the opposed

14. Mr. Eliaz randomly selects a student from his algebra class each day. Each student is equally likely to be selected. There is an equal number of male and female students in his class. On Monday, Tuesday, Wednesday, and Thursday of this week, the randomly selected student is a male student. Which statement **best** describes the probability Mr. Eliaz selects a male student on Friday?

    A. The probability Mr. Eliaz selects a male student on Friday is the same as it was on each of the other days.

    B. The probability Mr. Eliaz selects a male student on Friday is less than it was on other days because he has already selected a male student 4 days in a row.

    C. The probability Mr. Eliaz selects a male student on Friday is greater than it was on other days because he has already selected a male student 4 days in a row.

    D. The probability Mr. Eliaz selects a male student on Friday is impossible to determine without knowing how many students are in his class.

Item Information	
Alignment	D-S.3.2
Answer Key	A
Depth of Knowledge	2
p-value A	44% (correct answer)
p-value B	26%
p-value C	12%
p-value D	18%
Option Annotations	A. Correct: recognizes that the probability a male student is selected does not change from day to day since each student is equally likely to be selected on any given day B. considers that the previous results influence Friday's result C. considers that the previous results influence Friday's result D. considers that the actual numbers (rather than the ratio) are needed

15. A nursery sells tulip plants. Each plant has 1 tulip. The tulips come in 4 different colors. The tulip plants available at the nursery are listed below.

- 22 plants with a red tulip
- 30 plants with a pink tulip
- 28 plants with a yellow tulip
- 20 plants with a white tulip

Amy purchases one tulip plant at random. What is the probability that Amy's tulip plant has a tulip that is **not** pink?

A. $\dfrac{1}{4}$

B. $\dfrac{3}{10}$

C. $\dfrac{7}{10}$

D. $\dfrac{3}{4}$

Item Information	
Alignment	D-S.3.2.2
Answer Key	C
Depth of Knowledge	2
p-value A	16%
p-value B	21%
p-value C	49% (correct answer)
p-value D	14%
Option Annotations	A. finds the probability it will have pink flowers by noting that pink is 1 of 4 colors
	B. finds the probability it will have pink flowers
	C. Correct: determines the probability by writing a fraction with the total number of tulips that are not pink (70) as the numerator and the total number of tulips (100) as the denominator, and then simplifies the fraction OR first determines the probability the tulip is pink by writing a fraction using the number of tulips that are pink (30) as the numerator and the total number of tulips (100) as the denominator, simplifies the fraction $\left(\frac{3}{10}\right)$, and then determines the probability that the tulip is not pink by subtracting the probability the tulip is pink from 1
	D. reasons that there are 3 nonpink options out of a total of 4 options

16. The table below shows the number of each color of paper clip in a container.

Paper Clips in a Container

Color of Paper Clips	Number of Paper Clips
blue	13
green	4
white	8
yellow	10

A paper clip is randomly selected from the container three times and is replaced each time. What is the **approximate** probability of first selecting a blue paper clip and then 2 green paper clips?

A.   0.00397

B.   0.00485

C.   0.04245

D.   0.08571

Item Information

Item Information	
Alignment	D-S.3.2.3
Answer Key	B
Depth of Knowledge	2
p-value A	18%
p-value B	36% (correct answer)
p-value C	24%
p-value D	22%
Option Annotations	A. determines the probability without replacement B. Correct: determines the probability by multiplying the probability of selecting blue by the probability of selecting green twice $\left(\dfrac{13}{35} \cdot \dfrac{4}{35} \cdot \dfrac{4}{35}\right)$; the denominator does not change because the selected paper clip is replaced each time; since the order matters (first blue, then green twice), only one permutation of the probability is needed C. determines the probability of the first two events (1 blue, then 1 green) D. calculates $\dfrac{3}{35}$ because 3 paper clips are selected out of 35 paper clips

OPEN-ENDED QUESTION

17. Dustin earns $9.80 per hour at his job.

Last week Dustin worked *x* hours on Thursday and 6 hours on Saturday.

A. Write an expression that can be used to calculate Dustin's earnings on these two days.

Dustin's older brother Jeff earns 5% more per hour at his job than Dustin earns.

B. How much money, in dollars, does Jeff earn in an hour? Show or explain all your work.

Go to the next page to finish question 17.

GO ON ⟩

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

Laura earns 10% more per hour than Dustin. This week Dustin and Laura worked the same number of hours. Dustin earned $137.20. He calculated the amount Laura earned to be $152.44 because 137.20 ÷ 0.90 = 152.44.

