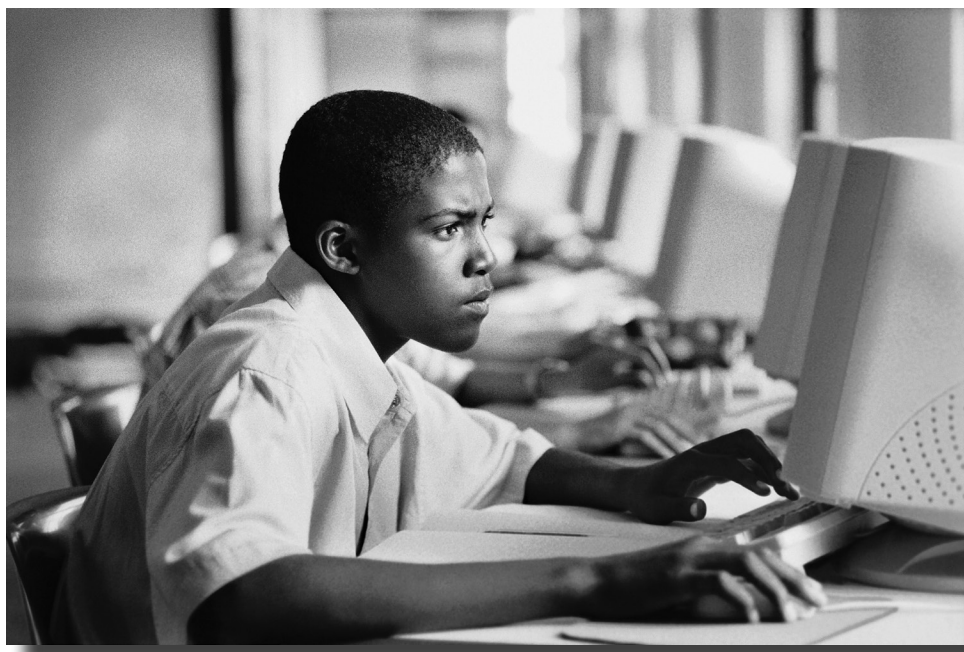




**pennsylvania**  
DEPARTMENT OF EDUCATION

# **The Pennsylvania System of School Assessment**

## **Mathematics Item and Scoring Sampler**



**2023–2024  
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](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, 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 (OE) 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<sup>1</sup> as examples for creating assessment items at the classroom level. Classroom teachers may find it beneficial to have students respond to the open-ended 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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<sup>1</sup> 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.

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

<sup>2</sup> 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

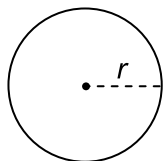
Formulas that you may need on this test are found below.  
 You may refer back to this page at any time during the mathematics test.  
 You may use calculator  $\pi$  or the number 3.14 as an approximation of  $\pi$ .

2023  
Grade 7

**Simple Interest**

$$I = Prt$$

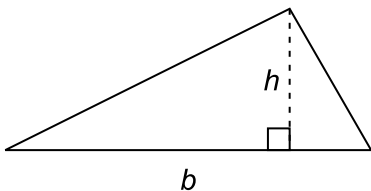
**Circle**



$$C = 2\pi r$$

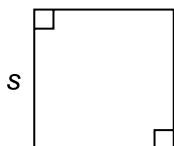
$$A = \pi r^2$$

**Triangle**



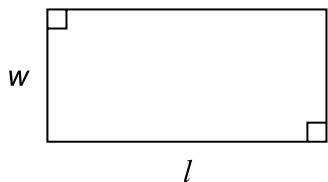
$$A = \frac{1}{2}bh$$

**Square**



$$A = s^2$$

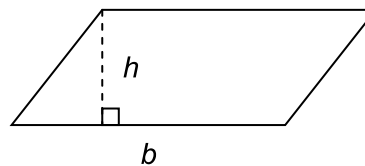
**Rectangle**



$$A = lw$$

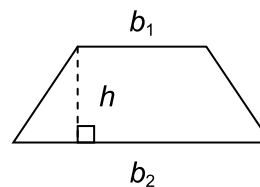
$$P = 2l + 2w$$

**Parallelogram**



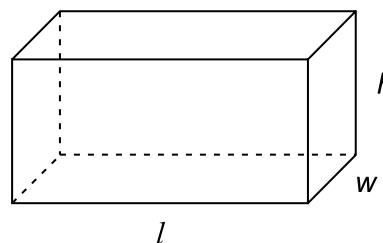
$$A = bh$$

**Trapezoid**



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

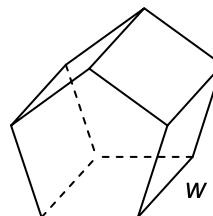
**Rectangular Prism**



$$V = lwh$$

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

**Polygonal Prism**



$$V = Bw, \text{ where } B = \text{area of the base}$$

$$SA = Pw + 2B, \text{ where } P = \text{perimeter of base}$$



**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. An expression is shown below.

$$^{-}0.31 \bullet 4.2 \div 2$$

What is the value of the expression?

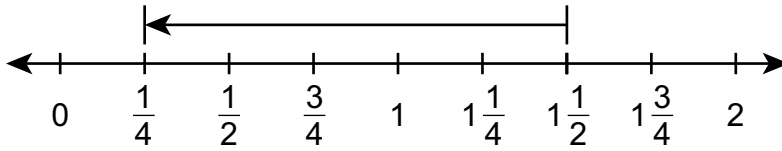
- A.  $^{-}0.651$
- B.  $^{-}0.093$
- C.  $0.093$
- D.  $0.651$

Item Information	
Alignment	A-N.1.1.3
Answer Key	A
Depth of Knowledge	1
p-value A	47% (correct answer)
p-value B	22%
p-value C	15%
p-value D	16%
Option Annotations	<p>A. Correct: first multiplies <math>-0.31</math> by <math>4.2</math> and then divides that product (<math>-1.302</math>) by <math>2</math></p> <p>B. does not align partial products of <math>62</math> and <math>1,240</math>, adding the partial products as <math>62 + 124 = 186</math>, and then divides <math>-0.186</math> by <math>2</math> to determine that the quotient is <math>-0.093</math></p> <p>C. does not align partial products of <math>62</math> and <math>1,240</math>, adding the partial products as <math>62 + 124 = 186</math>, divides <math>0.186</math> by <math>2</math> to determine that the quotient is <math>0.093</math>, and then reasons the quotient is positive since the sign of the “greatest” number is positive</p> <p>D. multiplies <math>-0.31</math> by <math>4.2</math>, then divides that product (<math>-1.302</math>) by <math>2</math>, but then reasons the quotient is positive since the sign of the “greatest” number is positive</p>

