pennsylvania
DEPARTMENT OF EDUCATION

PENNSYLVANIA
KEYSTONE EXAMS

Algebra I

Item and Scoring Sampler

2019

Pennsylvania Department of Education Bureau of Curriculum, Assessment and Instruction—September 2019

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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 to the Pennsylvania Core Standards. These tools include the standards, assessment anchor documents, Keystone Exams Test Definition, Classroom Diagnostic Tool, Standards Aligned System, and content-based item and scoring samplers. This 2018 Algebra I Item and Scoring Sampler is a useful tool for Pennsylvania educators in preparing students for the Keystone Exams.

This Item and Scoring Sampler contains released operational multiple-choice and constructed-response items that have appeared on previously administered Keystone Exams. These items will not appear on any future Keystone Exams. Released items provide an idea of the types of items that have appeared on operational exams and that will appear on future operational Keystone Exams. Each item has been through a rigorous review process to ensure alignment with the Assessment Anchors and Eligible Content statements. This sampler includes items that measure a variety of Assessment Anchor or Eligible Content statements, but it does not include sample items for all Assessment Anchor or Eligible Content statements.

The items in this sampler may be used as examples for creating assessment items at the classroom level and may also be copied and used as part of a local instructional program.[1] Classroom teachers may find it beneficial to have students respond to the constructed-response items in this sampler. Educators can then use the sampler as a guide to score the responses either independently or together with colleagues.

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

ABOUT THE KEYSTONE EXAMS

The Keystone Exams are end-of-course assessments currently designed to assess proficiencies in Algebra I, Biology, and Literature. For detailed information about how the Keystone Exams are being integrated into the Pennsylvania graduation requirements, please contact the Pennsylvania Department of Education or visit the PDE website at http://www.education.pa.gov.

Alignment

The Algebra I Keystone Exam consists of exam questions grouped into **two modules**:
Module 1—Operations and Linear Equations & Inequalities, and Module 2—Linear Functions and Data Organizations. Each module corresponds to specific content, aligned to statements and specifications included in the course-specific assessment anchor documents. The Algebra I content included in the Keystone Algebra I multiple-choice items will align with the Assessment Anchors as defined by the Eligible Content statements. The process skills, directives, and action statements will also specifically align with the Assessment Anchors as defined by the Eligible Content statements.

The content included in Algebra I constructed-response items aligns with content included in the Eligible Content statements. The process skills, directives, and action statements included in the performance demands of the Algebra I constructed-response items align with specifications included in the Assessment Anchor statements, the Anchor Descriptor statements, and/or the Eligible Content statements. In other words, the verbs or action statements used in the constructed-response items or stems can come from the Eligible Content, Anchor Descriptor, or Assessment Anchor statements.

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

Depth of Knowledge

Webb's Depth of Knowledge (DOK) was created by Dr. Norman Webb of the Wisconsin Center for Education Research. Webb's definition of depth of knowledge is the cognitive expectation demanded by standards, curricular activities, and assessment tasks. Webb's DOK includes four levels, from the lowest (basic recall) level to the highest (extended thinking) level.

Depth of Knowledge	
Level 1	Recall
Level 2	Basic Application of Skill/Concept
Level 3	Strategic Thinking
Level 4	Extended Thinking

Each Keystone item has been through a rigorous review process and is assigned a DOK level. For additional information about depth of knowledge, please visit the PDE website at http://static.pdesas.org/content/documents/Keystone_Exams_Understanding_Depth_of_Knowledge_and_Cognitive_Complexity.pdf.

Exam Format

The Keystone Exams are delivered in a paper-and-pencil format as well as in a computer-based online format. The multiple-choice items require students to select the best answer from four possible answer options and record their answers in the spaces provided. The correct answer for each multiple-choice item is worth one point. The constructed-response items require students to develop and write (or construct) their responses. Constructed-response items in Algebra I are scored using item-specific scoring guidelines based on a 0–4-point scale. Each multiple-choice item is designed to take about one to one-and-a-half minutes to complete. Each constructed-response item is designed to take about 10 minutes to complete. The estimated time to respond to a test question is the same for both test formats. During an actual exam administration, students are given additional time as necessary to complete the exam.

ITEM AND SCORING SAMPLER FORMAT

This sampler includes the test directions, scoring guidelines, and formula sheet that appear in the Keystone Exams. Each sample multiple-choice item is followed by a table that includes the alignment, the answer key, the DOK, the percentage[2] of students who chose each answer option, and a brief answer option analysis or rationale. Each constructed-response item is followed by a table that includes the alignment, the DOK, 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 Algebra I* used to develop the item-specific scoring guidelines should be used if any additional item-specific scoring guidelines are created for use within local instructional programs.

Example Multiple-Choice Item Information Table

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

Example Constructed-Response Item Information Table

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

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

ALGEBRA I EXAM DIRECTIONS

Directions:

Below are the exam directions available to students. These directions may be used to help students navigate through the exam.

Formulas that you may need to solve questions in this module are found on page 7 of this test booklet. You may refer to the formula page at any time during the exam.

You may use a calculator on this module. When performing operations with π (pi), you may use either calculator π or the number 3.14 as an approximation of π.

There are two types of questions in each module.

Multiple-Choice Questions:

These questions will ask you to select an answer from among four choices.

- First read the question and solve the problem on scratch paper. Then choose the correct answer.
- Only one of the answers provided is correct.
- If none of the choices matches your answer, go back and check your work for possible errors.
- Record your answer in the Algebra I answer booklet.

Constructed-Response Questions:

These questions will require you to write your response.

- These questions have more than one part. Be sure to read the directions carefully.
- You cannot receive the highest score for a constructed-response question without completing all the tasks in the question.
- If the question asks you to show your work or explain your reasoning, be sure to show your work or explain your reasoning. However, not all questions will require that you show your work or explain your reasoning. If the question does not require that you show your work or explain your reasoning, you may use the space provided for your work or reasoning, but the work or reasoning will not be scored.
- All responses must be written in the appropriate location within the response box in the Algebra I answer booklet. Some answers may require graphing, plotting, labeling, drawing, or shading. If you use scratch paper to write your draft, be sure to transfer your final response to the Algebra I answer booklet.

INFORMATION ABOUT ALGEBRA I

If you finish early, you may check your work in Module 1 [or Module 2] only.

- Do not look ahead at the questions in Module 2 of your exam materials.
- After you have checked your work, close your exam materials.

You may refer to this page at any time during this portion of the exam.

GENERAL DESCRIPTION OF SCORING GUIDELINES FOR ALGEBRA I

4 Points

- The response demonstrates a *thorough* understanding of the mathematical concepts and procedures required by the task.
- The response provides correct answer(s) with clear and complete mathematical procedures shown and a correct explanation, as required by the task. Response may contain a minor "blemish" or omission in work or explanation that does not detract from demonstrating a thorough understanding.

3 Points

- 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 Points

- 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 Point

- The response demonstrates a *minimal* understanding of the mathematical concepts and procedures required by the task.

0 Points

- The response has no correct answer and *insufficient* evidence to demonstrate any understanding of the mathematical concepts and procedures required by the task.

  Special Categories within zero reported separately:

  Blank Blank, entirely erased, entirely crossed out, or consists entirely of whitespace

  Refusal Refusal to respond to the task

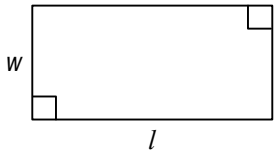
  Off Task Makes no reference to the item but is not an intentional refusal

  Foreign Language Written entirely in a language other than English

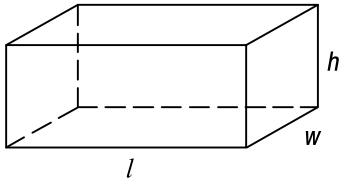
  Illegible Illegible or incoherent

FORMULA SHEET

Formulas that you may need to solve questions on this exam are found below.
You may use calculator π or the number 3.14 as an approximation of π.



$A = lw$



$V = lwh$

Linear Equations

Slope: $m = \frac{y_2 - y_1}{x_2 - x_1}$

Point-Slope Formula: $(y - y_1) = m(x - x_1)$

Slope-Intercept Formula: $y = mx + b$

Standard Equation of a Line: $Ax + By = C$

Arithmetic Properties

Additive Inverse: $a + (-a) = 0$

Multiplicative Inverse: $a \cdot \frac{1}{a} = 1$

Commutative Property: $a + b = b + a$
$a \cdot b = b \cdot a$

Associative Property: $(a + b) + c = a + (b + c)$
$(a \cdot b) \cdot c = a \cdot (b \cdot c)$

Identity Property: $a + 0 = a$
$a \cdot 1 = a$

Distributive Property: $a \cdot (b + c) = a \cdot b + a \cdot c$

Multiplicative Property of Zero: $a \cdot 0 = 0$

Additive Property of Equality:
If $a = b$, then $a + c = b + c$

Multiplicative Property of Equality:
If $a = b$, then $a \cdot c = b \cdot c$

ALGEBRA I MODULE 1
Multiple-Choice Items

1. Which expression can be simplified to the form $3\sqrt{y+3}$, where y is a positive integer?

A. $\sqrt{18}$

B. $\sqrt{63}$

C. $\sqrt{75}$

D. $\sqrt{84}$

Item Information	
Alignment	A1.1.1.1.2
Answer Key	B
Depth of Knowledge	2
p-value A	38%
p-value B	41% (correct answer)
p-value C	11%
p-value D	10%
Option Annotations	A student could determine the **correct** answer, option B, by determining that it is the only option to meet two requirements: the number under the radical before it is simplified must be a multiple of 9 in order to have a 3 outside the radical after it is simplified, and since y is a positive integer, the number under the radical before simplifying must be at least the fourth multiple of 9, or 36. A student could arrive at an **incorrect** answer by finding an expression which only meets one of the requirements. For example, a student could arrive at option A by meeting the requirement that the number under the radical before it is simplified be a multiple of 9 while not using a positive integer for y.

