pennsylvania
DEPARTMENT OF EDUCATION

The Pennsylvania System of School Assessment

Mathematics
Item and Scoring Sampler

2022–2023
Grade 3

Pennsylvania Department of Education Bureau of Curriculum, Assessment and Instruction—August 2022

MATHEMATICS TEST DIRECTIONS

Directions: On the following pages are the Mathematics questions.

- You may not use a calculator on this test.
- You may need a ruler for question(s) 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 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 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 booklet.

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

MULTIPLE-CHOICE ITEMS

1. The Liberty Bell weighs 2,080 pounds.

What is the value of the 8 in 2,080?

Ⓐ 8 ones

Ⓑ 8 tens

Ⓒ 8 hundreds

Ⓓ 8 thousands

Item Information	
Alignment	A-T.1.1
Answer Key	B
Depth of Knowledge	1
p-value A	4%
p-value B	79% (correct answer)
p-value C	7%
p-value D	10%
Option Annotations	A. confuses tens with ones B. Correct: recognizes the 8 is in the tens place C. confuses tens with hundreds D. confuses tens with thousands

2. A number sentence is shown below.

$$35 < 42$$

Which statement would require the symbol to change?

Ⓐ Add 150 to each number.

Ⓑ Divide each number by 7.

Ⓒ Subtract 10 from each number.

Ⓓ Round each number to the nearest 10.

Item Information	
Alignment	A-T.1.1.1
Answer Key	D
Depth of Knowledge	2
p-value A	7%
p-value B	14%
p-value C	8%
p-value D	71% (correct answer)
Option Annotations	A. does not recognize that addition of the same number does not change the relationship B. does not recognize that division by the same number does not change the relationship C. does not recognize that subtraction by the same number does not change the relationship D. Correct: rounds the 35 up to 40, rounds the 42 down to 40, and recognizes the inequality symbol (<) would change to an equal sign (=)

3. Four numbers are shown below.

1,991 1,199 1,919 1,999

Which list shows the numbers in order from **greatest** to **least**?

Ⓐ 1,999 1,991 1,199 1,919

Ⓑ 1,991 1,999 1,919 1,199

Ⓒ 1,999 1,991 1,919 1,199

Ⓓ 1,999 1,919 1,991 1,199

Item Information	
Alignment	A-T.1.1.4
Answer Key	C
Depth of Knowledge	1
p-value A	19%
p-value B	9%
p-value C	60% (correct answer)
p-value D	12%
Option Annotations	A. compares the tens place but not the hundreds place in the last two numbers in the answer choice B. makes an error comparing the ones place in the first two numbers in the answer choice C. Correct: orders the numbers by comparing the digits in the thousands place, then the digits in the hundreds place, then the digits in the tens place, and then the digits in the ones place D. makes an error in the tens place for the two middle numbers in the answer choice

4. Gary pours all his milk into 4 glasses.

He fills each glass with 6 ounces of milk.

Sara has the same amount of milk as Gary has.

She also has the same number of glasses as Gary has.

She pours the same amount of milk into each of her glasses as Gary pours into each of his glasses.

Which statement is true?

Ⓐ Sara pours a total of 24 ounces of milk into 4 glasses.

Ⓑ Sara pours a total of 24 ounces of milk into 6 glasses.

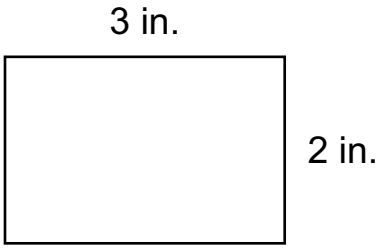
Ⓒ Sara pours a total of 10 ounces of milk into 4 glasses.

Ⓓ Sara pours a total of 10 ounces of milk into 6 glasses.

Item Information	
Alignment	B-O.1.2.1
Answer Key	A
Depth of Knowledge	2
p-value A	61% (correct answer)
p-value B	15%
p-value C	17%
p-value D	7%
Option Annotations	A. Correct: multiplies 4 by 6 to get 24 ounces of milk, and then identifies 4 as the divisor B. misunderstands the amount of milk in each glass C. interprets 4 as a divisor but does not find the correct product D. does not find the correct product and confuses the amounts

5. Corey made a design using rectangles that are all the same size.

One of the rectangles is shown below.



Corey's design has a total area of 48 square inches.

How many rectangles are in Corey's design?

Ⓐ 6

Ⓑ 8

Ⓒ 12

Ⓓ 42

Item Information	
Alignment	B-O.2 D-M.3.1.2
Answer Key	B
Depth of Knowledge	2
p-value A	34%
p-value B	38% (correct answer)
p-value C	20%
p-value D	8%
Option Annotations	A. selects the area of one rectangle B. Correct: finds the area of one rectangle by multiplying side lengths (3 inches and 2 inches), and then divides 48 square inches by the area of one rectangle (6 square inches) C. chooses a divisor of 48 D. subtracts the area of one rectangle from the total area

6. Emma buys 7 packages of toy rings.

Each package contains 2 bags with 5 rings in each.

Emma uses the expression $(7 \times 2) \times 5$ to find the total number of rings.

Which expression shows another way to find the total number of rings?

Ⓐ $(7 + 2) \times 5$

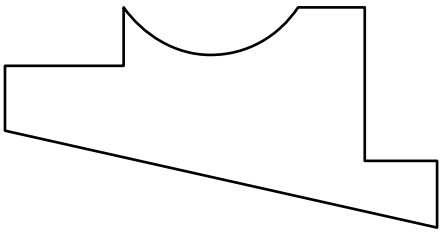
Ⓑ $(7 \times 2) + 5$

Ⓒ $7 \times (2 \times 5)$

Ⓓ $7 \times (5 \times 10)$

Item Information	
Alignment	B-O.2.1.2
Answer Key	C
Depth of Knowledge	1
p-value A	11%
p-value B	13%
p-value C	68% (correct answer)
p-value D	8%
Option Annotations	A. uses addition instead of multiplication B. uses addition instead of multiplication C. Correct: recognizes that, when multiplying, grouping symbols may be moved without changing the value of the expression (associative property of multiplication) D. multiplies 2 by 5 to get 10 but introduces a second 5

7. A shape is shown below.



Which statement **best** explains whether the shape is a polygon?

Ⓐ Because it has many sides, the shape is a polygon.

Ⓑ Because one side is curved, the shape is not a polygon.

Ⓒ Because it has an inside and an outside, the shape is a polygon.

Ⓓ Because the sides have different lengths, the shape is not a polygon.