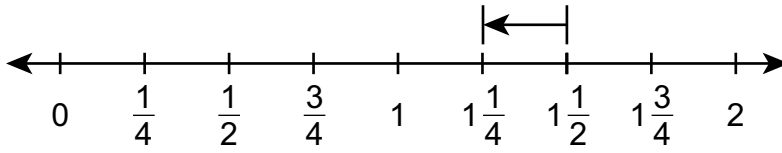
A calculator is permitted for use in solving questions 2–17 in this sampler.

2. Which number line models the expression  $1\frac{1}{2} - \frac{1}{4}$ ?

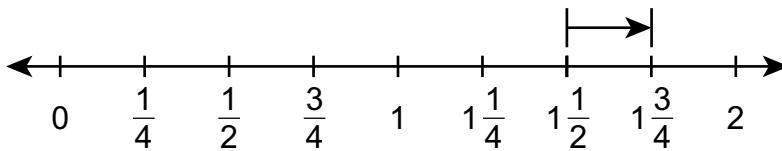
A.



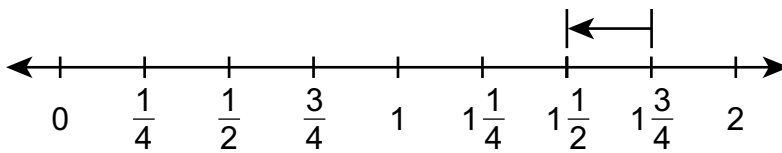
B.



C.



D.



Item Information	
Alignment	A-N.1.1.2
Answer Key	B
Depth of Knowledge	1
p-value A	30%
p-value B	61% (correct answer)
p-value C	5%
p-value D	4%
Option Annotations	<p>A. starts at <math>1\frac{1}{2}</math> and ends at <math>\frac{1}{4}</math> rather than moving <math>\frac{1}{4}</math> units to the left</p> <p>B. Correct: starts at <math>1\frac{1}{2}</math> and moves <math>\frac{1}{4}</math> units to the left to show subtracting <math>\frac{1}{4}</math> from <math>1\frac{1}{2}</math></p> <p>C. starts at <math>1\frac{1}{2}</math> and moves <math>\frac{1}{4}</math> units to the right rather than moving <math>\frac{1}{4}</math> units to the left</p> <p>D. adds the given fractions and then moves <math>\frac{1}{4}</math> units to the left to show subtraction</p>

3. Gerry is packing dishes into boxes to be shipped. It takes Gerry  $2\frac{3}{4}$  hours to pack  $4\frac{1}{2}$  boxes. At this rate, how many boxes of dishes can Gerry pack in 1 hour?
- A.  $\frac{11}{18}$
- B.  $1\frac{3}{4}$
- C.  $1\frac{7}{11}$
- D.  $2\frac{1}{4}$

Item Information	
Alignment	A-R.1.1.1
Answer Key	C
Depth of Knowledge	2
p-value A	24%
p-value B	21%
p-value C	36% (correct answer)
p-value D	19%
Option Annotations	<p>A. divides <math>2\frac{3}{4}</math> by <math>4\frac{1}{2}</math></p> <p>B. subtracts <math>2\frac{3}{4}</math> from <math>4\frac{1}{2}</math> rather than using division</p> <p>C. Correct: recognizes that division is needed to find the unit rate and divides the number of boxes <math>\left(4\frac{1}{2}\right)</math> by the number of hours <math>\left(2\frac{3}{4}\right)</math> by converting both mixed numbers to improper fractions <math>\left(4\frac{1}{2} = \frac{9}{2} \text{ and } 2\frac{3}{4} = \frac{11}{4}\right)</math>, inverting the divisor <math>\left(\frac{11}{4} \text{ becomes } \frac{4}{11}\right)</math> before multiplying <math>\left(\frac{9}{2} \cdot \frac{4}{11} = \frac{36}{22} = \frac{18}{11}\right)</math>, and then converting the quotient back to a mixed number <math>\left(\frac{18}{11} = 1\frac{7}{11}\right)</math></p> <p>D. subtracts <math>4 - 2</math> and <math>\frac{3}{4} - \frac{1}{2}</math></p>

4. One of the tables shown below represents a proportional relationship between  $x$  and  $y$ .

$x$	$y$
-4	-7
-1	-1
2	5
3	7

$x$	$y$
-4	-12
-2	-6
1	3
2	6

Based on the table that represents a proportional relationship between  $x$  and  $y$ , which statement about the relationship is true?

- A. The relationship in table Q is proportional because it can be described by the equation  $y = 2x$ .
- B. The relationship in table R is proportional because it can be described by the equation  $y = 3x$ .
- C. The relationship in table Q is proportional because it can be described by the equation  $y = x - 1$ .
- D. The relationship in table R is proportional because it can be described by the equation  $y = x - 2$ .



Item Information	
Alignment	A-R.1.1.2 A-R.1.1.4
Answer Key	B
Depth of Knowledge	2
p-value A	12%
p-value B	64% (correct answer)
p-value C	12%
p-value D	12%
Option Annotations	<p>A. finds the rate of change for table Q but does not consider the constant term (+ 1), writes the equation as <math>y = 2x</math> rather than as <math>y = 2x + 1</math>, and then considers the relationship in table Q to be proportional because the incorrect equation represents a proportional relationship</p> <p>B. Correct: recognizes the relationship in table R to be proportional since the ratio between each <math>y</math>-value and its corresponding <math>x</math>-value is consistent and then finds the equation that represents the relationship by using the unit rate between the <math>y</math>-values and the <math>x</math>-values (3) as the rate of change</p> <p>C. considers that table Q is proportional since the rate of change is consistent (i.e., thinks any linear relationship is proportional) and then sets up the equation as <math>y + 2 = x + 1</math> since the <math>y</math>-values increase by 2 as the <math>x</math>-values increase by 1 (i.e., confuses the rate of change as the constants)</p> <p>D. recognizes that table R is proportional but then sets up the equation as <math>y + 3 = x + 1</math> since the <math>y</math>-values increase by 3 as the <math>x</math>-values increase by 1 (i.e., confuses the rate of change as the constants)</p>

5. A restaurant buys the eggs it uses from a farmer.
- The cost to buy 50 dozen eggs from the farmer is \$109.50.
  - The restaurant buys 8 dozen eggs each day from the farmer.
  - The restaurant buys the eggs 7 days each week.