2. A dog's body temperature (t), in degrees Fahrenheit (°F), is considered normal when the value of the expression below is no more than 0.75.

$$|t - 101.75|$$

A dog's body temperature is 101.2°F. Based on the expression, which statement about the dog's body temperature is true?

A. Since normal body temperature is from 100.25°F to 103.25°F, the dog's body temperature is considered normal.

B. Since normal body temperature is from 100.25°F to 103.25°F, the dog's body temperature is not considered normal.

C. Since normal body temperature is from 101°F to 102.5°F, the dog's body temperature is considered normal.

D. Since normal body temperature is from 101°F to 102.5°F, the dog's body temperature is not considered normal.

Item Information	
Alignment	A1.1.1.3.1
Answer Key	C
Depth of Knowledge	2
p-value A	15%
p-value B	9%
p-value C	61% (correct answer)
p-value D	15%
Option Annotations	A student could determine the **correct** answer, option C, by setting up the inequality $\|t - 101.75\| \leq 0.75$ and solving for t to find $101 \leq t \leq 102.5$ and comparing the given temperature, 101.2, to this range. A student could arrive at an **incorrect** answer by misinterpreting the meaning of the given context. For example, a student could arrive at option D by interpreting normal as being outside the range given by the context.

3. Over one week, a snack booth at a fair sold 362 cans of soft drinks for $1.75 each and 221 hot dogs for $2.35 each. Which calculation will give the **closest estimate** of the sales of soft drinks and hot dogs?

A. 300(2) + 200(2)

B. 400(2) + 200(2)

C. 400(2) + 200(3)

D. 400(2) + 300(3)

Item Information	
Alignment	A1.1.1.4.1
Answer Key	B
Depth of Knowledge	2
p-value A	17%
p-value B	69% (correct answer)
p-value C	10%
p-value D	4%
Option Annotations	A student could determine the **correct** answer, option B, by rounding each quantity of items to the nearest hundred and each price to the nearest dollar. A student could arrive at an **incorrect** answer by rounding incorrectly. For example, a student could arrive at option A by rounding 362 down to 300 instead of up to 400.

4. When $x^3 - 2x^2 - 15x$ is factored completely, which expression is one of the factors?

A. $x - 5$

B. $x + 5$

C. $x^2 - 5x$

D. $x^2 - 2x - 15$

Item Information	
Alignment	A1.1.1.5.2
Answer Key	A
Depth of Knowledge	1
p-value A	36% (correct answer)
p-value B	12%
p-value C	23%
p-value D	29%
Option Annotations	A student could determine the **correct** answer, option A, by factoring an x out of each term to arrive at $x(x^2 - 2x - 15)$, and then factoring the quadratic inside the parentheses. A student could arrive at an **incorrect** answer by not factoring completely. For example, a student could arrive at option D by stopping after the x is factored out of each term.

5. A clothing company sells hats online to its customers. The price of each hat is p dollars. The shipping cost is s dollars. The equation shown below can be used to find the total cost (c), in dollars, when n hats are purchased.

$$c = np + s$$

Which equation can be used to find the price of each hat when 5 hats are purchased, the shipping cost is $6, and the total cost is $41?

A. $c = 5(6) + 41$

B. $c = 6(41) + 5$

C. $41 = 5p + 6$

D. $41 = 6p + 5$

Item Information	
Alignment	A1.1.2.1.1
Answer Key	C
Depth of Knowledge	2
p-value A	7%
p-value B	4%
p-value C	84% (correct answer)
p-value D	5%
Option Annotations	A student could determine the **correct** answer, option C, by replacing the variables in the given equation with the corresponding numbers given in the context: n is replaced with 5, s is replaced with 6, and c is replaced with 41. A student could arrive at an **incorrect** answer by assigning given numbers to incorrect variables. For example, a student could arrive at option A by replacing n with 5, p with 6, and s with 41.

6. An equation and some of the steps used to solve the equation are shown below. One step is missing.

$$2(x - 3) + 10x = 5(3 + x)$$
$$?$$
$$2x - 5x + 10x = 15 + 6$$
$$7x = 21$$
$$x = 3$$

Which set of statements is **most likely** the missing step and the property that justifies the step?

A. $2x - (3 + 10x) = 5(3 + x)$
This step is justified by the associative property.

B. $2(x - 3) = 5(3 + x) - 10x$
This step is justified by the associative property.

C. $2x - 6 + 10x = 15 + 5x$
This step is justified by the distributive property.

D. $2x - 3 + 10x = 15 + x$
This step is justified by the distributive property.

Item Information	
Alignment	A1.1.2.1.2
Answer Key	C
Depth of Knowledge	2
p-value A	6%
p-value B	7%
p-value C	81% (correct answer)
p-value D	6%
Option Annotations	A student could determine the **correct** answer, option C, by applying the distributive property to arrive at an equation that is equivalent to the given equation and leads to the equation after the question mark in one more step. A student could arrive at an **incorrect** answer by applying an incorrect property. For example, a student could arrive at answer B by applying the additive property of equality, resulting in an equivalent equation which does not lead to the equation after the question mark in one step.

7. A student is selling small and large frozen pizzas for a school fund-raiser.

- The student earns $3 for each small pizza sold.
- The student earns $4 for each large pizza sold.
- The student has sold exactly 30 pizzas.
- The student has earned $100.

How many small pizzas and large pizzas has the student sold?

A. 10 small pizzas
20 large pizzas

B. 14 small pizzas
16 large pizzas

C. 18 small pizzas
12 large pizzas

D. 20 small pizzas
10 large pizzas

Item Information	
Alignment	A1.1.2.2.1
Answer Key	D
Depth of Knowledge	2
p-value A	6%
p-value B	4%
p-value C	3%
p-value D	87% (correct answer)
Option Annotations	A student could determine the **correct** answer, option D, by setting up a system of equations where x is the number of small pizzas and y is the number of large pizzas: $x + y = 30$ and $3x + 4y = 100$, and then solving for x and y. A student could arrive at an **incorrect** answer by switching the association of values. For example, a student could arrive at option A by switching the meaning of the variable assigned to the number of small pizzas with the variable assigned to the number of large pizzas.

8. The system of equations below describes the relationship between the time (t), in seconds, two objects have been traveling and each object's velocity (v), in feet per second.

$$v = -32t$$
$$v = -32t + 16$$

Based on the system of equations, which statement about the velocity of the objects is true?

A. The objects never travel at the same velocity.

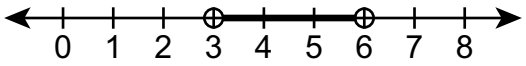
B. The objects always travel at the same velocity.

C. The objects travel at the same velocity only after they have been traveling for $\frac{1}{4}$ second.

D. The objects travel at the same velocity only after they have been traveling for $\frac{1}{2}$ second.

Item Information	
Alignment	A1.1.2.2.2
Answer Key	A
Depth of Knowledge	2
p-value A	55% (correct answer)
p-value B	13%
p-value C	14%
p-value D	18%
Option Annotations	A student could determine the **correct** answer, option A, by setting the two equations equal to each other, solving to find the false statement 0 = 16, and interpreting this as indicating no solution. A student could arrive at an **incorrect** answer by finding the zero of one of the equations. For example, a student could arrive at option D by setting $v = 0$ in the second equation and solving for t.

9. The solution set of an inequality is shown below.



Which inequality has this solution set?

A. $1 < 3x < 2$

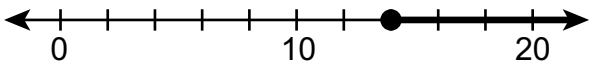
B. $1 < x + 2 < 4$

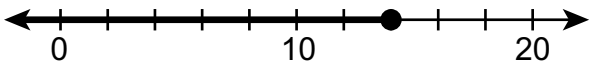
C. $6 < 2x < 9$

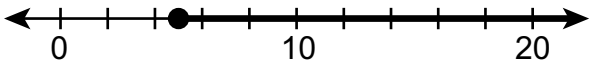
D. $6 < x + 3 < 9$

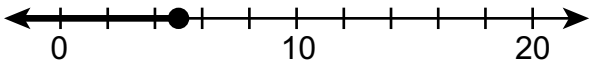
Item Information	
Alignment	A1.1.3.1.1
Answer Key	D
Depth of Knowledge	1
p-value A	10%
p-value B	12%
p-value C	11%
p-value D	67% (correct answer)
Option Annotations	A student could determine the **correct** answer, option D, by identifying the solution set as $3 < x < 6$ and finding the inequality with the same solution set. A student could arrive at an **incorrect** answer by not correctly manipulating the inequalities. For example, a student could arrive at option B by adding 2 to cancel the + 2.

10. Sandy has at least 2 times as many pencils as David has. David has 3 pencils more than Pietro has. Pietro has 4 pencils. Which number line shows the solution set for the possible numbers of pencils that Sandy has?

A. 

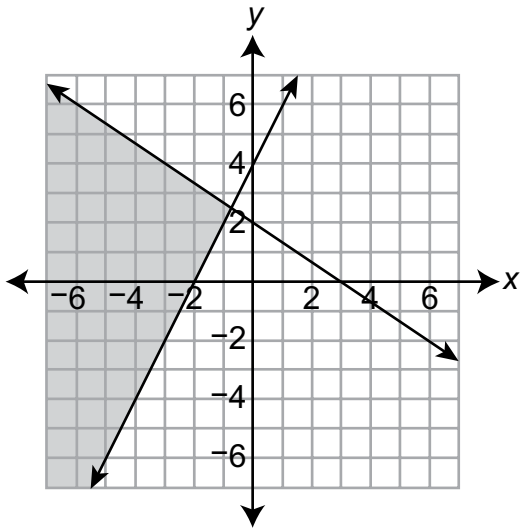
B. 