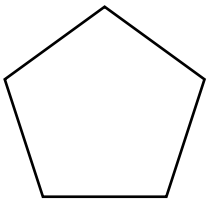
Item Information	
Alignment	C-G.1
Answer Key	B
Depth of Knowledge	1
p-value A	13%
p-value B	54% (correct answer)
p-value C	10%
p-value D	23%
Option Annotations	A. knows a polygon has sides but overlooks the curved side B. Correct: recognizes that polygons cannot have any curved sides C. knows a polygon is closed but overlooks the curved side D. thinks of only regular polygons

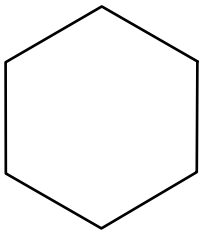
8. Keenan makes a cardboard polygon.

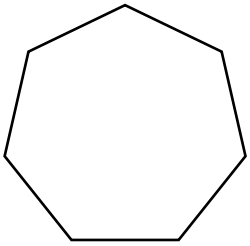
Then he cuts it straight from one corner to another corner.

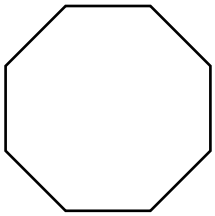
The result is two trapezoids.

Which polygon could be Keenan's original polygon?

Ⓐ 

Ⓑ 

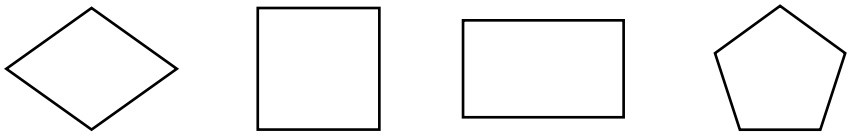
Ⓒ 

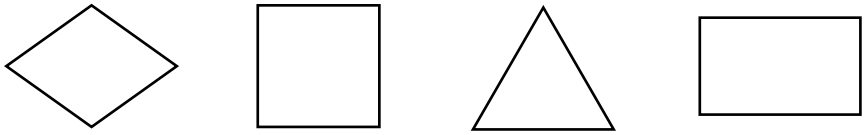
Ⓓ 

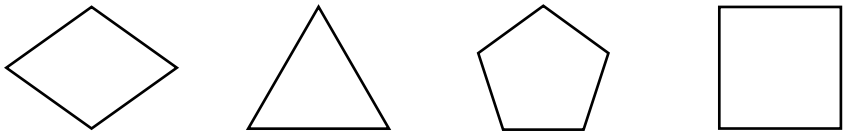
Item Information	
Alignment	C-G.1.1
Answer Key	B
Depth of Knowledge	2
p-value A	25%
p-value B	45% (correct answer)
p-value C	11%
p-value D	19%
Option Annotations	A. focuses on one trapezoid but does not realize the other part would be a triangle B. Correct: recognizes that a cut from one corner to its opposite corner would result in two trapezoids C. focuses on one trapezoid but does not realize the other part would have 5 sides D. recognizes that a trapezoid can be taken from the top and bottom but neglects the third piece

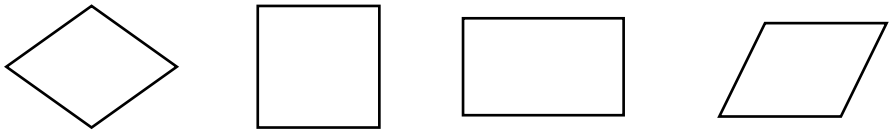
9. Paula makes a quilt using only quadrilateral shapes.

Which group of shapes could Paula use to make her quilt?

Ⓐ 

Ⓑ 

Ⓒ 

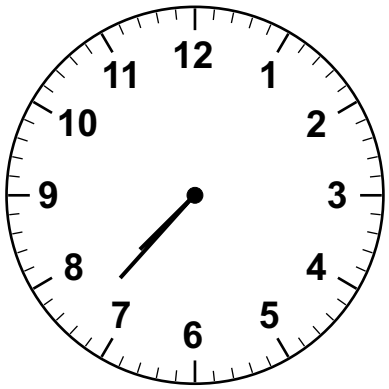
Ⓓ 

Item Information	
Alignment	C-G.1.1.2
Answer Key	D
Depth of Knowledge	1
p-value A	9%
p-value B	7%
p-value C	8%
p-value D	76% (correct answer)
Option Annotations	A. thinks that a shape is a quadrilateral as long as it has 4 or more sides B. thinks that a shape is a quadrilateral as long as it has no more than 4 sides C. confuses “quadrilateral” and “polygon” D. Correct: recognizes that each shape has exactly 4 sides

10. The television weather report begins at 7:23 each day.

Which clock shows the time when the weather report begins?

Ⓐ



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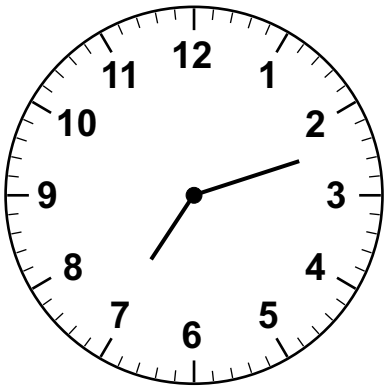

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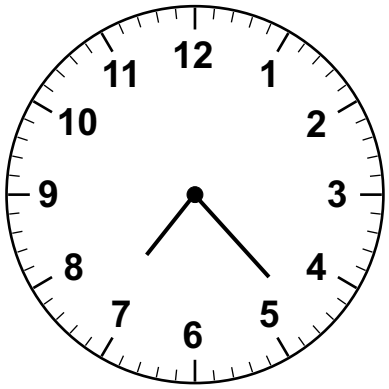

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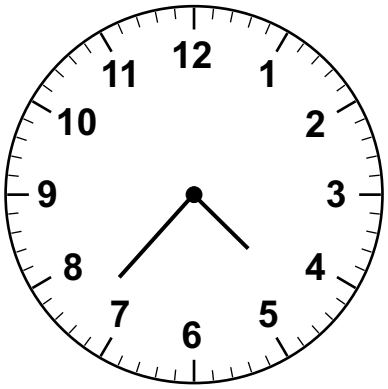


Item Information	
Alignment	D-M.1.1.1
Answer Key	C
Depth of Knowledge	1
p-value A	2%
p-value B	9%
p-value C	73% (correct answer)
p-value D	16%
Option Annotations	A. counts minutes counterclockwise B. places the minute hand between 2 and 3 instead of at 23 C. Correct: recognizes the hour (shorter) hand should be almost halfway between the 7 and the 8 and the minute (longer) hand should be a little over halfway between the 4 and the 5 D. reverses the places of the hour and minute hands

11. Arianna used 16 gallons of water taking a shower.

The shower lasted for 8 minutes.

How many gallons of water were used each minute?