Which equation can be used to determine the total amount ( $y$ ), in dollars, the restaurant spends on the eggs it buys from the farmer for  $x$  weeks?

- A.  $y = 109.50x$
- B.  $y = 122.64x$
- C.  $y = 109.50x + 56$
- D.  $y = 122.64x + 56$

Item Information	
Alignment	A-R.1.1.4 A-R.1.1.3
Answer Key	B
Depth of Knowledge	2
p-value A	25%
p-value B	34% (correct answer)
p-value C	29%
p-value D	12%
Option Annotations	<p>A. does not consider that the restaurant buys 56 dozen eggs per week and uses \$109.50, the cost of 50 dozen eggs, as the rate of change</p> <p>B. Correct: determines the cost per dozen eggs by dividing the cost \$109.50 by 50 dozen eggs, determines the number of eggs bought per week by multiplying the 8 dozen eggs bought each day by 7 days, and then finds the rate of change by multiplying the 56 dozen eggs bought per week by the cost per dozen (\$2.19)</p> <p>C. does not consider that the restaurant buys 56 dozen eggs per week and uses \$109.50, the cost of 50 dozen eggs, as the rate of change and the product of 7 and 8 as the constant term of equation</p> <p>D. uses the product of 7 and 8 as the constant term of equation</p>

6. The set of ordered pairs below represents the relationship between the number of steps ( $x$ ) Mr. Davino takes and the distance ( $y$ ), in miles, he walks.

$$\{(528, 0.25), (1584, 0.75), (2640, 1.25), (3696, 1.75)\}$$

Based on the ordered pairs, which distance is **closest** to the distance Mr. Davino walks by taking 8,900 steps?

- A. 2.4 miles
- B. 2.8 miles
- C. 3.0 miles
- D. 4.2 miles

Item Information	
Alignment	A-R.1.1.6
Answer Key	D
Depth of Knowledge	2
p-value A	16%
p-value B	18%
p-value C	21%
p-value D	45% (correct answer)
Option Annotations	<p>A. divides 8,900 by 3,696</p> <p>B. calculates <math>8,900 \div (3,696 - 528)</math></p> <p>C. determines the factor of increase either from only the first <math>x</math>-value to the next <math>x</math>-value (<math>1584 \div 528</math>) OR from only the first <math>y</math>-value to the next <math>y</math>-value (<math>0.75 \div 0.25</math>)</p> <p>D. Correct: calculates the rate of change as 2,112 by using the ratio <math>\frac{x}{y}</math> (e.g., <math>\frac{3696}{1.75}</math>) and then divides 8,900 by 2,112</p>

7. Michael enrolls customers for a food delivery service. For each customer he enrolls, he earns \$20 plus 15% of the value of the customer’s first order. The expression below represents Michael’s earnings, in dollars, based on the value of a customer’s first order ( $x$ ).

$$20 + 0.15x$$

How would the expression change if Michael earned 10% of the value of each customer’s first order instead of 15% of the value?

- A. The 20 would decrease by 5.
- B. The 0.15 would change to 0.10.
- C. The entire expression would be multiplied by  $\frac{2}{3}$ .
- D. The entire expression would be multiplied by 0.10.

Item Information	
Alignment	B-E.1
Answer Key	B
Depth of Knowledge	2
p-value A	14%
p-value B	63% (correct answer)
p-value C	10%
p-value D	13%
Option Annotations	<p>A. decreases the fixed amount by 5 rather than decreasing the percentage</p> <p>B. Correct: recognizes that the 15% is represented by 0.15 in the original equation and changes 0.15 to 0.10 since 0.10 is the decimal equivalent of 10%</p> <p>C. considers that the whole expression should be multiplied by <math>\frac{10\%}{15\%} = \frac{0.10}{0.15} = \frac{2}{3}</math></p> <p>D. recognizes that 0.10 is the decimal equivalent of 10% but thinks the entire expression should be multiplied by 0.10, which would result in 10% of Michael’s total earnings rather than a change from 15% to 10% of the first order</p>

8. A rectangular prism has a length of  $x$  units, a width of  $y$  units, and a height of 3 units. The expression shown below represents the surface area, in square units, of the prism.

$$2(xy + 3x + 3y)$$

Which statement describes how to create an equivalent expression to represent the surface area, in square units, of the prism?

- A. Combine  $3x$  and  $3y$  because they are like terms.
- B. Apply the distributive property and multiply only the  $xy$  term by 2.
- C. Combine the three terms in the parentheses because they are all like terms.
- D. Apply the distributive property and multiply each of the three terms in the parentheses by 2.

Item Information	
Alignment	B-E.1.1
Answer Key	D
Depth of Knowledge	1
p-value A	14%
p-value B	17%
p-value C	16%
p-value D	53% (correct answer)
Option Annotations	<p>A. considers terms with the same coefficient (3) to be like terms</p> <p>B. recognizes that the distributive property can be used to create an equivalent expression but applies the distributive property to only the first term rather than to all three terms</p> <p>C. considers all three terms in the parentheses to be like terms because they all have at least one variable (an <math>x</math>, a <math>y</math>, or both an <math>x</math> and a <math>y</math>)</p> <p>D. Correct: recognizes that the distributive property can be used to create an equivalent expression and understands that each term in the parentheses (not just the first term) needs to be multiplied by the factor 2</p>

9. Ms. Carter makes shirts. She charges \$12 per shirt. She also charges \$70 per order regardless of the number of shirts ordered. Which equation could be used to calculate the total cost ( $c$ ), in dollars, of an order of  $n$  shirts?
- A.  $c = n + 82$
  - B.  $c = 12n + 70$
  - C.  $c = 840n$
  - D.  $c = \frac{n}{12} + 70$