C. 

D. 

Item Information	
Alignment	A1.1.3.1.2
Answer Key	A
Depth of Knowledge	2
p-value A	65% (correct answer)
p-value B	12%
p-value C	18%
p-value D	5%
Option Annotations	A student could determine the **correct** answer, option A, by adding 4 and 3 to find the number of pencils David has and then multiplying the sum by 2 to find the minimum number of pencils Sandy has (14) and identifying the number line with a closed circle at 14 and shading to the right of the closed circle to represent the situation. A student could arrive at an **incorrect** answer by applying operations in the wrong order. For example, a student could arrive at option C by multiplying 4 by 2 and then subtracting 3 to find a minimum number of 5.

11. The graph of the solution set for a system of inequalities is shown below.



Which system of inequalities is represented by the graph?

A. $-2x + y \leq 4$
$2x + 3y \leq 6$

B. $-2x + y \geq 4$
$2x + 3y \geq 6$

C. $-2x + y \leq 4$
$2x + 3y \geq 6$

D. $-2x + y \geq 4$
$2x + 3y \leq 6$

Item Information	
Alignment	A1.1.3.2.1
Answer Key	D
Depth of Knowledge	1
p-value A	23%
p-value B	18%
p-value C	23%
p-value D	36% (correct answer)
Option Annotations	A student could determine the **correct** answer, option D, by determining that the shaded region is above the line $-2x + y = 4$ and below the line $2x + 3y = 6$. A student could arrive at an **incorrect** answer by switching the direction of the inequalities. For example, a student could arrive at option C by switching the direction of both inequalities.

12. A teacher is buying word games and board games for his students.

- Each word game can be played by up to 4 students.
- Each board game can be played by 2 students.
- The teacher needs enough games for 30 students to play at the same time.
- The maximum amount that the teacher can spend on the games is $200.

The number of word games (x) and the number of board games (y) the teacher buys must satisfy the system of linear inequalities below.

$$4x + 2y \geq 30$$

$$14.5x + 18y \leq 200$$

The teacher plans to buy 5 word games and 8 board games. Which statement about the number of games the teacher plans to buy is true?

A. There will be enough games for 30 students to play at the same time, but the total cost will be greater than the maximum amount.

B. There will be enough games for 30 students to play at the same time, and the total cost will be less than the maximum amount.

C. There will not be enough games for 30 students to play at the same time, and the total cost will be greater than the maximum amount.

D. There will not be enough games for 30 students to play at the same time, but the total cost will be less than the maximum amount.

Item Information	
Alignment	A1.1.3.2.2
Answer Key	A
Depth of Knowledge	2
p-value A	63% (correct answer)
p-value B	19%
p-value C	12%
p-value D	6%
Option Annotations	A student could determine the **correct** answer, option A, by substituting 5 for x and 8 for y in the inequalities and then solving to find that the first inequality is satisfied but the second is not. A student could arrive at an **incorrect** answer by not performing all operations after substituting numbers for variables. For example, a student could arrive at option B by not multiplying the number of games by the cost per game.

CONSTRUCTED-RESPONSE ITEM

13. In a science experiment, a scientist records the wavelengths of six waves. The wavelengths, in nanometers, are listed below.

$$0.0001 \qquad \frac{5}{100} \qquad 10^{-3} \qquad 1.0001 \qquad \frac{1}{1{,}000} \qquad 2 \times 10^{-2}$$

A. Which two wavelengths are equal to one another?

equal wavelengths: _____ and _____

B. Which wavelength is the shortest?

shortest wavelength: _____

Go to the next page to finish question 13.

GO ON

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

To find the speed of a wave, the scientist uses the formula shown below.

$$\text{speed} = (\text{wavelength}) \bullet (\text{frequency})$$

The wave with wavelength 10^{-3} nanometer has a frequency of 10^{x}. The speed of the wave is 10^{y}, where $y > 3$.

C. Write an inequality in terms of x to represent all possible values of x.

inequality: _____

The wavelength of a seventh wave is recorded. The wavelength is greater than 2×10^{-2} nanometer and less than $\frac{5}{100}$ nanometer.

D. Write a possible wavelength, in nanometers, for the seventh wavelength. Write the possible wavelength as a fraction with a denominator of 100.

possible wavelength: _____ nanometer

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

#13 Item Information

Alignment	A1.1.1	**Depth of Knowledge**	2	**Mean Score**	1.97

Assessment Anchor this item will be reported under:

A1.1.1—Operations with Real Numbers and Expressions

Specific Anchor Descriptor addressed by this item:

A1.1.1.1—Represent and/or use numbers in equivalent forms (e.g., integers, fractions, decimals, square roots, and exponents).
A1.1.1.3—Use exponents, roots, and/or absolute values to solve problems.

Scoring Guide

Score	Description
4	The student demonstrates a thorough understanding of operations with real numbers and expressions by correctly solving problems with clear and complete procedures and explanations when required.
3	The student demonstrates a general understanding of operations with real numbers and expressions by solving problems and providing procedures and explanations with only minor errors or omissions.
2	The student demonstrates a partial understanding of operations with real numbers and expressions by providing a portion of the correct problem solving, procedures, and explanations.
1	The student demonstrates a minimal understanding of operations with real numbers and expressions.
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 points.
2	Student earns 2 points.
1	Student earns 1 point.
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?
10^{-3} (nanometer) AND $\frac{1}{1{,}000}$ (nanometer) **OR** 10^{-3} (nanometer) AND .001 (nanometer) **OR** .001 (nanometer) AND $\frac{1}{1{,}000}$ (nanometer) **OR** 3 AND 5	

Part B (1 point):

1 point for correct answer

What?	Why?
0.0001 (nanometer) **OR** 1	

Part C (1 point):

1 point for correct answer

What?	Why?
$^{-}3 + x > 3$ **OR** $x > 6$	

Part D (1 point):

1 point for correct answer

What?	Why?
Answers may vary. Accept any answer in the form $\frac{x}{100}$, where $2 < x < 5$. **Sample Responses:** $\frac{4}{100}$ (nanometer) **OR** $\frac{2.5}{100}$ (nanometer)	

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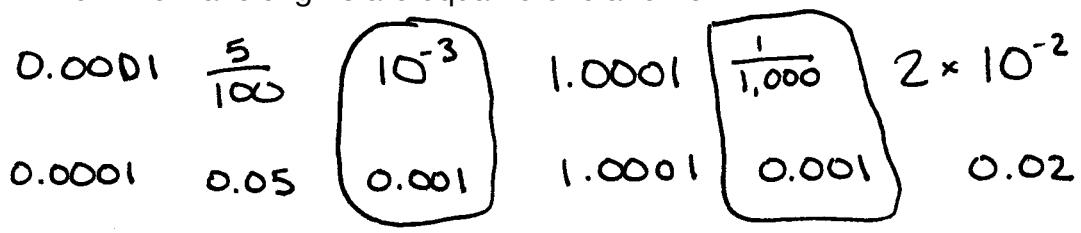
STUDENT RESPONSE

Response Score: 4 points

13. In a science experiment, a scientist records the wavelengths of six waves. The wavelengths, in nanometers, are listed below.

$0.0001 \quad \frac{5}{100} \quad 10^{-3} \quad 1.0001 \quad \frac{1}{1{,}000} \quad 2 \times 10^{-2}$

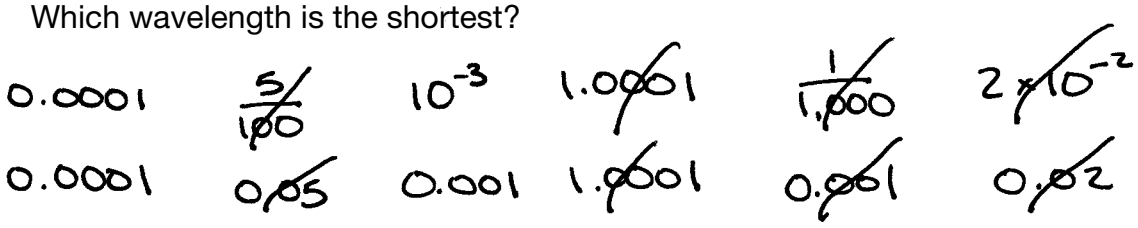
A. Which two wavelengths are equal to one another?



equal wavelengths: 10^{-3} and $\frac{1}{1{,}000}$

The response provides a correct answer.

B. Which wavelength is the shortest?



shortest wavelength: 0.0001

The response provides a correct answer.

Go to the next page to finish question 13.

GO ON

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

To find the speed of a wave, the scientist uses the formula shown below.

speed = (wavelength) • (frequency)

The wave with wavelength 10^{-3} nanometer has a frequency of 10^{x}. The speed of the wave is 10^{y}, where $y > 3$.

C. Write an inequality in terms of x to represent all possible values of x.

$10^{y} = 10^{-3} \cdot 10^{x}$ $x > 6$

$10^{3} = 1{,}000$

$10^{-3} \cdot 10^{6} = 10^{3}$

10^{y}, where $y > 3$ can't work

x has to be greater than 6

inequality: $x > 6$

The response provides a correct inequality.

The wavelength of a seventh wave is recorded. The wavelength is greater than 2×10^{-2} nanometer and less than $\frac{5}{100}$ nanometer.

D. Write a possible wavelength, in nanometers, for the seventh wavelength. Write the possible wavelength as a fraction with a denominator of 100.

2×10^{-2} $\frac{5}{100}$ $0.02 < x < 0.05$

0.02 0.05

possible wave lengths

0.04

0.03

$0.04 = \frac{1}{25}$

$0.03 = \frac{3}{100}$

possible wavelength: $\frac{3}{100}$ nanometer

The response provides a correct answer.