Ⓐ 2

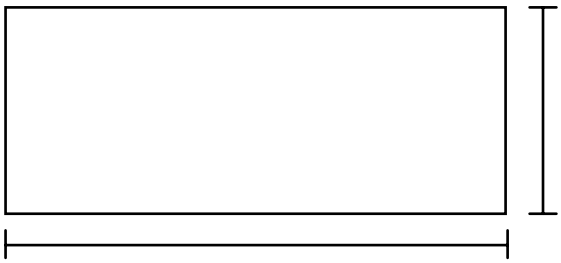
Ⓑ 4

Ⓒ 8

Ⓓ 24

Item Information	
Alignment	D-M.1.2.2
Answer Key	A
Depth of Knowledge	1
p-value A	57% (correct answer)
p-value B	7%
p-value C	18%
p-value D	18%
Option Annotations	A. Correct: divides the number of gallons (16) by the number of minutes (8) the shower lasted B. divides incorrectly C. subtracts D. adds

12. A rectangle is shown below.



Use your ruler to measure the lengths of the sides of the rectangle to the nearest centimeter.

Which measurement is **closest** to the area, in square centimeters, of the rectangle?

Ⓐ 12

Ⓑ 14

Ⓒ 18

Ⓓ 21

Item Information	
Alignment	D-M.1.2.3 D-M.3.1.2
Answer Key	C
Depth of Knowledge	1
p-value A	34%
p-value B	11%
p-value C	39% (correct answer)
p-value D	16%
Option Annotations	A. rounds both measurements down to 2 cm and to 6 cm B. rounds the shorter side down to 2 cm and the longer side up to 7 cm C. Correct: measures the shorter side as closer to 3 cm than to 2 cm, measures the longer side as closer to 6 cm than to 7 cm, and then multiplies the side lengths (3 cm and 6 cm) D. rounds both measurements up to 3 cm and to 7 cm

13. Cordelia and Reanna have different amounts of money.

When rounded to the nearest dollar, the amount they each have rounds to $4.

Which amounts of money could Cordelia and Reanna each have?

Ⓐ $3.49 and $4.49

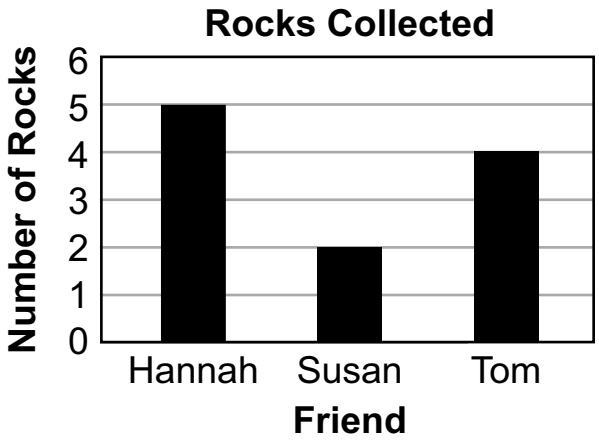
Ⓑ $3.49 and $4.50

Ⓒ $3.50 and $4.50

Ⓓ $3.50 and $4.49

Item Information	
Alignment	D-M.1.3.3
Answer Key	D
Depth of Knowledge	1
p-value A	19%
p-value B	11%
p-value C	22%
p-value D	48% (correct answer)
Option Annotations	A. incorrectly rounds $3.49 up to $4 B. incorrectly rounds $3.49 up to $4 and incorrectly rounds $4.50 down to $4 C. incorrectly rounds $4.50 down to $4 D. Correct: identifies that $3.50 rounds up to $4 and that $4.49 rounds down to $4

14. The bar graph below shows the numbers of rocks collected by three friends at a lake.



Which pictograph shows the same information as the bar graph?

Ⓐ

Rocks Collected

Friend	Number of Rocks
Hannah	5 rocks
Susan	2 rocks
Tom	4 rocks

Key: = 2 rocks

Ⓑ

Rocks Collected

Friend	Number of Rocks
Hannah	2 rocks, 1 rock
Susan	2 rocks
Tom	2 rocks

Key: = 2 rocks

Ⓒ

Rocks Collected

Friend	Number of Rocks
Hannah	3 rocks
Susan	1 rock
Tom	2 rocks

Key: = 2 rocks

Ⓓ

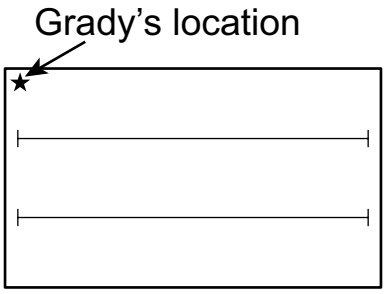
Rocks Collected

Friend	Number of Rocks
Hannah	2 rocks, 1 rock
Susan	1 rock
Tom	2 rocks

Key: = 2 rocks

Item Information	
Alignment	D-M.2.1.4
Answer Key	D
Depth of Knowledge	2
p-value A	35%
p-value B	3%
p-value C	3%
p-value D	59% (correct answer)
Option Annotations	A. does not apply the key (uses 1 “rock” = 1 rock) B. does not apply the key for Susan C. uses only whole “rocks” (does not use the half “rock” for Hannah) D. Correct: applies the key to each bar height, using a half “rock” for the odd height (5)

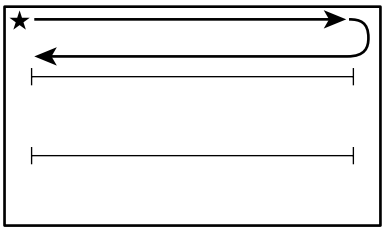
15. Grady is taking swimming lessons in the swimming pool shown below.



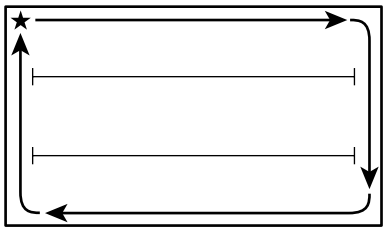
He is going to swim the **perimeter** of the pool.

Which diagram could show the path Grady swims?