Item Information	
Alignment	B-E.2.2
Answer Key	B
Depth of Knowledge	2
p-value A	12%
p-value B	70% (correct answer)
p-value C	8%
p-value D	10%
Option Annotations	<p>A. uses the sum <math>\\$12 + \\$70 = \\$82</math> as the initial fee</p> <p>B. Correct: recognizes that \$12 per shirt represents the rate of change, which is multiplied by the number of shirts (<math>n</math>), and recognizes that \$70 is the constant term since this initial fee is added to the total cost regardless of the number of shirts ordered</p> <p>C. uses the product <math>\\$12 \cdot \\$70 = \\$840</math> as the rate of change</p> <p>D. divides the number of shirts by \$12 rather than multiplying by \$12</p>

10. The equation shown below can be used to determine the total income ( $m$ ), in dollars, a salesperson makes in a month based on the total sales amount ( $s$ ), in dollars, the salesperson generates that month.

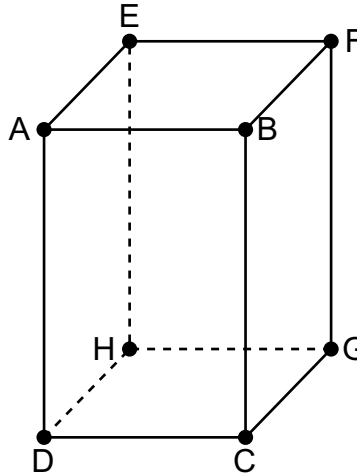
$$m = 4,250 + 0.06s$$

Last month, the salesperson generated a total of \$21,400 in sales. What was the salesperson's total income last month?

- A. \$1,284
- B. \$1,539
- C. \$5,534
- D. \$5,789

Item Information	
Alignment	B-E.2.2.1
Answer Key	C
Depth of Knowledge	2
p-value A	13%
p-value B	16%
p-value C	60% (correct answer)
p-value D	11%
Option Annotations	<p>A. multiplies 0.06 by 21,400 but does not add the constant term</p> <p>B. adds 4,250 to 21,400 before multiplying the sum (25,650) by 0.06</p> <p>C. Correct: recognizes that the total sales (\$21,400) should be multiplied by 0.06 before adding 4,250 to the product (\$1,284)</p> <p>D. adds 4,250 to 21,400 before multiplying the sum (25,650) by 0.06 and then adds 4,250 again</p>

11. Segments from 12 different lines form the rectangular prism shown below.



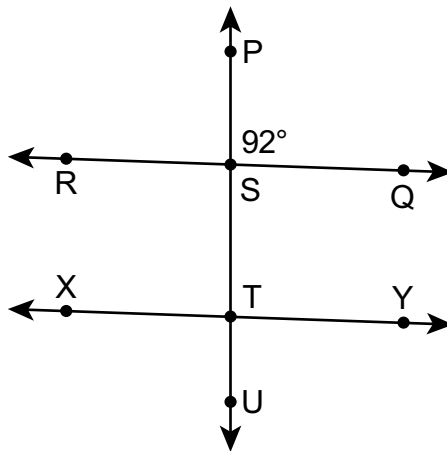
Which statement about the lines that form the rectangular prism is true?

- A. Line AB intersects line CG.
- B. Line CD intersects line EF.
- C. Line AD and line FG are not parallel, and they do not intersect.
- D. Line CD and line FG are not parallel, and they do not intersect.

Item Information	
Alignment	C-G.1.1
Answer Key	D
Depth of Knowledge	2
p-value A	13%
p-value B	11%
p-value C	21%
p-value D	55% (correct answer)
Option Annotations	<p>A. recognizes that lines AB and CG are not parallel but considers all nonparallel lines to be intersecting lines</p> <p>B. does not consider lines CD and EF to be on the same plane because they are not on the same face, concludes that they cannot be parallel, and considers all nonparallel lines to be intersecting lines</p> <p>C. does not consider lines AD and FG to be on the same plane because they are not on the same face and concludes that they cannot be parallel</p> <p>D. Correct: recognizes that lines CD and FG are not on the same plane, which means they are not parallel and do not intersect</p>



12. Two parallel lines are intersected by a third line as shown below.



Angle PSQ measures  $92^\circ$ . Which of the remaining angles formed by the three lines must also measure  $92^\circ$ ?

- A. only angle STY
- B. only angle STY and angle XTU
- C. only angle STY, angle XTU, and angle RST
- D. only angle STY, angle XTU, angle RST, and angle XTS

Item Information	
Alignment	C-G.2.1.2
Answer Key	C
Depth of Knowledge	1
p-value A	17%
p-value B	19%
p-value C	38% (correct answer)
p-value D	26%
Option Annotations	<p>A. considers the corresponding angle (angle STY) to be the only angle with the same measure as angle PSQ</p> <p>B. does not recognize that the vertical angle (angle RST) also has the same measure as angle PSQ</p> <p>C. Correct: identifies the corresponding angle (angle STY), the alternate exterior angle (angle XTU), and the vertical angle (angle RST) as the angles with the same measure as angle PSQ</p> <p>D. recognizes the three angles with the same measure as angle PSQ but also includes angle XTS even though angle XTS is supplementary to both angle STY and angle XTU</p>

13. A circle has a circumference of  $36\pi$  inches. What is the area, in square inches, of the circle?

- A.  $12\pi$
- B.  $72\pi$
- C.  $324\pi$
- D.  $1,296\pi$

Item Information	
Alignment	C-G.2.2.1
Answer Key	C
Depth of Knowledge	2
p-value A	19%
p-value B	27%
p-value C	39% (correct answer)
p-value D	15%
Option Annotations	<p>A. uses the area formula (<math>A = \pi r^2</math>) rather than the circumference formula (<math>C = 2\pi r</math>), substitutes <math>36\pi</math> in for <math>A</math> (<math>36\pi = \pi r^2</math>) to determine that <math>r = 6</math>, and then calculates the circumference using <math>C = 2\pi(6) = 12\pi</math> (i.e., determines the circumference of a circle with an area of <math>36\pi</math> square inches)</p> <p>B. thinks that the radius is 36 inches, substitutes <math>r = 36</math> into the circumference formula, and calculates <math>C = 2\pi(36) = 72\pi</math> (i.e., doubles the radius of 36 inches)</p> <p>C. Correct: uses the circumference formula to solve for <math>r</math> (<math>C = 2\pi r \rightarrow 36\pi = 2\pi r \rightarrow 18 = r</math>) and then finds the area using the area formula for a circle [<math>A = \pi r^2 = \pi(18)^2 = 324\pi</math>]</p> <p>D. uses <math>C = \pi r</math> as the circumference formula rather than <math>C = 2\pi r</math>, substitutes <math>36\pi</math> in for <math>C</math> (<math>36\pi = \pi r</math>) to determine that <math>r = 36</math>, and then calculates the area using <math>A = \pi(36)^2 = 1,296\pi</math></p>

14. A sample of 8 pitchers of skim milk and 8 pitchers of whole milk are in a refrigerator. The table below lists the amount of calcium, in milligrams, in each pitcher of milk.