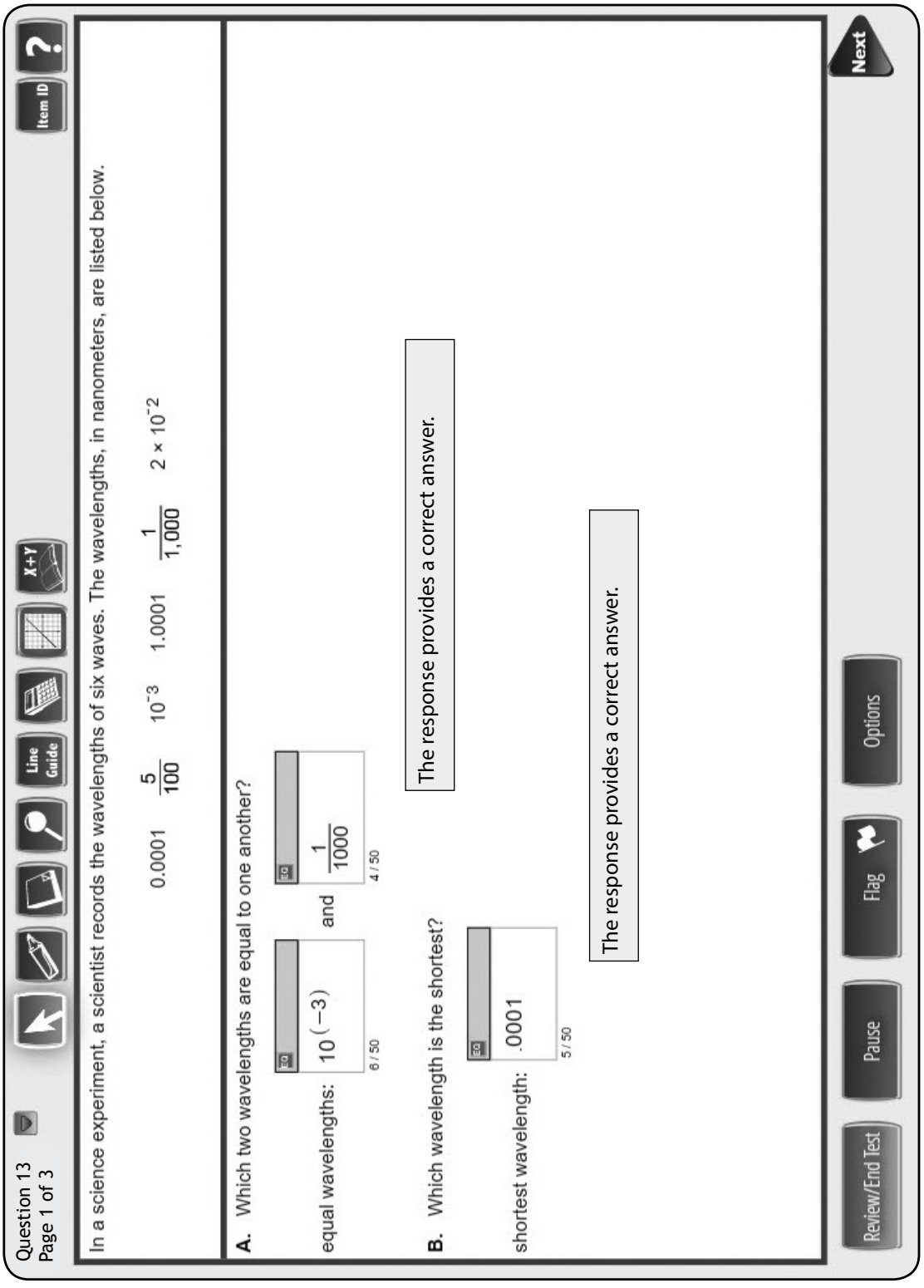
AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STOP

STUDENT RESPONSE

Response Score: 3 points

PARTS A AND B



STUDENT RESPONSE

PART C

STUDENT RESPONSE

PART D

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STUDENT RESPONSE

Response Score: 2 points

13. In a science experiment, a scientist records the wavelengths of six waves. The wavelengths, in nanometers, are listed below.

$$0.0001 \qquad \frac{5}{100} \qquad 10^{-3} \qquad 1.0001 \qquad \frac{1}{1{,}000} \qquad 2 \times 10^{-2}$$

A. Which two wavelengths are equal to one another?

equal wavelengths: .0001 and $\frac{1}{1{,}000}$

The response provides an incorrect answer.

B. Which wavelength is the shortest?

shortest wavelength: .0001

The response provides a correct answer

Go to the next page to finish question 13.

GO ON

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

To find the speed of a wave, the scientist uses the formula shown below.

speed = (wavelength) • (frequency)

The wave with wavelength 10^{-3} nanometer has a frequency of 10^{x}. The speed of the wave is 10^{y}, where $y > 3$.

C. Write an inequality in terms of x to represent all possible values of x.

$X > -3$

inequality: $X > -3$

The response provides an incorrect inequality.

The wavelength of a seventh wave is recorded. The wavelength is greater than 2×10^{-2} nanometer and less than $\frac{5}{100}$ nanometer.

D. Write a possible wavelength, in nanometers, for the seventh wavelength. Write the possible wavelength as a fraction with a denominator of 100.

possible wavelength: $\frac{4}{100}$ nanometer

The response provides a correct answer.

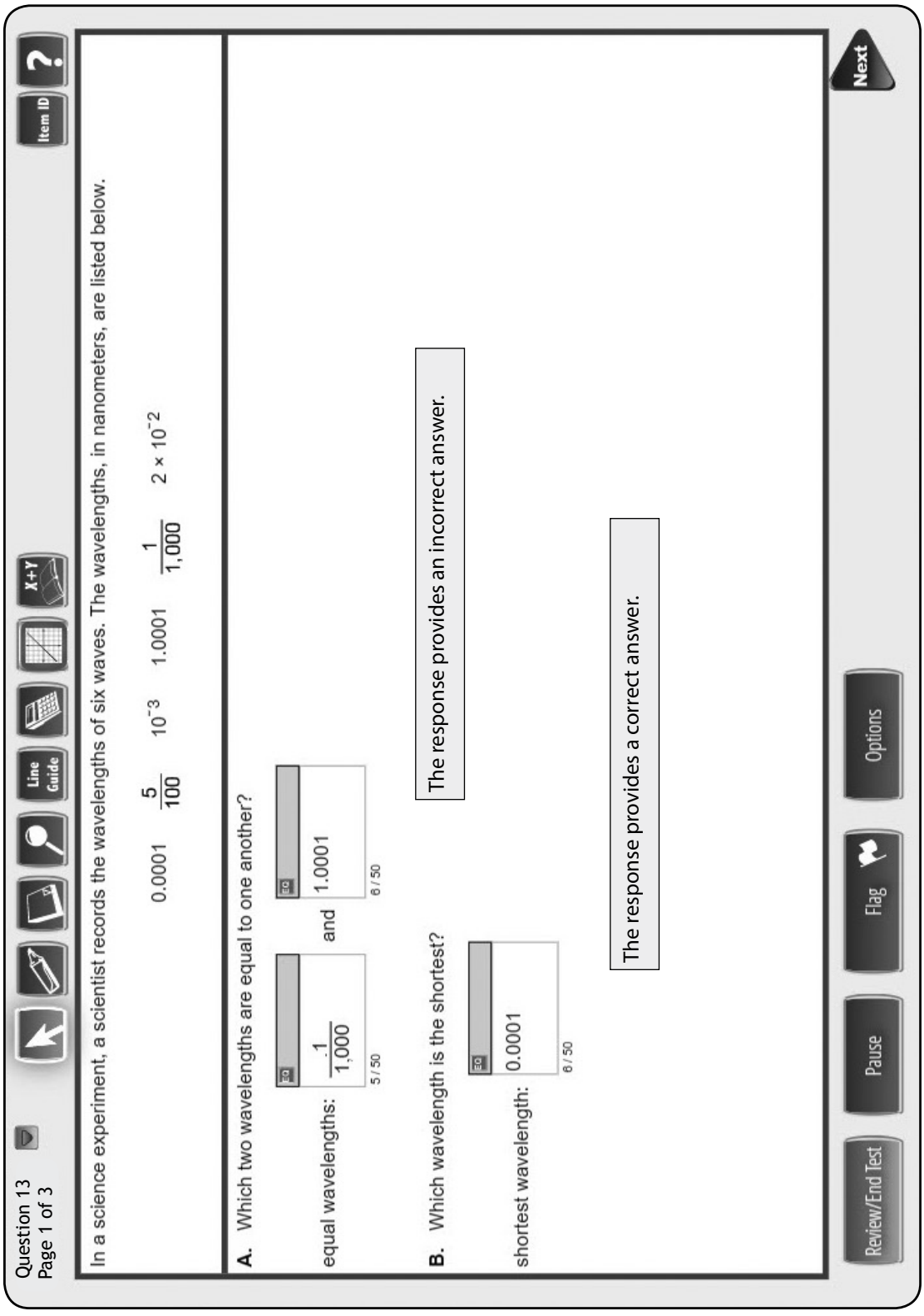
AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STOP

STUDENT RESPONSE

Response Score: 1 point

PARTS A AND B



STUDENT RESPONSE

PART C

STUDENT RESPONSE

PART D

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STUDENT RESPONSE

Response Score: 0 points

13. In a science experiment, a scientist records the wavelengths of six waves. The wavelengths, in nanometers, are listed below.

$$0.0001 \qquad \frac{5}{100} \qquad 10^{-3} \qquad 1.0001 \qquad \frac{1}{1{,}000} \qquad 2 \times 10^{-2}$$

A. Which two wavelengths are equal to one another?

The response provides an incorrect answer.

equal wavelengths: 0.0001 and $\frac{1}{1000}$

B. Which wavelength is the shortest?

The response provides an incorrect answer.

shortest wavelength: 10^{-3}

Go to the next page to finish question 13.