C. Describe the error in Dustin's work. State the actual amount Laura earned this week as part of your description.

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

#17 Item Information

Alignment	B-E.2.1.1 B-E.2.2.1	Depth of Knowledge	2	Mean Score	1.30

Assessment Anchor this item will be reported under:

M07.B-E.2—Solve real-world and mathematical problems using numerical and algebraic expressions, equations, and inequalities.

Specific Anchor Descriptor addressed by this item:

M07.B-E.2.1—Solve multi-step real-world and mathematical problems posed with positive and negative rational numbers.

M07.B-E.2.2—Use variables to represent quantities in a real-world or mathematical problem and construct simple equations and inequalities to solve problems.

Scoring Guide

Score	In this item, the student . . .
4	Demonstrates a thorough understanding of how to solve real-world and mathematical problems using numerical and algebraic expressions, equations, and inequalities by correctly solving problems and clearly explaining procedures.
3	Demonstrates a general understanding of how to solve real-world and mathematical problems using numerical and algebraic expressions, equations, and inequalities by correctly solving problems and clearly explaining procedures with only minor errors or omissions.
2	Demonstrates a partial understanding of how to solve real-world and mathematical problems using numerical and algebraic expressions, equations, and inequalities by correctly performing a significant portion of the required task.
1	Demonstrates minimal understanding of how to solve real-world and mathematical problems using numerical and algebraic expressions, equations, and inequalities.
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 how to solve real-world and mathematical problems using numerical and algebraic expressions, equations, and inequalities.
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

OR $\frac{1}{2}$ point for a correct equation (e.g., an equation of equivalent correct expressions)

What?	Why?
$x(9.80) + 6(9.80)$ **OR** $(x + 6)9.80$ **OR equivalent**	

Part B (1 point):

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

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

What?	Why?
($)10.29	**Sample Work:** $9.80 \times 1.05 = 10.29$ **OR** **Sample Explanation:** Since 5% of 9.80 is 0.49, I added 9.80 and 0.49 and got $10.29. **OR equivalent**

Part C (2 points):

1 point for correct answer

1 point for correct description of the error

What?	Why?
$150.92	**Sample Description:** Dustin picked 152.44 because 137.20 is 90% of it. **OR** Dustin divided by 0.9. **OR equivalent**

STUDENT RESPONSE

Response Score: 4 points

PARTS A and B

Question 17
Page 1 of 2

Dustin earns $9.80 per hour at his job.

Last week Dustin worked x hours on Thursday and 6 hours on Saturday.

A. Write an expression that can be used to calculate Dustin's earnings on these two days.

(6+x)*9.80

> The student provided a correct expression [(6+x) • 9.80] that can be used to calculate Dustin's earnings on these two days. This is found by taking the 6 hours Dustin worked on Saturday and adding the x hours Dustin worked on Thursday to get 6 + x. This part of the expression is put in parentheses and then multiplied by Dustin's hourly pay rate of $9.80 per hour to get the final correct complete expression of (6 + x) • 9.80. [1 point]

Dustin's older brother Jeff earns 5% more per hour at his job than Dustin earns.

B. How much money, in dollars, does Jeff earn in an hour? Show or explain all your work.

9.80 * .05=.49
9.80+.49=10.29
$10.29

> The student provided the correct answer ($10.29) with correct and complete support. The work provided shows first multiplying Dustin's hourly wage by 5% (9.80 • .05 = .49) and then adding the .49 to the original hourly wage (9.80 + .49 = 10.29) to find how much Jeff earns in an hour. [1 point]

36 / 1000

PART C

Dustin earns $9.80 per hour at his job.

Laura earns 10% more per hour than Dustin. This week Dustin and Laura worked the same number of hours. Dustin earned $137.20. He calculated the amount Laura earned to be $152.44 because 137.20 ÷ 0.90 = 152.44.

C. Describe the error in Dustin's work. State the actual amount Laura earned this week as part of your description.

He used .90 and it has nothing to do with it.
also he divided. The real amount is $150.92.

The student provided the correct answer (*$150.92*) and a correct description of the error (*he divided*). While showing how to determine the answer is not required for Part C, the student likely multiplied $137.20 by 10% to get 13.72 and then added $13.72 to the original $137.20 to get $150.92. [2 points]

STUDENT RESPONSE

Response Score: 3 points

17. Dustin earns $9.80 per hour at his job.

Last week Dustin worked *x* hours on Thursday and 6 hours on Saturday.