**Amount of Calcium (milligrams)**

<b>Skim Milk</b>	853	854	856	857	865	886	904	916
<b>Whole Milk</b>	818	836	841	870	874	879	881	938

Based on the information shown in the table, which statement about the distribution of calcium in skim milk and the distribution of calcium in whole milk is true?

- A. Both distributions have exactly one mode.
- B. Both distributions have a median that is less than 870 milligrams.
- C. The range of the distribution of calcium in whole milk is almost twice the range of the distribution of calcium in skim milk.
- D. The range of the distribution of calcium in whole milk is 85 milligrams more than the range of the distribution of calcium in skim milk.

<b>Item Information</b>	
Alignment	D-S.2.1.1
Answer Key	C
Depth of Knowledge	2
p-value A	17%
p-value B	18%
p-value C	44% (correct answer)
p-value D	21%
Option Annotations	<p>A. does not recognize that neither distribution has a mode</p> <p>B. either does not recognize that the whole milk distribution has a median of 872 OR uses the median value of both distributions combined (867.5) rather than the median values of each distribution</p> <p>C. Correct: determines the range of each distribution by finding the difference between the maximum and minimum values (<math>916 - 853 = 63</math> and <math>938 - 818 = 120</math>) and then compares the two differences (<math>63 \cdot 2 = 126</math>, which is close to 120)</p> <p>D. subtracts the minimum value for the skim milk (853) from the maximum value for the whole milk (938) and considers this to be the difference between the range of each distribution</p>

15. A crate contains green, red, and yellow apples. Information about the number of apples of each color in the crate is listed below.
- green: 24
  - red: 15
  - yellow: ?

One apple is randomly selected from the crate. The probability of the apple being red is  $\frac{1}{3}$ . How many yellow apples are in the crate?

- A. 2
- B. 6
- C. 39
- D. 45

Item Information	
Alignment	D-S.3
Answer Key	B
Depth of Knowledge	2
p-value A	8%
p-value B	51% (correct answer)
p-value C	29%
p-value D	12%
Option Annotations	<p>A. uses the two known values to determine <math>\frac{15}{24 + 15} = \frac{15}{39} = \frac{5}{13}</math> but then uses <math>\frac{1}{3} = \frac{5}{15}</math> to set up the equation <math>\frac{5}{13 + ?} = \frac{5}{15}</math>, resulting in <math>? = 2</math> as the number of yellow apples</p> <p>B. Correct: calculates the total number of apples in the crate by solving the proportion <math>\frac{1}{3} = \frac{15}{x}</math>, determining that <math>x = 45</math>, and then determines the number of yellow apples by subtracting the number of green apples and the number of red apples from 45 (<math>45 - 24 - 15 = 6</math>)</p> <p>C. adds 24 and 15 (i.e., thinks the number of yellow apples is equal to the number of green apples and red apples combined)</p> <p>D. calculates the total number of apples in the crate by solving the proportion <math>\frac{1}{3} = \frac{15}{x}</math>, determining that <math>x = 45</math>, but then considers that <math>x</math> represents the number of yellow apples rather than the total number of apples in the crate</p>

16. Dorian and Sarah are the only two students running for class president. There are 311 votes in the election. Every vote is for either Dorian or Sarah. Which outcome is **certain** to happen?
- A. Either Dorian or Sarah will receive exactly 156 votes.
  - B. Neither Dorian nor Sarah will receive exactly 156 votes.
  - C. Either Dorian or Sarah will receive at least 156 votes.
  - D. Neither Dorian nor Sarah will receive at least 156 votes.

Item Information	
Alignment	D-S.3.1.1
Answer Key	C
Depth of Knowledge	2
p-value A	13%
p-value B	23%
p-value C	54% (correct answer)
p-value D	10%
Option Annotations	<p>A. assumes that one student will receive exactly 1 more vote than the other student</p> <p>B. either recognizes that a vote of 156-to-155 is unlikely but confuses unlikely for impossible OR divides 311 by 2 and thinks each student will receive 155.5 votes and does not consider that the number of votes needs to be a whole number</p> <p>C. Correct: recognizes that one student must receive more than half the votes since half of 311 is 155.5</p> <p>D. confuses certain with impossible</p>

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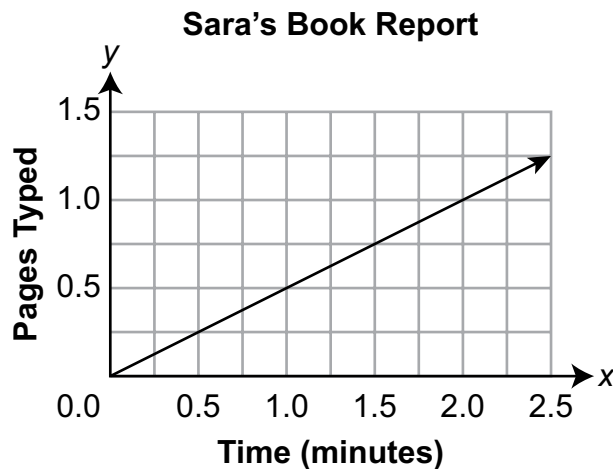
## OPEN-ENDED QUESTION

17. Gavin, Sara, and Frank are each typing a book report.

Gavin can type  $\frac{1}{2}$  page of his book report in  $5\frac{3}{4}$  minutes.