GO ON

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

To find the speed of a wave, the scientist uses the formula shown below.

$$\text{speed} = (\text{wavelength}) \bullet (\text{frequency})$$

The wave with wavelength 10^{-3} nanometer has a frequency of 10^{x}. The speed of the wave is 10^{y}, where $y > 3$.

C. Write an inequality in terms of x to represent all possible values of x.

The response provides an incorrect inequality.

inequality: $10y > 3$

The wavelength of a seventh wave is recorded. The wavelength is greater than 2×10^{-2} nanometer and less than $\frac{5}{100}$ nanometer.

D. Write a possible wavelength, in nanometers, for the seventh wavelength. Write the possible wavelength as a fraction with a denominator of 100.

The response provides an incorrect answer.

possible wavelength: $\frac{20}{100}$ nanometer

AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STOP

CONSTRUCTED-RESPONSE ITEM

14. Four people each deliver food to people's homes.

Curtis charges a flat fee of $2.50 for each delivery plus $0.20 per mile for each mile he drives. For one delivery, Curtis drives 6 miles.

A. How much does Curtis charge to deliver the food?

Audrey charges a flat fee of $4 for each delivery plus a certain amount, in dollars per mile, for each mile she drives. For a distance of 30 miles, Curtis and Audrey charge the same amount.

B. How much does Audrey charge, in dollars per mile? Show or explain all your work.

Go to the next page to finish question 14.

GO ON

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

The amounts of money Peter and Maria each charge to deliver food are described below.

- Peter charges a flat fee of $3.75 for each delivery plus $0.10 per mile for each mile he drives.
- Maria charges a flat fee of $2.25 for each delivery plus $0.25 per mile for each mile she drives.

Peter says there are two distances for which he and Maria charge the same amount. To prove Peter is not correct, Maria graphs a line for her delivery charges and a line for Peter's delivery charges. Each line represents the relationship between the amount (y), in dollars, each person charges for a delivery and the distance (x), in miles, each drives for the delivery.

C. Without showing the graph, explain how Maria's graph of the two lines proves Peter is **not** correct.

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

#14 Item Information

Alignment	A1.1.2	**Depth of Knowledge**	2	**Mean Score**	1.73

Assessment Anchor this item will be reported under:

A1.1.2—Linear Equations

Specific Anchor Descriptor addressed by this item:

A1.1.2.1—Write, solve, and/or graph linear equations using various methods.
A1.1.2.2—Write, solve, and/or graph systems of linear equations using various methods.

Scoring Guide

Score	Description
4	The student demonstrates a thorough understanding of linear equations by correctly solving problems with clear and complete procedures and explanations when required.
3	The student demonstrates a general understanding of linear equations by solving problems and providing procedures and explanations with only minor errors or omissions.
2	The student demonstrates a partial understanding of linear equations by providing a portion of the correct problem solving, procedures, and explanations.
1	The student demonstrates a minimal understanding of linear equations.
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 linear equations.
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?
$3.70	

Part B (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?
($)0.15 (per mile) **OR** 0.15 (dollars per mile) **OR** 15¢ (per mile) **OR** 15 cents (per mile) (*Note: Student must include correct monetary unit if using 15.*)	**Sample Work:** $4 + 30r = 2.50 + 0.20(30)$ $4 + 30r = 2.50 + 6$ $30r = 4.5$ $r = 0.15$ **OR** **Sample Explanation:** For a distance of 30 miles, Curtis charges $8.50. Audrey charges a base rate of $4, so she must charge $4.50 for the mileage. So her rate per mile is $4.5 \div 30 = 0.15$. **OR equivalent**

Part C (1 point):

1 point for correct and complete explanation

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

Note: No credit for drawing the graph, but explanation still eligible for full or partial credit.

What?	Why?
	Sample Explanations: Since the two lines have different rates of change ($0.10 versus $0.25), the two lines can intersect at only one point. **OR** Since the two lines have different flat fees ($3.75 versus $2.25), the two lines can either be parallel or intersect at only one point. Since the two lines have one point in common (at 10 miles), they cannot be parallel. So, the two lines can intersect at only one point. **OR equivalent**

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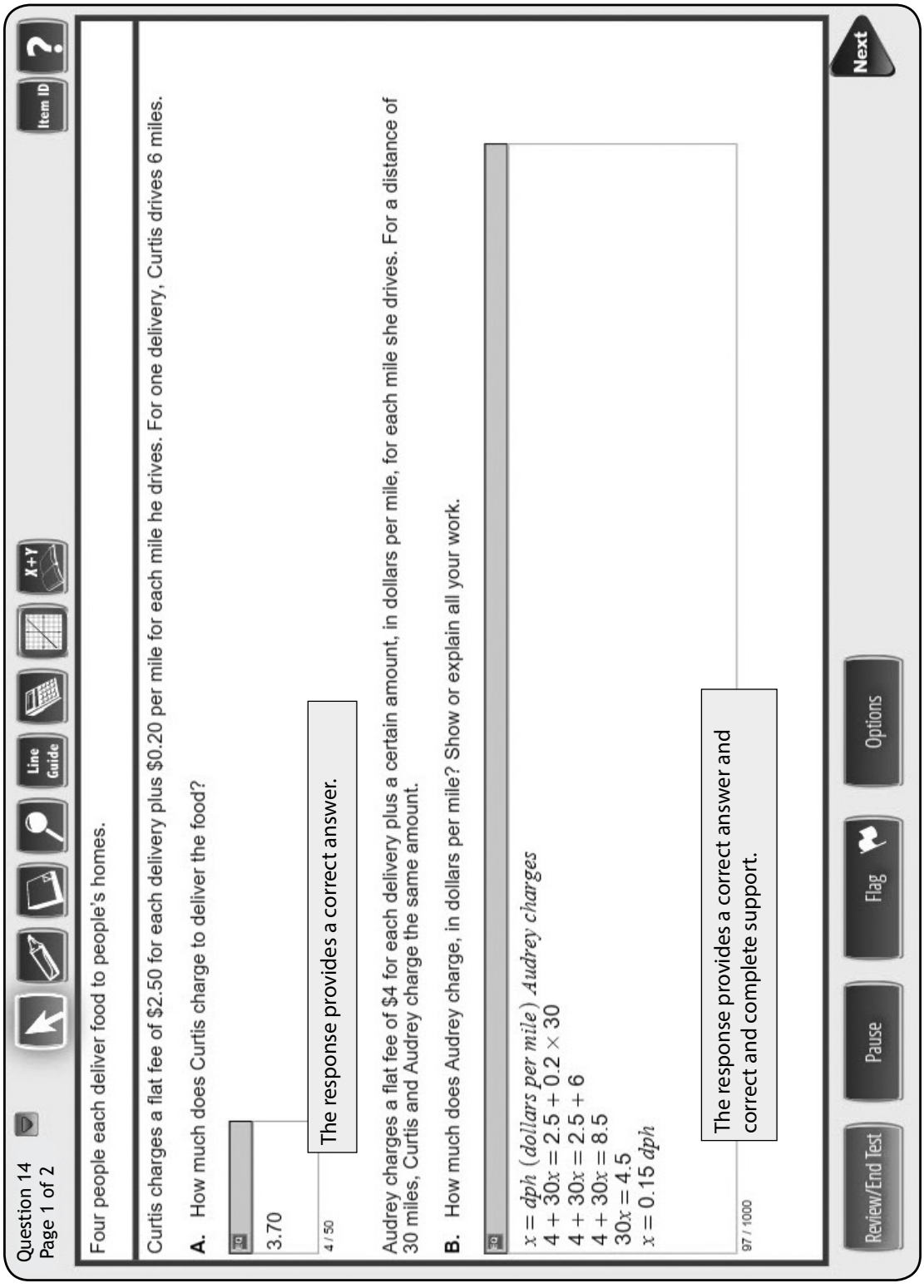
STUDENT RESPONSE

Response Score: 4 points

PARTS A AND B



STUDENT RESPONSE

PART C

STUDENT RESPONSE

Response Score: 3 points

14. Four people each deliver food to people's homes.

Curtis charges a flat fee of $2.50 for each delivery plus $0.20 per mile for each mile he drives. For one delivery, Curtis drives 6 miles.

A. How much does Curtis charge to deliver the food?

$2.50 + 0.2(6) = y$

$2.50 + 1.2 = y$

Curtis will charge $3.70 to deliver 6 miles.

The response provides a correct answer.

Audrey charges a flat fee of $4 for each delivery plus a certain amount, in dollars per mile, for each mile she drives. For a distance of 30 miles, Curtis and Audrey charge the same amount.

B. How much does Audrey charge, in dollars per mile? Show or explain all your work.

Curtis: $2.50 + .2(30)$

Audrey: $4 + 30x = 8.5$

$-4 \quad -4$

8.5

-4.0

4.5

$.15$

8.5

$\frac{30x}{30} = \frac{4.5}{30}$

$\frac{4.5}{30} = .15$

Audrey charges .15 cents per mile

The response provides an incorrect answer with correct and complete support.

Go to the next page to finish question 14.

GO ON

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

The amounts of money Peter and Maria each charge to deliver food are described below.

- Peter charges a flat fee of $3.75 for each delivery plus $0.10 per mile for each mile he drives.
- Maria charges a flat fee of $2.25 for each delivery plus $0.25 per mile for each mile she drives.

Peter says there are two distances for which he and Maria charge the same amount. To prove Peter is not correct, Maria graphs a line for her delivery charges and a line for Peter's delivery charges. Each line represents the relationship between the amount (y), in dollars, each person charges for a delivery and the distance (x), in miles, each drives for the delivery.

C. Without showing the graph, explain how Maria's graph of the two lines proves Peter is **not** correct.

The two lines only intersect once meaning that there is only one distance that Maria and Peter overlap, which is at 10 miles.

The response provides a correct and complete explanation.