A. Write an expression that can be used to calculate Dustin's earnings on these two days.

$$9.80 \cdot (6 + x)$$

> The student provided a correct expression [$9.80 \cdot (6 + x)$] that can be used to calculate Dustin's earnings on these two days. This is found by taking the 6 hours Dustin worked on Saturday and adding the *x* hours Dustin worked on Thursday to get $6 + x$. This part of the expression is put in parentheses and then multiplied by Dustin's hourly pay rate of $9.80 per hour to get the final correct complete expression of *9.80 • (6 + x)*.
> [1 point]

Dustin's older brother Jeff earns 5% more per hour at his job than Dustin earns.

B. How much money, in dollars, does Jeff earn in an hour? Show or explain all your work.

He gets paid $11.76 an hour.

$$9.80 + 1.96$$
$$11.76$$

$$0.05\overline{)9.80} = 1.96$$

> The student provided an incorrect answer (*$11.76 an hour*) with incorrect support. The work provided shows 9.80 divided by 0.05 (*5%*) to get 1.96. Additionally, this calculation is incorrect, as 9.80 ÷ 0.05 = 196, not 1.96. This is an incorrect first step, as 9.80 should be multiplied by 0.05 to find 5% of $9.80. The student then added the 1.96 to the 9.80 for an incorrect answer of 11.76. [0 points]

Go to the next page to finish question 17.

GO ON ⟩

17. _Continued._ Please refer to the previous page for task explanation.

Laura earns 10% more per hour than Dustin. This week Dustin and Laura worked the same number of hours. Dustin earned $137.20. He calculated the amount Laura earned to be $152.44 because 137.20 ÷ 0.90 = 152.44.

C. Describe the error in Dustin's work. State the actual amount Laura earned this week as part of your description.

He divided 137.20 ÷ 0.90 instead of multiplying 137.20 and the 10%, which gives you 13.72. I added 137.20 and 13.72 and got $150.92. So $150.92 is the amount Laura got paid.

> The student provided the correct answer ($150.92) and a correct description of the error (_He divided 137.20 ÷ 0.90 instead of multiplying 137.20 and the 10%_). [2 points]

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 17
Page 1 of 2

Dustin earns $9.80 per hour at his job.

Last week Dustin worked x hours on Thursday and 6 hours on Saturday.

A. Write an expression that can be used to calculate Dustin's earnings on these two days.

6+x*9.80

> The student provided an incorrect expression (6 + x • 9.80). Parentheses are needed around the 6 + x portion of the expression, as both values need to be multiplied by the 9.80 for a correct expression. In the expression provided, only the x-value would be multiplied by the 9.80, resulting in 9.80x + 6, an incorrect expression. [0 points]

Dustin's older brother Jeff earns 5% more per hour at his job than Dustin earns.

B. How much money, in dollars, does Jeff earn in an hour? Show or explain all your work.

9.80 * .05=.49

9.80+.49=10.29

Jeff earn $10.29 an hour.

> The student provided the correct answer (Jeff earns $10.29 an hour) with correct and complete support. The work provided shows first multiplying Dustin's hourly wage by 5% (9.80 • .05 = .49) and then adding the .49 to the original hourly wage (9.80 + .49 = 10.29) to find how much Jeff earns in an hour. [1 point]

87 / 1600

PART C

Question 17
Page 2 of 2

Dustin earns $9.80 per hour at his job.

Laura earns 10% more per hour than Dustin. This week Dustin and Laura worked the same number of hours. Dustin earned $137.20. He calculated the amount Laura earned to be $152.44 because $137.20 + 0.90 = 152.44$.

C. Describe the error in Dustin's work. State the actual amount Laura earned this week as part of your description.

Dustin should have found out how much Laura earned ($10.78) an multiplied it by how many hours they worked (14).

Laura earned $150.92

The student provided the correct answer (*Laura earned $150.92*) with an incorrect explanation. The student explained what Dustin should have done [*Dustin should have found out how much Laura earned ($10.78) an multiplied it by how many hours they worked (14)*]. The provided support does not describe the error (Dustin divided) and earns no credit. [1 point]

STUDENT RESPONSE

Response Score: 1 point

17. Dustin earns $9.80 per hour at his job.

Last week Dustin worked x hours on Thursday and 6 hours on Saturday.

A. Write an expression that can be used to calculate Dustin's earnings on these two days.

$$6x + 2 = 9.80$$

> The student provided an incorrect equation ($6x + 2 = 9.80$). The 6 and x must be multiplied by the 9.80 for a correct expression. [0 points]

Dustin's older brother Jeff earns 5% more per hour at his job than Dustin earns.