A. What is Gavin's typing rate, in pages per minute?

The graph shown below can be used to determine the number of pages of her book report that Sara has typed based on the amount of time, in minutes, she has been typing.



One point on the graph has an x-coordinate of 1.

B. What does this point represent in terms of Sara's typing rate?

Go to the next page to finish question 17.





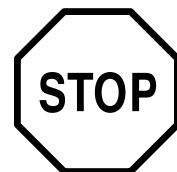
17. **Continued.** Please refer to the previous page for task explanation.

Frank's book report will be 3 pages long. He has 40% of his book report typed.

He can type at a rate of  $\frac{1}{8}$  page per minute.

- C. How much more time, in minutes, does Frank need to finish typing his book report? Show or explain all your work.

**After you have finished your work, close this booklet so your teacher will know you are finished.**



## Item-Specific Scoring Guideline

### #17 Item Information

<b>Alignment</b>	A-R.1.1.1 A-R.1.1.5 A-R.1.1.6	<b>Depth of Knowledge</b>	2	<b>Mean Score</b>	1.03
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### Assessment Anchor this item will be reported under:

M07.A-R.1 — Demonstrate an understanding of proportional relationships.

### Specific Anchor Descriptor addressed by this item:

M07.A-R.1.1 — Analyze, recognize, and represent proportional relationships and use them to solve real-world and mathematical problems.

### Scoring Guide

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

**Top-Scoring Response**

**Part A (1 point):**

1 point for correct answer

What?	Why?
<p>Answers may vary. Accept any fraction equivalent to <math>\frac{2}{23}</math> or any decimal from 0.08 to 0.09.</p> <p><b>Sample Responses:</b></p> $\frac{2}{23}$ <p>0.0869</p>	

**Part B (1 point):**

1 point for correct and complete response

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

What?	Why?
<p><b>Sample Responses:</b></p> <p>The <math>y</math>-coordinate of this point represents the number of pages Sara types each minute.</p> <p><b>OR</b></p> <p>Sara can type 0.5 pages per minute.</p> <p><b>OR equivalent</b></p>	

**Part C (2 points):**

1 point for correct answer

1 point for correct and complete support

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

What?	Why?
<p>14.4 (minutes)</p> <p><b>OR</b></p> <p><math>14\frac{2}{5}</math> (minutes)</p> <p><b>OR</b></p> <p>14 minutes 24 seconds</p>	<p><b>Sample Work:</b></p> <p><math>0.4(3) = 1.2</math> pages</p> <p><math>3 - 1.2 = 1.8</math> pages</p> <p><math>1.8 \div \frac{1}{8} = 14.4</math> minutes</p> <p><b>OR</b></p> <p><b>Sample Explanation:</b></p> <p>Since Frank has 40% of his report typed and his final report will be 3 pages long, that means he has typed <math>0.4(3) = 1.2</math> pages. So, he has <math>3 - 1.2 = 1.8</math> pages remaining to type. Since he types at a rate of <math>\frac{1}{8}</math> page per minute, Frank needs <math>1.8 \div \frac{1}{8} = 14.4</math> more minutes to finish typing his book report.</p> <p><b>OR equivalent</b></p>

## STUDENT RESPONSE

## Response Score: 4 points

17. Gavin, Sara, and Frank are each typing a book report.

Gavin can type  $\frac{1}{2}$  page of his book report in  $5\frac{3}{4}$  minutes.

A. What is Gavin's typing rate, in pages per minute?

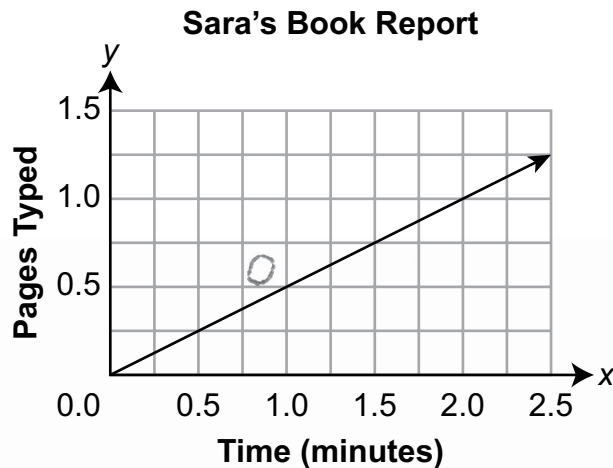
$$\frac{1}{2} = .5$$

$$5\frac{3}{4} = 5.75$$

$$\frac{.5}{5.75} = .08 \text{ pages per minute}$$

Part A. The student provided the correct answer (.08 pages per minute) for Gavin's typing rate. The work shown is correct, though not necessary for credit. The student correctly converted the fractions  $\frac{1}{2}$  and  $5\frac{3}{4}$  to decimals (.5 and 5.75, respectively) and then correctly divided .5 by 5.75 to arrive at the correct answer. [1 point]

The graph shown below can be used to determine the number of pages of her book report that Sara has typed based on the amount of time, in minutes, she has been typing.



One point on the graph has an x-coordinate of 1.

B. What does this point represent in terms of Sara's typing rate?

Sara can type  $\frac{1}{2}$  or .5 pages in 1 minute.

Part B. The student provided the correct response ( $\frac{1}{2}$  or .5 pages in 1 minute). The student correctly interpreted the graph, observing that the x-coordinate of 1 represents 1 minute and corresponds to 0.5 pages typed on the y-axis. [1 point]

Go to the next page to finish question 17.



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

Frank's book report will be 3 pages long. He has 40% of his book report typed.

He can type at a rate of  $\frac{1}{8}$  page per minute.

- C. How much more time, in minutes, does Frank need to finish typing his book report? Show or explain all your work.

$$3 \div \frac{1}{8} = 24 \text{ minutes total}$$

$$24 \cdot .4 = 9.6 \text{ minutes done}$$

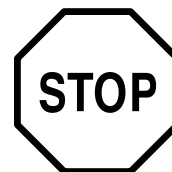
$$24 - 9.6 = 14.4 \text{ minutes more}$$

Frank needs 14.4 minutes more to finish typing his book report

Part C. The student provided the correct answer (*Frank needs 14.4 minutes more to finish typing his book report*) with correct and complete support. The work provided shows the student first found the total time it takes to type the book report ( $3 \div \frac{1}{8} = 24 \text{ minutes total}$ ). Then, the student calculated how long it took to type the 40% already completed ( $24 \cdot .4 = 9.6 \text{ minutes done}$ ) and subtracted that 40% from the total ( $24 - 9.6 = 14.4 \text{ minutes more}$ ).