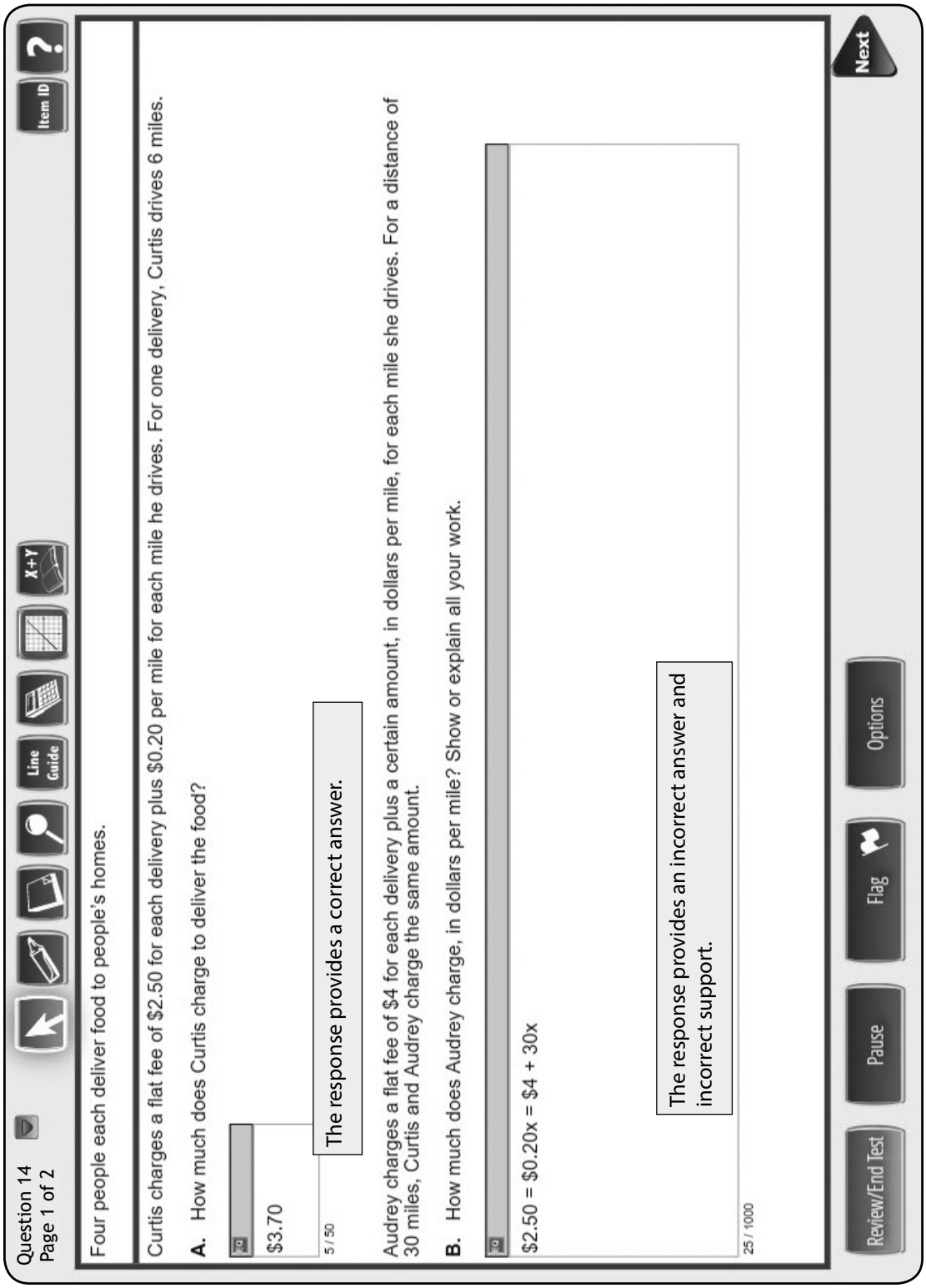
AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STOP

STUDENT RESPONSE

Response Score: 2 points

PARTS A AND B



STUDENT RESPONSE

PART C

STUDENT RESPONSE

Response Score: 1 point

14. Four people each deliver food to people's homes.

Curtis charges a flat fee of $2.50 for each delivery plus $0.20 per mile for each mile he drives. For one delivery, Curtis drives 6 miles.

A. How much does Curtis charge to deliver the food?

$2.50 + 0.20(6)$

$2.50 + 1.2$

$= \$3.70$

The response provides a correct answer.

Audrey charges a flat fee of $4 for each delivery plus a certain amount, in dollars per mile, for each mile she drives. For a distance of 30 miles, Curtis and Audrey charge the same amount.

B. How much does Audrey charge, in dollars per mile? Show or explain all your work.

$30 - 4 = \#26$

The response provides an incorrect answer and incorrect support.

Go to the next page to finish question 14.

GO ON

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

The amounts of money Peter and Maria each charge to deliver food are described below.

- Peter charges a flat fee of $3.75 for each delivery plus $0.10 per mile for each mile he drives.
- Maria charges a flat fee of $2.25 for each delivery plus $0.25 per mile for each mile she drives.

Peter says there are two distances for which he and Maria charge the same amount. To prove Peter is not correct, Maria graphs a line for her delivery charges and a line for Peter's delivery charges. Each line represents the relationship between the amount (y), in dollars, each person charges for a delivery and the distance (x), in miles, each drives for the delivery.

C. Without showing the graph, explain how Maria's graph of the two lines proves Peter is **not** correct.

It proves to Peter that if they touch on the graph that it is not the same after sertain miles.

The response provides an incorrect explanation.

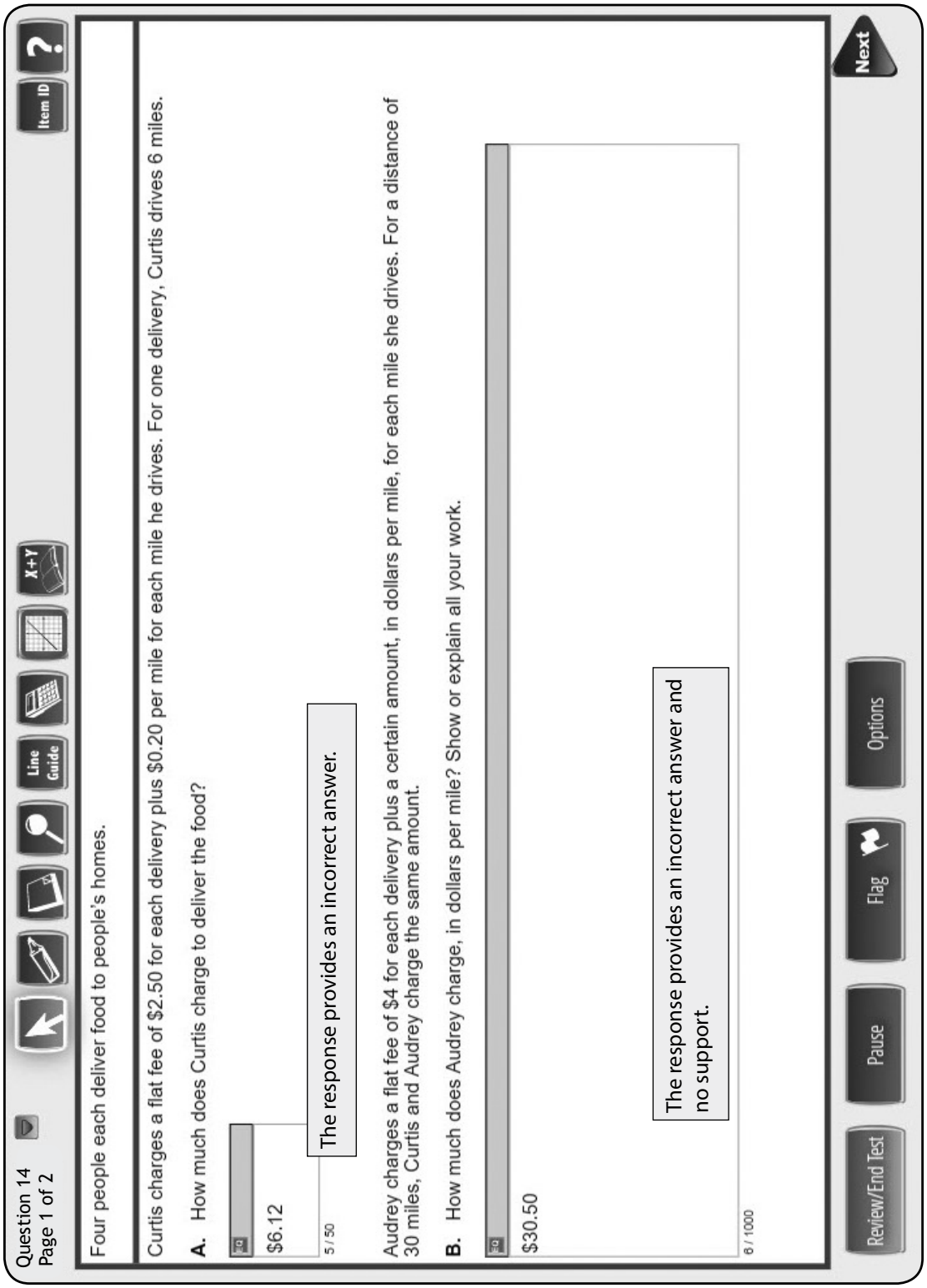
AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STOP