Ⓐ



Ⓑ



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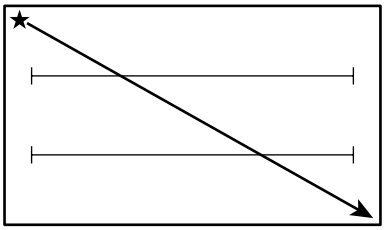

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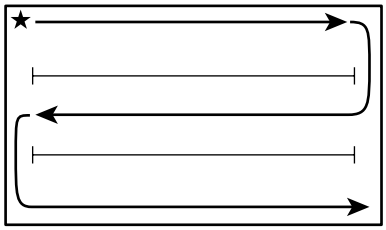
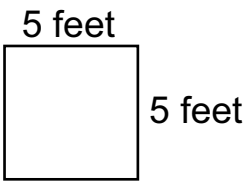


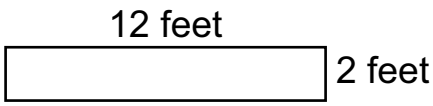
Item Information	
Alignment	D-M.4
Answer Key	B
Depth of Knowledge	2
p-value A	11%
p-value B	75% (correct answer)
p-value C	5%
p-value D	9%
Option Annotations	A. confuses perimeter with length B. Correct: recognizes that the perimeter is the distance around the pool C. confuses perimeter with diagonal D. confuses perimeter with area

16. Which rectangle has an area of 24 square feet and a perimeter less than 25 feet?

Ⓐ



Ⓑ



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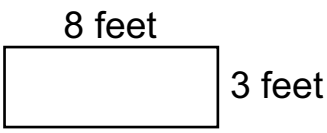
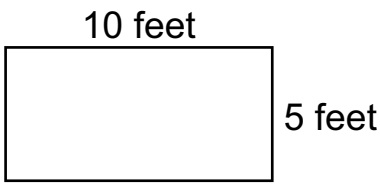


Ⓓ



Item Information	
Alignment	D-M.4.1.1
Answer Key	C
Depth of Knowledge	2
p-value A	15%
p-value B	26%
p-value C	46% (correct answer)
p-value D	13%
Option Annotations	A. switches the target values and identifies a rectangle with an area of 25 feet and a perimeter less than 24 feet B. identifies a rectangle with an area of 24 feet but determines the perimeter by adding the side lengths that are labeled without doubling the sum ($12 + 2 < 25$) C. Correct: multiplies the side lengths to determine the area ($8 \times 3 = 24$) and either adds all four side lengths ($8 + 3 + 8 + 3 = 22$) or adds the side lengths that are labeled and then doubles the sum ($8 + 3 = 11$, $11 \times 2 = 22$) to determine the perimeter is less than 25 feet D. switches the target values, determines the area using the formula for the area of a triangle ($\frac{1}{2} \times 10 \times 5 = 25$), and determines the perimeter by adding the side lengths that are labeled without doubling the sum ($10 + 5 < 24$)

OPEN-ENDED QUESTION

17. Kaylee is painting a picture for her art class.

Kaylee uses the colors red, yellow, green, orange, blue, and purple.

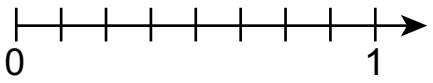
A. Purple is what fraction of Kaylee's colors?

PUT your answer in the **BLANK BELOW**.

Answer: _____

Kaylee paints $\frac{2}{8}$ of her picture with yellow paint.