[2 points]

**After you have finished your work, close this booklet so your teacher will know you are finished.**



## STUDENT RESPONSE

Response Score: 3 points



## PART A

Question 17  
Page 1 of 3

EQ

Gavin, Sara, and Frank are each typing a book report.

Gavin can type  $\frac{1}{2}$  page of his book report in  $5\frac{3}{4}$  minutes.

A. What is Gavin's typing rate, in pages per minute?

11 1/2 pages per min.

Review/End Test   Pause   Flag   Options   Next

Part A. The student provided an incorrect answer (*11 1/2 pages per min.*) for Gavin's typing rate. While support is not required for Part A, the student likely set up the division incorrectly, using  $5\frac{3}{4} \div \frac{1}{2}$  rather than  $\frac{1}{2} \div 5\frac{3}{4}$ . [0 points]



PART B

Question 17

Page 2 of 3

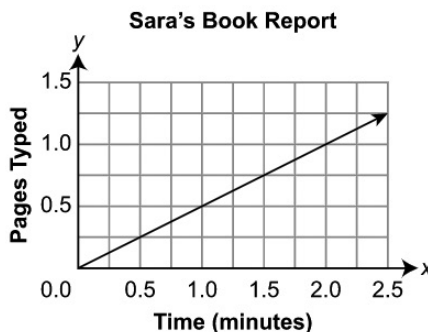


Item ID



Gavin, Sara, and Frank are each typing a book report.

The graph shown below can be used to determine the number of pages of her book report that Sara has typed based on the amount of time, in minutes, she has been typing.



One point on the graph has an  $x$ -coordinate of 1.

**B.** What does this point represent in terms of Sara's typing rate?

EQ

That she can type half a page per min.

38 / 1000

Review/End Test

Pause

Flag

Options

Back

Next

Part B. The student provided the correct response (*half a page per min.*). The student correctly interpreted the graph, observing that the  $x$ -coordinate of 1 represents 1 minute and corresponds to 0.5 pages typed on the  $y$ -axis. [1 point]

## PART C

Question 17  
Page 3 of 3

Frank's book report will be 3 pages long. He has 40% of his book report typed. He can type at a rate of  $\frac{1}{8}$  page per minute.

C. How much more time, in minutes, does Frank need to finish typing his book report? Show or explain all your work.

EQ

$3 * 40\% = 1.2$   
 $3 - 1.2 = 1.8$  pages left  
 $1.8\text{pg} / 0.125 \text{ per min} = 14.4$   
 $14.4 = 14 \frac{2}{5}$   
  
 $14 \frac{2}{5}$  minutes

97 / 1000

Review/End Test   Pause   Flag   Options   Back   Next

Part C. The student provided the correct answer ( $14 \frac{2}{5}$  minutes) with correct and complete support. The work provided shows the student first found how many pages have been typed so far ( $3 * 40\% = 1.2$ ) and then subtracted the 1.2 pages completed from 3 pages total to find there are  $1.8$  pages left. The student divided the remaining 1.8 pages by the  $\frac{1}{8}$  page per minute typing rate (converted to decimal form of 0.125) to find the answer of 14.4. The student then converted the decimal form of the answer to a fraction ( $14.4 = 14 \frac{2}{5}$ ).

[2 points]

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## STUDENT RESPONSE

## Response Score: 2 points

17. Gavin, Sara, and Frank are each typing a book report.

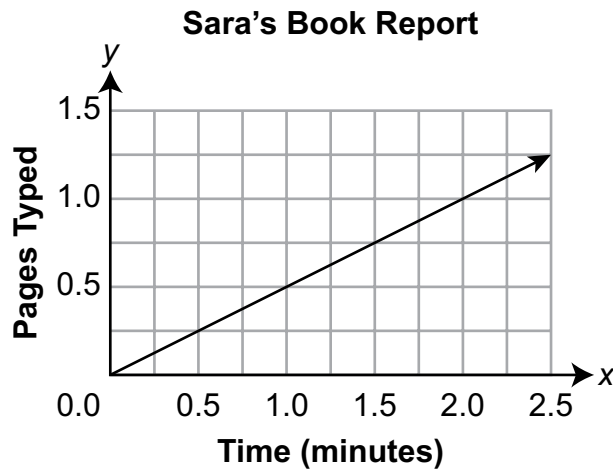
Gavin can type  $\frac{1}{2}$  page of his book report in  $5\frac{3}{4}$  minutes.

A. What is Gavin's typing rate, in pages per minute?

$$\frac{1}{2} \div 5\frac{3}{4} = \frac{2}{23}$$

Part A. The student provided the correct answer ( $\frac{2}{23}$ ) for Gavin's typing rate. No support (work or explanation) is required, but the student's work shows the correct setup ( $\frac{1}{2} \div 5\frac{3}{4} = \frac{2}{23}$ ) to calculate the correct answer. [1 point]

The graph shown below can be used to determine the number of pages of her book report that Sara has typed based on the amount of time, in minutes, she has been typing.



One point on the graph has an x-coordinate of 1.

B. What does this point represent in terms of Sara's typing rate?

That she can type half a page in one minute

Part B. The student provided the correct response (*half a page in one minute*). The student correctly interpreted the graph, observing that the x-coordinate of 1 represents 1 minute and corresponds to 0.5 pages typed on the y-axis. [1 point]

Go to the next page to finish question 17.



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

Frank's book report will be 3 pages long. He has 40% of his book report typed.

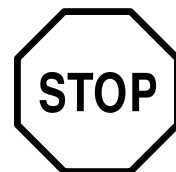
He can type at a rate of  $\frac{1}{8}$  page per minute.