B. How much money, in dollars, does Jeff earn in an hour? Show or explain all your work.

Dustin = $9.80 per hour
Jeff = 5% more than Dustin

$9.80 × 5% = 0.49$

$$\begin{array}{r} 9.80 \\ + 0.49 \\ \hline 10.29 \end{array}$$

Jeff earns $10.29 in one hour

> The student provided the correct answer (*Jeff earns $10.29 in one hour*) with correct and complete support. The work provided shows first multiplying Dustin's hourly wage by 5% ($9.80 × 5\% = 0.49$) and then adding the 0.49 to the original hourly wage ($9.80 + 0.49 = 10.29$) to find how much Jeff earns in an hour. [1 point]

Go to the next page to finish question 17. | GO ON >

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

Laura earns 10% more per hour than Dustin. This week Dustin and Laura worked the same number of hours. Dustin earned $137.20. He calculated the amount Laura earned to be $152.44 because 137.20 ÷ 0.90 = 152.44.

C. Describe the error in Dustin's work. State the actual amount Laura earned this week as part of your description.

Dustin forgot to add the 10 Percent to his final answer, so the equation should of been

137.20 ÷ 0.90 = 152.44 + 10%.

Her actual amount would

be 152.54.

> The student provided an incorrect answer (*152.54*) with an incorrect explanation (*Dustin forgot to add the 10 Percent to his final answer, so the equation should of been 137.20 ÷ 0.90 = 152.44 + 10%*). The error Dustin made was that he divided, not that he forgot to add the 10% to his answer. [0 points]

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

Dustin earns $9.80 per hour at his job.

Last week Dustin worked x hours on Thursday and 6 hours on Saturday.

A. Write an expression that can be used to calculate Dustin's earnings on these two days.

6(9.80x)

> The student provided an incorrect expression [6(9.80x)]. The 6 and x must be added together and both multiplied by the 9.80 for a correct expression. [0 points]

Dustin's older brother Jeff earns 5% more per hour at his job than Dustin earns.

B. How much money, in dollars, does Jeff earn in an hour? Show or explain all your work.

Jeff earn $9.85 dollars at his his job. If you add 9.80 * 5% you will get $9.85.

> The student provided an incorrect answer ($9.85) with incorrect support. The student incorrectly represented the 5% as $0.05, or 5 cents, and added that amount to Dustin's hourly pay rate of $9.80 to get an answer of $9.85. [0 points]

PART C

Dustin earns $9.80 per hour at his job.

Laura earns 10% more per hour than Dustin. This week Dustin and Laura worked the same number of hours. Dustin earned $137.20. He calculated the amount Laura earned to be $152.44 because 137.20 + 0.90 = 152.44.

C. Describe the error in Dustin's work. State the actual amount Laura earned this week as part of your description.

Dustin did the math wrong. Laura earns 10% more per hour so that means she earns 0.98 more cents.
If Dustin earns $137.20 then that means Laura earned $138.18.

The student provided an incorrect answer (*$138.18*) with an incorrect explanation. The student claimed that Laura *earn[ed] 0.98 more cents* (10% of $9.80) per hour. However, as written, "0.98 more cents" would be less than one penny per hour. No support showing how to determine the answer is required, so it is unclear where an error was made. The student may have added $0.98 (10% of $9.80) to Dustin's earnings for the week ($137.20 + $0.98 = $138.18). [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.1.1.1	C	1	7%	35%	49%	9%
2	A-R.1.1.1	B	2	20%	56%	12%	12%
3	A-R.1.1.3 B-E.2.2.2	A	2	43%	22%	24%	11%
4	A-R.1.1.4	B	2	12%	53%	10%	25%
5	A-R.1.1.5	B	2	10%	70%	9%	11%
6	A-R.1.1.6 C-G.1.1.1	B	2	21%	44%	20%	15%
7	B-E.1.1	C	1	8%	13%	71%	8%
8	B-E.1.1.1	D	1	4%	9%	4%	83%
9	C-G.1.1.4	A	2	43%	15%	26%	16%
10	C-G.2.1	D	2	22%	23%	20%	35%
11	C-G.2.1.2	C	1	18%	23%	40%	19%
12	C-G.2.2	A	2	38%	14%	14%	34%
13	D-S.1.1.2	C	2	26%	21%	33%	20%
14	D-S.3.2	A	2	44%	26%	12%	18%
15	D-S.3.2.2	C	2	16%	21%	49%	14%
16	D-S.3.2.3	B	2	18%	36%	24%	22%

Open-Ended

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
17	B-E.2.1.1 B-E.2.2.1	4	2	1.30

PSSA Grade 7 Mathematics
Item and Scoring Sampler