STUDENT RESPONSE

Response Score: 0 points

PARTS A AND B



STUDENT RESPONSE

PART C

ALGEBRA I MODULE 1—SUMMARY DATA

MULTIPLE-CHOICE

Sample Number	Alignment	Answer Key	Depth of Knowledge	*p*-values A	*p*-values B	*p*-values C	*p*-values D
1	A1.1.1.1.2	B	2	38%	41%	11%	10%
2	A1.1.1.3.1	C	2	15%	9%	61%	15%
3	A1.1.1.4.1	B	2	17%	69%	10%	4%
4	A1.1.1.5.2	A	1	36%	12%	23%	29%
5	A1.1.2.1.1	C	2	7%	4%	84%	5%
6	A1.1.2.1.2	C	2	6%	7%	81%	6%
7	A1.1.2.2.1	D	2	6%	4%	3%	87%
8	A1.1.2.2.2	A	2	55%	13%	14%	18%
9	A1.1.3.1.1	D	1	10%	12%	11%	67%
10	A1.1.3.1.2	A	2	65%	12%	18%	5%
11	A1.1.3.2.1	D	1	23%	18%	23%	36%
12	A1.1.3.2.2	A	2	63%	19%	12%	6%

CONSTRUCTED-RESPONSE

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
13	A1.1.1	4	2	1.97
14	A1.1.2	4	2	1.73

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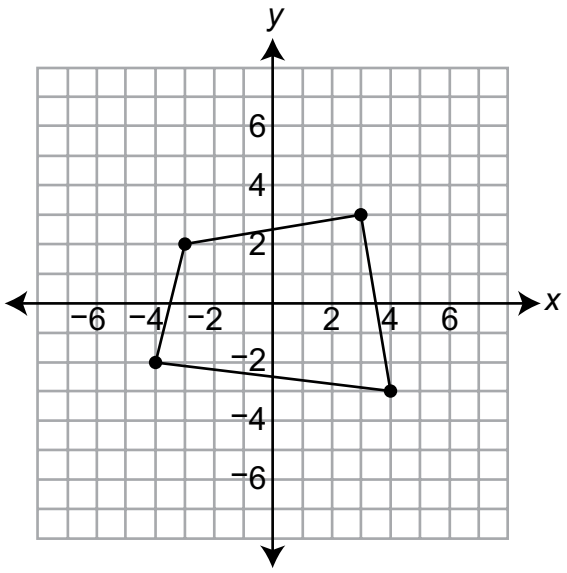
ALGEBRA I MODULE 2
Multiple-Choice Items

1. A graph of a relation is shown below.



Removing which line segment from the graph would make the relation a function of x?

A. the line segment with endpoints $(-4, -2)$ and $(-3, 2)$

B. the line segment with endpoints $(-3, 2)$ and $(3, 3)$

C. the line segment with endpoints $(3, 3)$ and $(4, -3)$

D. the line segment with endpoints $(4, -3)$ and $(-4, -2)$

Item Information	
Alignment	A1.2.1.1.2
Answer Key	D
Depth of Knowledge	2
p-value A	23%
p-value B	19%
p-value C	20%
p-value D	38% (correct answer)
Option Annotations	A student could determine the **correct** answer, option D, by recognizing that for all values except $^{-}4$ and 4 in the domain of the relation, there are two values in the range, and in each case, one of the two values is on the line segment between (4, $^{-}3$) and ($^{-}4$, $^{-}2$). A student could arrive at an **incorrect** answer by applying an incorrect definition of a function. For example, a student could arrive at option A by applying a definition of a function that only requires the graph to not be a closed shape.

2. The set of ordered pairs below is a relation.

{(0.5, 2), (1.5, 5), (4.0, 12), (6.5, 15)}

Which relation has the same domain as the given relation?

A. {(1, 5), (2, 2), (−3, 15), (−8, 12)}

B. {(0.5, 1), (1.5, 4), (4.0, 11), (6.5, 14)}

C. {(2, 1.1), (5, 2.2), (12, 3.3), (15, 4.4)}

D. {(−1, 6.5), (−3, 1.5), (−6, 4.0), (−10, 0.5)}

Item Information	
Alignment	A1.2.1.1.3
Answer Key	B
Depth of Knowledge	1
p-value A	12%
p-value B	72% (correct answer)
p-value C	11%
p-value D	5%
Option Annotations	A student could determine the **correct** answer, option B, by recognizing that the domain is the set of the *x*-values in a given set and finding the option with the same set of *x*-values as the given set. A student could arrive at an **incorrect** answer by applying an incorrect definition of domain. For example, a student could arrive at option A by comparing the *y*-values instead of the *x*-values.

3. A teacher buys some pencils.

- He buys 2 pencils for each of his students.
- He buys 10 additional pencils.
- Each pencil costs $0.10.

Which equation describes the total amount of money (y), in dollars, that the teacher spends on pencils as a function of the number of students (x) he has?

A. $y = 1.20x$

B. $y = 2.00x$

C. $y = 0.20x + 1$

D. $y = 0.10x + 12$

Item Information	
Alignment	A1.2.1.2.1
Answer Key	C
Depth of Knowledge	2
p-value A	10%
p-value B	9%
p-value C	49% (correct answer)
p-value D	32%
Option Annotations	A student could determine the **correct** answer, option C, by finding the slope, $0.10 \times 2 = 0.20$, and the constant, $0.1 \times 10 = 1$, and finding the corresponding equation. A student could arrive at an **incorrect** answer by using the given values in the wrong places. For example, a student could arrive at option D by using the cost of each pencil as the slope and adding the number of pencils per student, 2, to the number of additional pencils, 10, and using the sum as the constant.

4. The table below represents a function of x.

x	y
4	16
6	12
8	8
10	4

Which equation describes the function?

A. $y = -2x + 12$

B. $y = -2x + 24$

C. $y = 2x + 12$

D. $y = 2x + 24$

Item Information	
Alignment	A1.2.1.2.2
Answer Key	B
Depth of Knowledge	2
p-value A	7%
p-value B	74% (correct answer)
p-value C	13%
p-value D	6%
Option Annotations	A student could determine the **correct** answer, option B, by using the values in the table to find the slope and intercept and setting up an equation in the form $y = mx + b$. A student could arrive at an **incorrect** answer by using the wrong values for slope and intercept in an equation in the form $y = mx + b$. For example, a student could arrive at option C by using the difference in x-values between rows in the table as slope and using the x-intercept instead of the y-intercept.

5. Bari paid a total of $62 for 3 hours of driving lessons. This included a $20 fee for the driver's manual and an hourly rate for use of the car. What is the hourly rate Bari paid?

A. $14

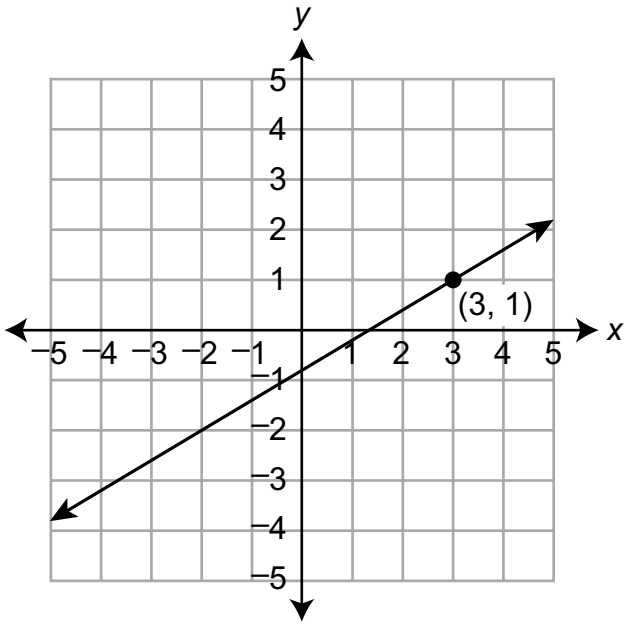
B. $20

C. $21

D. $27

Item Information	
Alignment	A1.2.2.1.2
Answer Key	A
Depth of Knowledge	2
p-value A	70% (correct answer)
p-value B	10%
p-value C	14%
p-value D	6%
Option Annotations	A student could determine the **correct** answer, option A, by subtracting the constant from the total and then dividing the difference by the number of hours. A student could arrive at an **incorrect** answer by not using all relevant information. For example, a student could arrive at option C by failing to subtract the constant fee and then rounding the quotient to the nearest whole dollar.

6. The graph shown below represents a linear function.



Which equation describes the linear function?

A. $y + 1 = \frac{3}{5}(x + 3)$

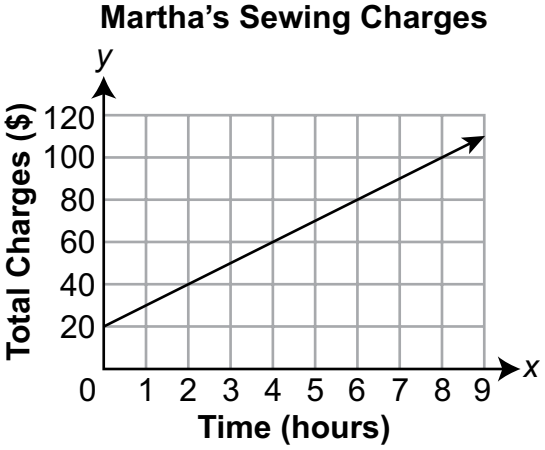
B. $y - 1 = \frac{3}{5}(x + 3)$

C. $y + 1 = \frac{3}{5}(x - 3)$

D. $y - 1 = \frac{3}{5}(x - 3)$

Item Information	
Alignment	A1.2.2.1.3
Answer Key	D
Depth of Knowledge	1
p-value A	28%
p-value B	18%
p-value C	15%
p-value D	39% (correct answer)
Option Annotations	A student could determine the **correct** answer, option D, by setting up an equation for the line in the form $y - y_1 = m(x - x_1)$. A student could arrive at an **incorrect** answer by using coordinates incorrectly when setting up an equation for the line. For example, a student could arrive at option A by using the wrong signs (or operation) when setting up the equation for the line.

7. Martha earns money sewing curtains. She charges a flat fee to meet with a customer and take window measurements and an hourly rate to sew the curtains. The graph below shows the relationship between the time, in hours, Martha works on a sewing project and the total amount, in dollars, she charges.