- C. How much more time, in minutes, does Frank need to finish typing his book report? Show or explain all your work.

$$3 \div 40\% \Rightarrow \frac{1}{8} = 7.375 \text{ minutes}$$

Part C. The student provided an incorrect answer (*7.375 minutes*) with incorrect and incomplete support. The work shown ( $3 \div 40\% - \frac{1}{8}$ ) features incorrect steps (the student divided 3 by 40% rather than multiplying 3 by 40% and subtracting the product from 3, and then subtracted  $\frac{1}{8}$  from the result instead of dividing the result by  $\frac{1}{8}$ ) and does not earn any credit. [0 points]

**After you have finished your work, close this booklet so your teacher will know you are finished.**



## STUDENT RESPONSE

Response Score: 1 point



## PART A

Question 17  
Page 1 of 3

Item ID ?

Gavin, Sara, and Frank are each typing a book report.

Gavin can type  $\frac{1}{2}$  page of his book report in  $5\frac{3}{4}$  minutes.

A. What is Gavin's typing rate, in pages per minute?

EQ

2/23 pages per min

Review/End Test Pause Flag Options Next

Part A. The student provided the correct answer ( $2/23$  pages per min) for Gavin's typing rate. While support is not required for Part A, the student likely divided  $\frac{1}{2}$  by  $5\frac{3}{4}$ . [1 point]

PART B

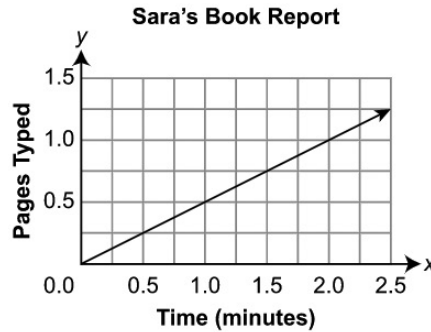
Question 17  
Page 2 of 3



Item ID ?

Gavin, Sara, and Frank are each typing a book report.

The graph shown below can be used to determine the number of pages of her book report that Sara has typed based on the amount of time, in minutes, she has been typing.



One point on the graph has an  $x$ -coordinate of 1.

**B.** What does this point represent in terms of Sara's typing rate?

EQ

(1.0, 0.5)

10 / 1000

Review/End Test

Pause

Flag

Options

Back

Next

Part B. The student provided an incorrect response. Rather than describing what the point represents, the student identified the ordered pair for the point that has an  $x$ -coordinate of 1 [(1.0, 0.5)]. [0 points]

## PART C

Question 17  
Page 3 of 3

Frank's book report will be 3 pages long. He has 40% of his book report typed. He can type at a rate of  $\frac{1}{8}$  page per minute.

C. How much more time, in minutes, does Frank need to finish typing his book report? Show or explain all your work.

EQ

$$40\% \div \frac{1}{8} = 3.2$$

(3.2 min)

19 / 1000

Review/End Test   Pause   Flag   Options   Back   Next

Part C. The student provided an incorrect answer (3.2 min) with incorrect and incomplete support. The work shown

$\left(40\% \div \frac{1}{8}\right)$  is an incorrect step and does not earn any credit. [0 points]



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## STUDENT RESPONSE

## Response Score: 0 points

17. Gavin, Sara, and Frank are each typing a book report.

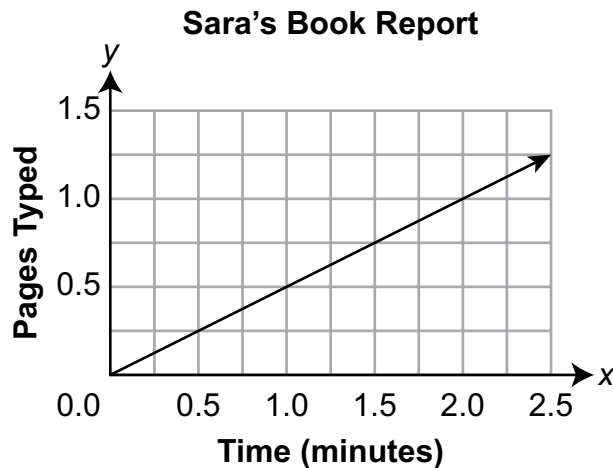
Gavin can type  $\frac{1}{2}$  page of his book report in  $5\frac{3}{4}$  minutes.

A. What is Gavin's typing rate, in pages per minute?

$$5.75 \div .5 = 11.5 \text{ pages per minute}$$

Part A. The student provided an incorrect answer (11.5 pages per minute) for Gavin's typing rate. Though support (work or explanation) is not required, the work shows that the student set up the division incorrectly, using  $5.75 \div .5$  rather than  $.5 \div 5.75$ . [0 points]

The graph shown below can be used to determine the number of pages of her book report that Sara has typed based on the amount of time, in minutes, she has been typing.



One point on the graph has an x-coordinate of 1.

B. What does this point represent in terms of Sara's typing rate?

Sara has been typing for 2.5 minutes and has typed 1.3 pages.

Part B. The student provided an incorrect response. The student attempted to describe the rightmost point on the graph (Sara has been typing for 2.5 minutes and has typed 1.3 pages.) rather than the point that has an x-coordinate of 1. [0 points]

Go to the next page to finish question 17.





**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.1.1.3	A	1	47%	22%	15%	16%
2	A-N.1.1.2	B	1	30%	61%	5%	4%
3	A-R.1.1.1	C	2	24%	21%	36%	19%
4	A-R.1.1.2 A-R.1.1.4	B	2	12%	64%	12%	12%
5	A-R.1.1.4 A-R.1.1.3	B	2	25%	34%	29%	12%
6	A-R.1.1.6	D	2	16%	18%	21%	45%
7	B-E.1	B	2	14%	63%	10%	13%
8	B-E.1.1	D	1	14%	17%	16%	53%
9	B-E.2.2	B	2	12%	70%	8%	10%
10	B-E.2.2.1	C	2	13%	16%	60%	11%
11	C-G.1.1	D	2	13%	11%	21%	55%
12	C-G.2.1.2	C	1	17%	19%	38%	26%
13	C-G.2.2.1	C	2	19%	27%	39%	15%
14	D-S.2.1.1	C	2	17%	18%	44%	21%
15	D-S.3	B	2	8%	51%	29%	12%
16	D-S.3.1.1	C	2	13%	23%	54%	10%

**Open-Ended**

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
17	A-R.1.1.1 A-R.1.1.5 A-R.1.1.6	4	2	1.03



# **PSSA Grade 7 Mathematics Item and Scoring Sampler**

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