B. **PLOT** a point on the number line shown below to represent the fraction of Kaylee's picture that is yellow.



Go to the next page to finish question 17.

GO ON

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

Kaylee painted a green rectangle and an orange rectangle on her picture.

The green rectangle has side lengths of 3 inches and 4 inches.

The orange rectangle has side lengths of 2 inches and 6 inches.

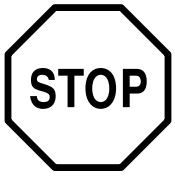
Kaylee makes the incorrect claim shown below.

> The area of the green rectangle is less than the area of the orange rectangle since $14 < 16$.

C. **EXPLAIN** the mistake Kaylee **most likely** made when finding the areas of the two rectangles.

D. **REWRITE** Kaylee's claim with the correct comparison of the areas.

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



Item-Specific Scoring Guideline

#17 Item Information

Alignment	A-F.1.1.1 A-F.1.1.2 D-M.3.1.2	**Depth of Knowledge**	2	**Mean Score**	1.48

Assessment Anchor this item will be reported under:

M03.A-F.1—Develop an understanding of fractions as numbers.

Specific Anchor Descriptor addressed by this item:

M03.A-F.1.1—Develop and apply number theory concepts to compare quantities and magnitudes of fractions and whole numbers.

M03.D-M.3.1—Find the areas of plane figures.

M03.D-M.4.1—Find and use the perimeters of plane figures.

Scoring Guide

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

Top-Scoring Response

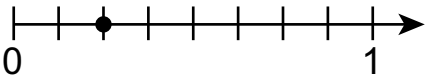
Part A (1 point):

1 point for correct answer

What?	Why?
$\frac{1}{6}$	

Part B (1 point):

1 point for correct answer

What?	Why?
 **OR** Student uses any other correct identification of $\frac{2}{8}$ on the number line.	

Part C (1 point):

1 point for correct and complete explanation

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

What?	Why?
	Sample Explanation: Kaylee found the perimeters of both rectangles instead of the areas. **OR equivalent**

Part D (1 point):

1 point for correct and complete response

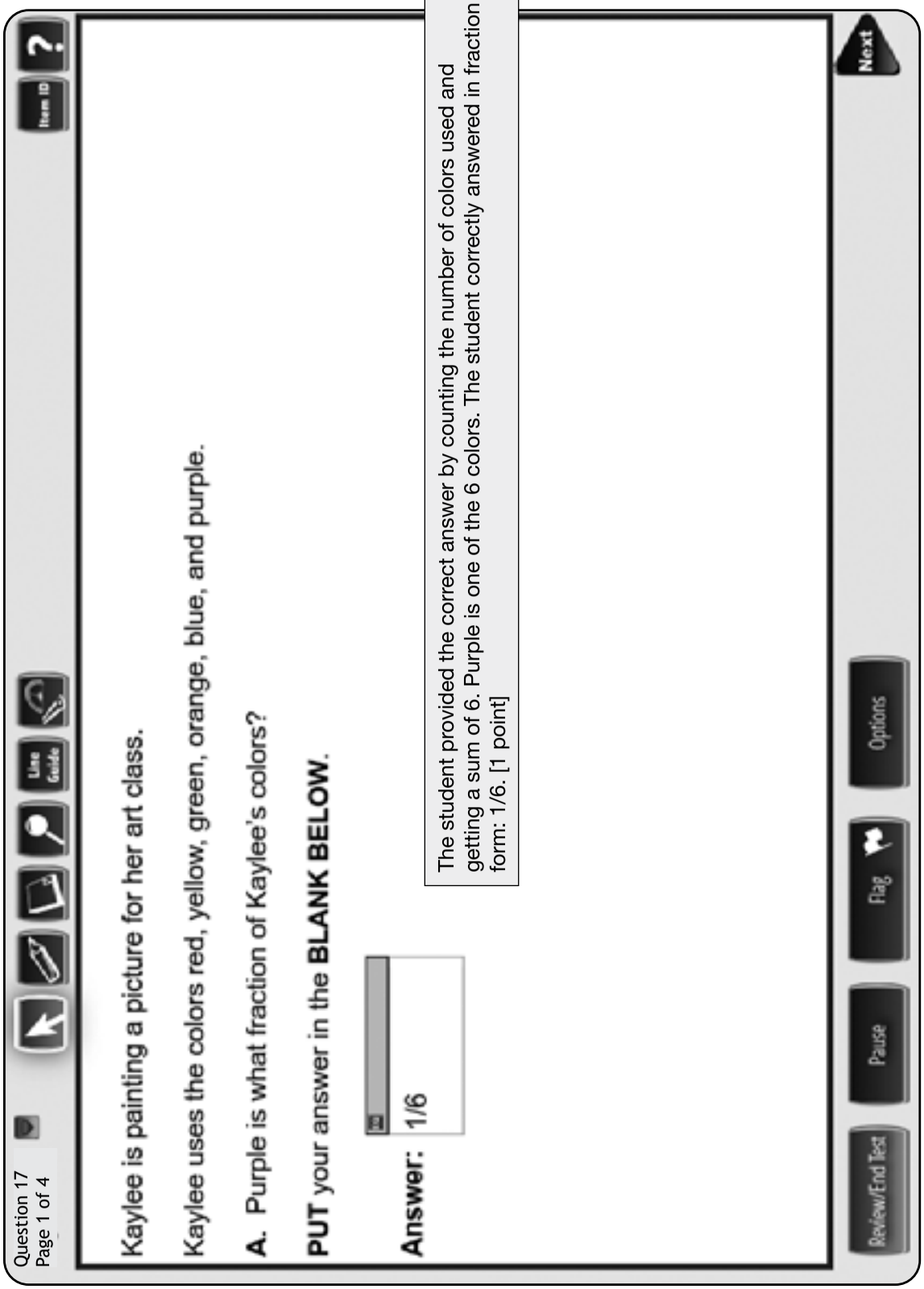
OR $\frac{1}{2}$ point for correct but incomplete response

What?	Why?
Sample Responses: The area of the green rectangle is equal to the area of the orange rectangle since 12 = 12. **OR** The area of the green rectangle is equal to the area of the orange rectangle since 3 × 4 = 2 × 6. **OR equivalent**	

STUDENT RESPONSE

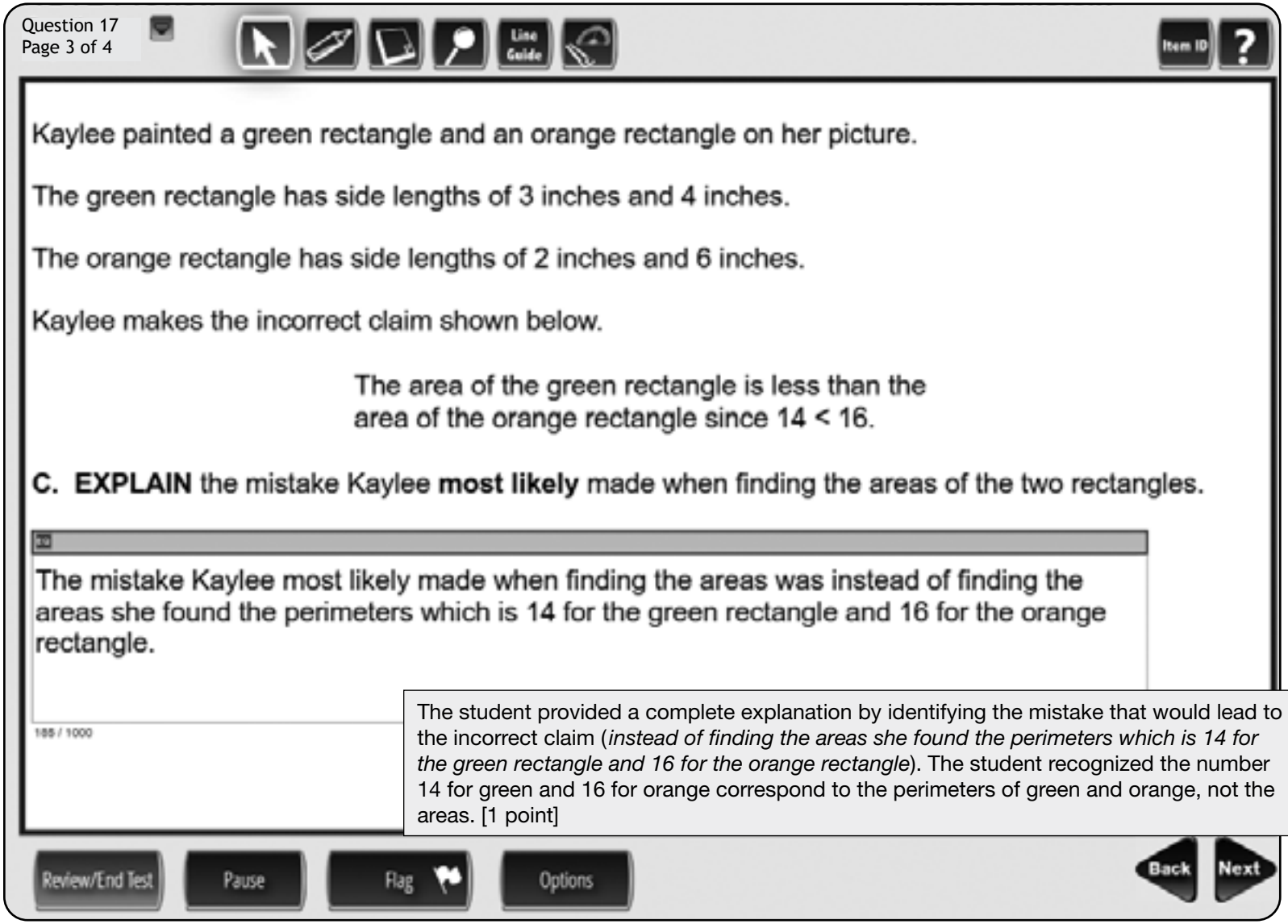
Response Score: 4 points

PART A

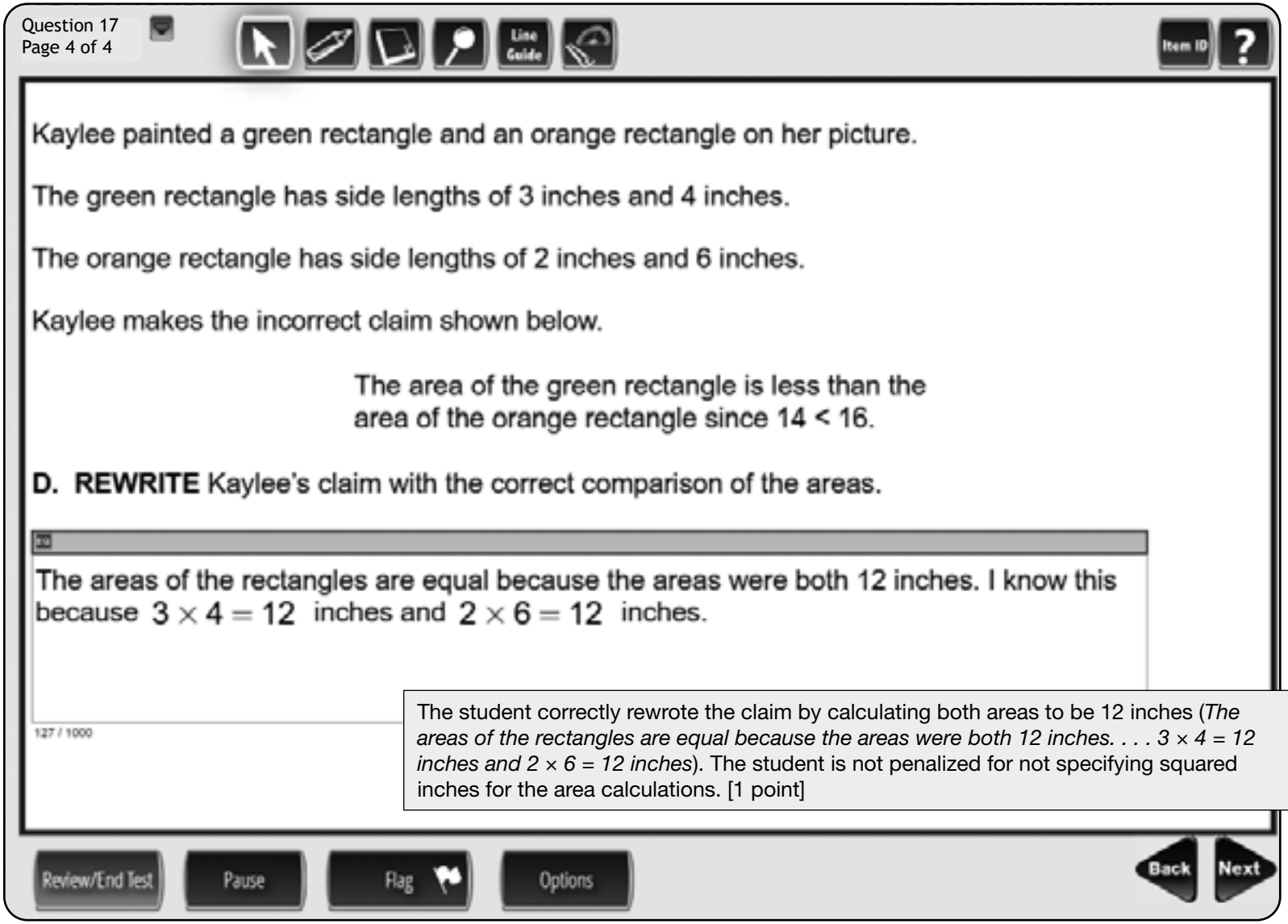


The student provided the correct answer by counting the number of colors used and getting a sum of 6. Purple is one of the 6 colors. The student correctly answered in fraction form: 1/6. [1 point]

The student provided the correct answer by recognizing there are 8 equal intervals between 0 and 1. The student plotted a solid dot correctly at the appropriate location (the second tick mark after the 0). [1 point]



The student provided a complete explanation by identifying the mistake that would lead to the incorrect claim (*instead of finding the areas she found the perimeters which is 14 for the green rectangle and 16 for the orange rectangle*). The student recognized the number 14 for green and 16 for orange correspond to the perimeters of green and orange, not the areas. [1 point]

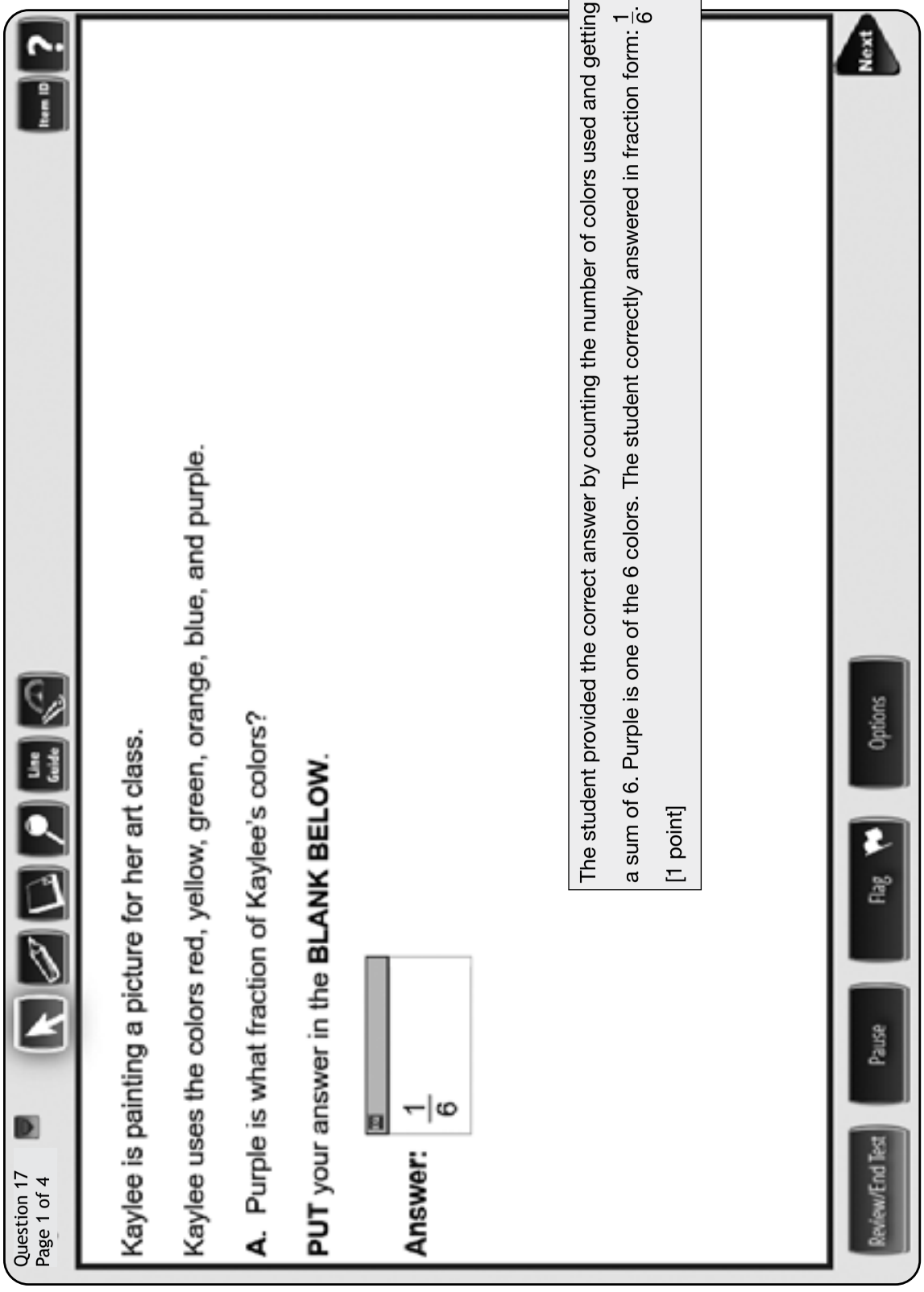


The student correctly rewrote the claim by calculating both areas to be 12 inches (*The areas of the rectangles are equal because the areas were both 12 inches. . . . 3 × 4 = 12 inches and 2 × 6 = 12 inches*). The student is not penalized for not specifying squared inches for the area calculations. [1 point]

STUDENT RESPONSE

Response Score: 2 points

PART A



The student provided the correct answer by counting the number of colors used and getting a sum of 6. Purple is one of the 6 colors. The student correctly answered in fraction form: $\frac{1}{6}$.

[1 point]

The student provided an incorrect answer by placing a mark near the $\frac{7}{8}$ position of the number line instead of at the $\frac{2}{8}$ position. [0 points]

Question 17
Page 3 of 4

Kaylee painted a green rectangle and an orange rectangle on her picture.

The green rectangle has side lengths of 3 inches and 4 inches.

The orange rectangle has side lengths of 2 inches and 6 inches.

Kaylee makes the incorrect claim shown below.

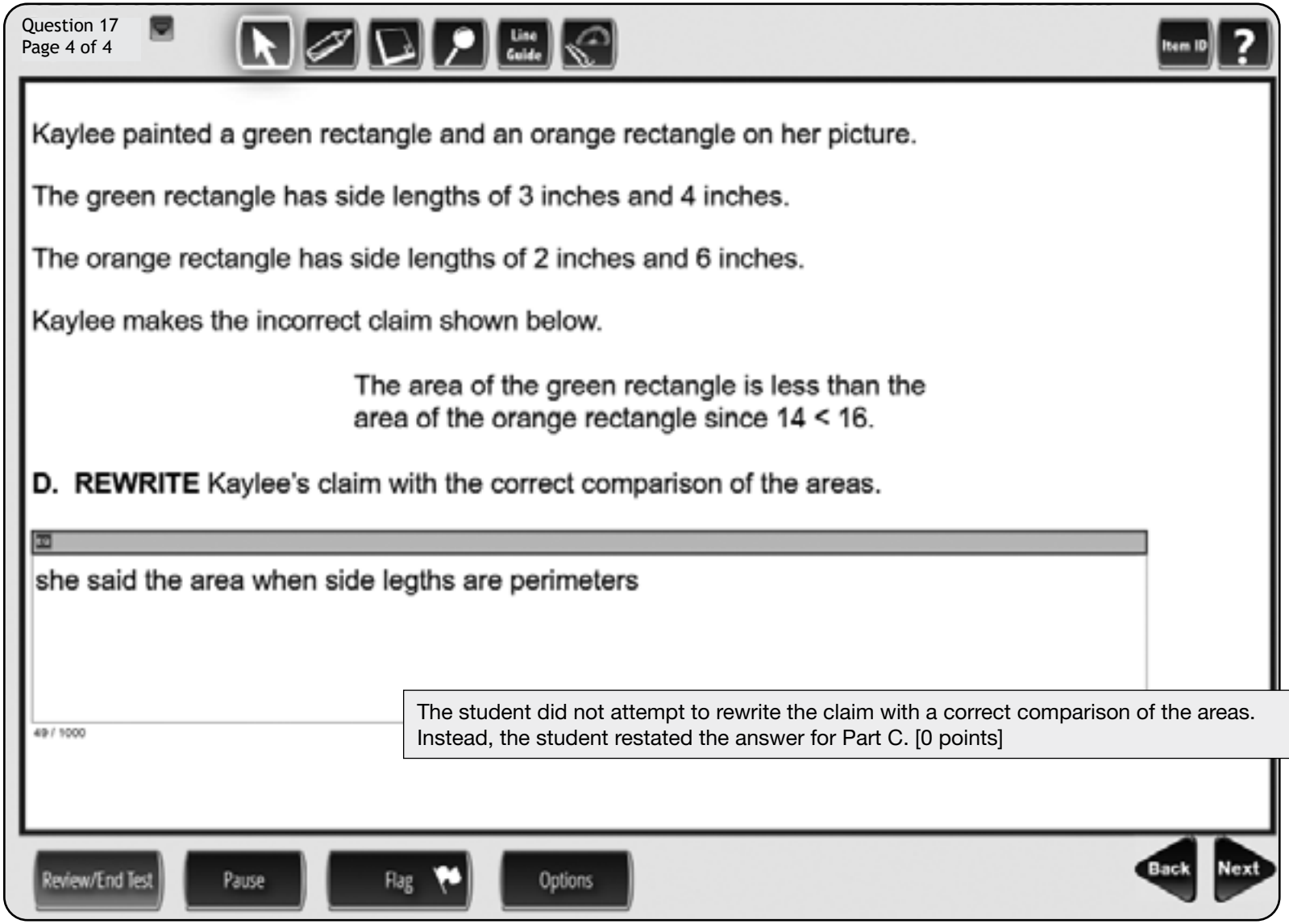
> The area of the green rectangle is less than the area of the orange rectangle since 14 < 16.

C. EXPLAIN the mistake Kaylee **most likely** made when finding the areas of the two rectangles.

She said the area and it is the legth around so it is the primiter

66 / 1000

The student provided a complete explanation by identifying the mistake that would lead to the incorrect claim (*She said the area and it is the legth around so it is the primiter*). The student recognized that the number 14 for green and 16 for orange correspond to the perimeters of green and orange, not the areas. [1 point]

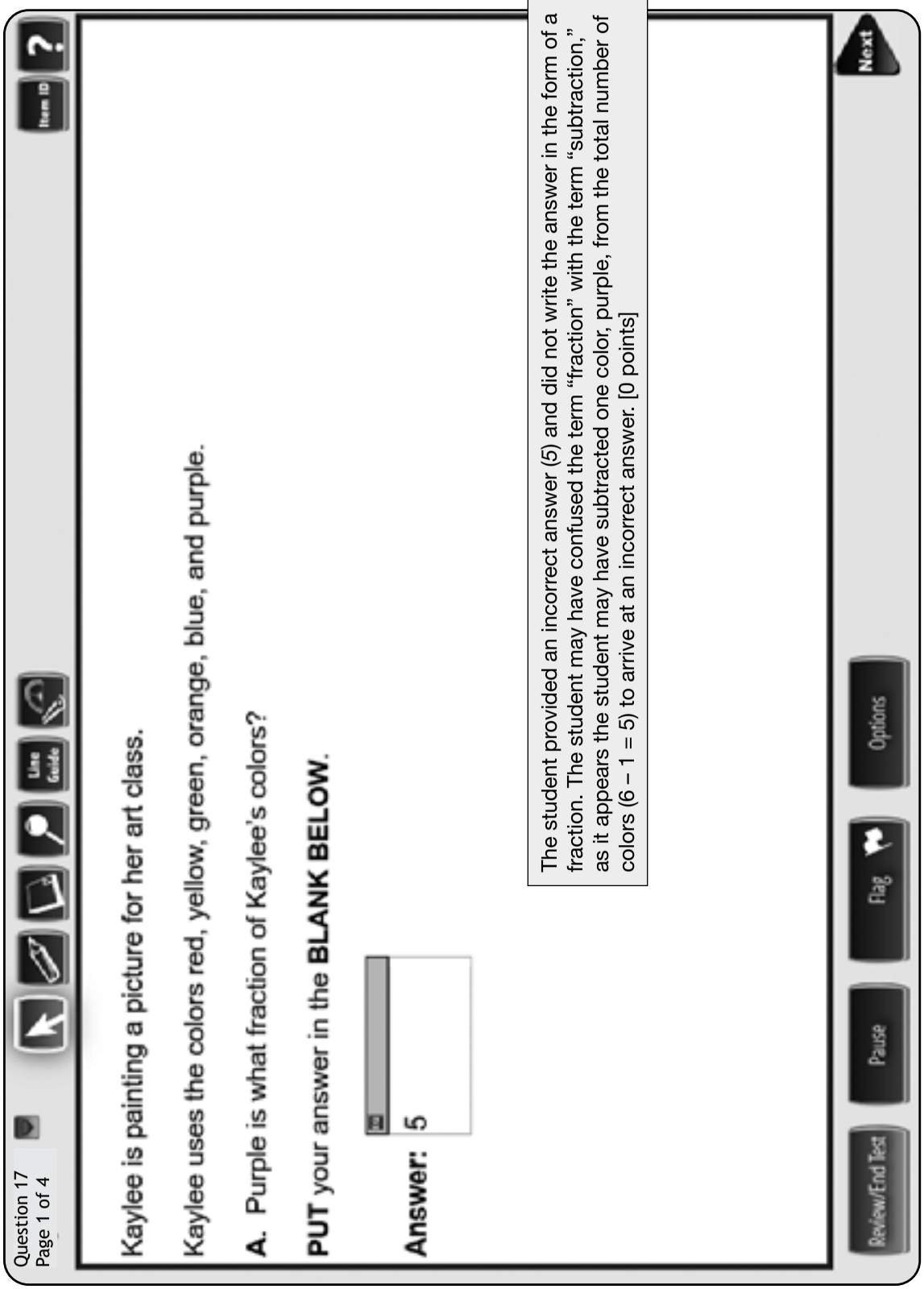


The student did not attempt to rewrite the claim with a correct comparison of the areas. Instead, the student restated the answer for Part C. [0 points]

STUDENT RESPONSE

Response Score: 0 points

PART A



The student provided an incorrect answer (5) and did not write the answer in the form of a fraction. The student may have confused the term "fraction" with the term "subtraction," as it appears the student may have subtracted one color, purple, from the total number of colors (6 – 1 = 5) to arrive at an incorrect answer. [0 points]

Question 17
Page 2 of 4

Kaylee paints $\frac{2}{8}$ of her picture with yellow paint.

B. PLOT a point on the number line shown below to represent the fraction of Kaylee's picture that is yellow.

The student provided an incorrect answer by placing multiple marks from the $\frac{1}{8}$ position through the $\frac{6}{8}$ position. [0 points]

Question 17
Page 3 of 4

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The green rectangle has side lengths of 3 inches and 4 inches.

The orange rectangle has side lengths of 2 inches and 6 inches.

Kaylee makes the incorrect claim shown below.

> The area of the green rectangle is less than the area of the orange rectangle since 14 < 16.

C. EXPLAIN the mistake Kaylee **most likely** made when finding the areas of the two rectangles.

16 is biger then 14 because 14+2=16. So 16 is larger then 14.

61 / 1000

The student provided an incorrect explanation that does not explain the mistake made by Kaylee. The student did not recognize that the most likely error was finding perimeter instead of area. [0 points]

Question 17
Page 4 of 4

Kaylee painted a green rectangle and an orange rectangle on her picture.

The green rectangle has side lengths of 3 inches and 4 inches.

The orange rectangle has side lengths of 2 inches and 6 inches.

Kaylee makes the incorrect claim shown below.

> The area of the green rectangle is less than the area of the orange rectangle since 14 < 16.

D. REWRITE Kaylee's claim with the correct comparison of the areas.

So 16 is the biger number.

26 / 1000

The student did not rewrite the claim to be a correct comparison of the areas. The answer provided (*So 16 is the biger number*) indicates that this student did not know how to calculate either rectangle's correct area. [0 points]

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

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-T.1.1	B	1	4%	79%	7%	10%
2	A-T.1.1.1	D	2	7%	14%	8%	71%
3	A-T.1.1.4	C	1	19%	9%	60%	12%
4	B-O.1.2.1	A	2	61%	15%	17%	7%
5	B-O.2 D-M.3.1.2	B	2	34%	38%	20%	8%
6	B-O.2.1.2	C	1	11%	13%	68%	8%
7	C-G.1	B	1	13%	54%	10%	23%
8	C-G.1.1	B	2	25%	45%	11%	19%
9	C-G.1.1.2	D	1	9%	7%	8%	76%
10	D-M.1.1.1	C	1	2%	9%	73%	16%
11	D-M.1.2.2	A	1	57%	7%	18%	18%
12	D-M.1.2.3 D-M.3.1.2	C	1	34%	11%	39%	16%
13	D-M.1.3.3	D	1	19%	11%	22%	48%
14	D-M.2.1.4	D	2	35%	3%	3%	59%
15	D-M.4	B	2	11%	75%	5%	9%
16	D-M.4.1.1	C	2	15%	26%	46%	13%

Open-Ended

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
17	A-F.1.1.1 A-F.1.1.2 D-M.3.1.2	4	2	1.48