What is the hourly rate that Martha charges for sewing curtains?

A. $10.00

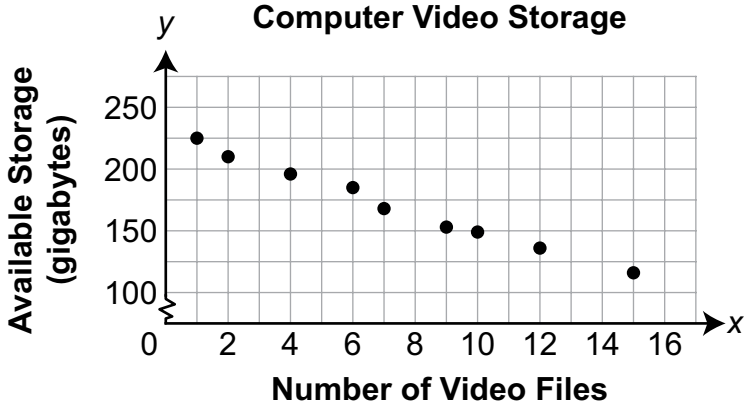
B. $12.50

C. $15.00

D. $20.00

Item Information	
Alignment	A1.2.2.1.4
Answer Key	A
Depth of Knowledge	2
p-value A	63% (correct answer)
p-value B	6%
p-value C	8%
p-value D	23%
Option Annotations	A student could determine the **correct** answer, option A, by finding the slope of the graph. A student could arrive at an **incorrect** answer by not considering the flat fee. For example, a student could arrive at option D by not subtracting the constant before dividing to find slope.

8. The scatter plot below shows the relationship between the number of video files (x) stored on a computer and the number of gigabytes (y) of storage space available on the computer.



Based on the scatter plot, which equation represents a line of best fit that could be used to predict the number of gigabytes of storage space available on the computer based on the number of video files that could be stored on the computer?

A. $y = -14x + 250$

B. $y = -9x + 116$

C. $y = -8x + 227$

D. $y = -4x + 189$

Item Information	
Alignment	A1.2.2.2.1
Answer Key	C
Depth of Knowledge	2
p-value A	23%
p-value B	13%
p-value C	46% (correct answer)
p-value D	18%
Option Annotations	A student could determine the **correct** answer, option C, by estimating the slope and *y*-intercept of a line that is close to all the given points. A student could arrive at an **incorrect** answer by incorrectly estimating slope. For example, a student could arrive at option A by using the difference between the smallest and the largest number of video files as the slope.

9. A data set shows a basketball team's final scores for one season. Some information about the scores in the data set is listed below.

- The minimum value is 42.
- The lower quartile value is 54.
- The **median** is 60.
- The upper quartile value is 72.
- The maximum value is 90.

Of the team's final scores for the season, 75% of them are **most likely** between which two values?

A. 42 and 66

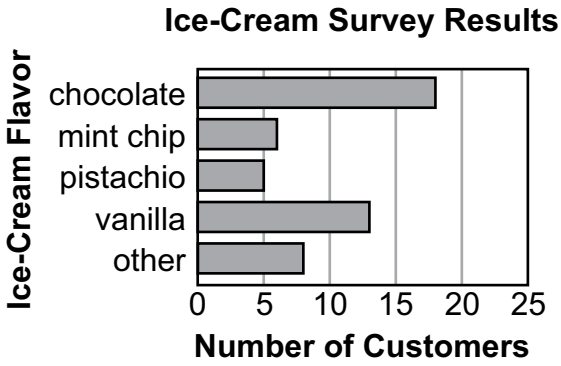
B. 42 and 72

C. 60 and 72

D. 72 and 90

Item Information	
Alignment	A1.2.3.1.1
Answer Key	B
Depth of Knowledge	2
p-value A	11%
p-value B	57% (correct answer)
p-value C	21%
p-value D	11%
Option Annotations	A student could determine the **correct** answer, option B, by recognizing that the quartile values divide a set into subsets which each include about 25% of the data points, so 75% of the data points are most likely in a range of three quartiles. A student could arrive at an **incorrect** answer by incorrectly interpreting the meaning of a quartile. For example, a student could arrive at option D by only selecting the single quartile which is greater than about 75% of the data points.

10. The owner of an ice-cream stand conducts a random survey of 50 people to determine which ice-cream flavor customers prefer to buy. The bar graph below shows the results of the survey.



The ice-cream stand is expected to serve 350 customers on the first day of summer. Based on the results of the survey, which value is **most likely** the number of customers who will buy an ice-cream flavor other than chocolate on the first day of summer?

A. 56

B. 126

C. 168

D. 224

Item Information	
Alignment	A1.2.3.2.1
Answer Key	D
Depth of Knowledge	2
p-value A	17%
p-value B	22%
p-value C	18%
p-value D	43% (correct answer)
Option Annotations	A student could determine the **correct** answer, option D, by using the graph to determine that 64% of customers buy a flavor other than chocolate and then finding 64% of 350. A student could arrive at an **incorrect** answer by calculating a value other than the most likely number of customers who buy a flavor other than chocolate. For example, a student could arrive at option B by calculating the number of customers most likely to order chocolate.

11. A scatter plot shows the relationship between the distances (x), in miles, from a local airport to airports in various cities and the time (y), in minutes, a flight between the airports takes. The equation below describes the line of best fit for the scatter plot.

$$y = 0.16x + 58.62$$

Based on the equation, which value is the **most likely** distance, in miles, between two airports when a flight between the airports takes 240 minutes?

A. 1,134

B. 1,441

C. 1,866

D. 2,251

Item Information	
Alignment	A1.2.3.2.3
Answer Key	A
Depth of Knowledge	2
p-value A	69% (correct answer)
p-value B	15%
p-value C	9%
p-value D	7%
Option Annotations	A student could determine the **correct** answer, option A, by substituting 240 for y in the given equation and solving for x. A student could arrive at an **incorrect** answer by incorrectly solving the equation for x. For example, a student could arrive at option B by dividing by 0.16 before subtracting 58.62.

12. There are 28 students whose last names begin with the letters G, H, J, or K. Information about the probability of randomly selecting one of these students is listed below.

- probability of selecting a student whose last name begins with G: $\frac{1}{7}$
- probability of selecting a student whose last name begins with G or H: $\frac{5}{14}$

How many of these students have a last name that begins with H?

A. 4

B. 5

C. 6

D. 7

Item Information	
Alignment	A1.2.3.3.1
Answer Key	C
Depth of Knowledge	2
p-value A	30%
p-value B	16%
p-value C	38% (correct answer)
p-value D	16%
Option Annotations	A student could determine the **correct** answer, option C, by subtracting the probability of G from the probability of G or H and then multiplying the difference by 28. A student could arrive at an **incorrect** answer by calculating the incorrect number of students. For example, a student could arrive at option A by finding the number of students whose last name begins with G.

CONSTRUCTED-RESPONSE ITEM

13. Jerry sells a particular type of coin online. The amount he charges his customers for the coins includes shipping. Jerry uses the equation shown below to determine the total amount (y), in dollars, he will charge for x coins.

$$y = 32.95x + 12.95$$

A. How much does Jerry charge a customer for 10 coins?

B. Explain what the number 32.95 means in the context of the problem.

Go to the next page to finish question 13.

GO ON

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

Zack and Dave each bought some coins from Jerry online. Dave bought 5 more coins than Zack bought.

C. Explain why it is **not** necessary to know how many coins Zack bought to determine how much more Dave paid than Zack paid.

Jerry has a sale on his website. During the sale, Kerry bought twice as many coins as Lou bought. Kerry's total cost is twice Lou's total cost.

D. Explain how you know that Jerry charged $0 for shipping during the sale.

AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

Item-Specific Scoring Guideline

#13 Item Information

Alignment	A1.2.2	**Depth of Knowledge**	3	**Mean Score**	1.76

Assessment Anchor this item will be reported under:

A1.2.2—Coordinate Geometry

Specific Anchor Descriptor addressed by this item:

A1.2.2.1—Describe, compute, and/or use the rate of change (slope) of a line.

Scoring Guide

Score	Description
4	The student demonstrates a thorough understanding of coordinate geometry by correctly solving problems with clear and complete procedures and explanations when required.
3	The student demonstrates a general understanding of coordinate geometry by solving problems and providing procedures and explanations with only minor errors or omissions.
2	The student demonstrates a partial understanding of coordinate geometry by providing a portion of the correct problem solving, procedures, and explanations.
1	The student demonstrates a minimal understanding of coordinate geometry.
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 coordinate geometry.
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?
$342.45	

Part B (1 point):

1 point for correct and complete explanation

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

What?	Why?
	Sample Explanation: The cost per coin. **OR equivalent**

Part C (1 point):

1 point for correct and complete explanation

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

What?	Why?
	Sample Explanations: Dave just has to pay the additional cost for the 5 coins and the cost per coin is always the same. **OR** Dave just has to pay the additional cost for the 5 coins and the shipping fee is always the same. **OR equivalent**

Part D (1 point):

1 point for correct and complete explanation

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

What?	Why?
	Sample Explanations: Since Kerry paid twice as much for twice as many coins, the total cost is directly proportional to the number of coins bought. This means the shipping charge must have been reduced to $0.00. **OR** If there was a shipping charge, Kerry's total cost would have been less than twice as much as Lou's total cost. **OR equivalent**

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STUDENT RESPONSE

Response Score: 4 points

13. Jerry sells a particular type of coin online. The amount he charges his customers for the coins includes shipping. Jerry uses the equation shown below to determine the total amount (y), in dollars, he will charge for x coins.

$$y = 32.95x + 12.95$$

A. How much does Jerry charge a customer for 10 coins?

he charges $342.45
for 10 coins

$342.45

The response provides a correct answer.

B. Explain what the number 32.95 means in the context of the problem.

The cost of the coin excluding the shipping fee.

The response provides a correct and complete explanation (*the cost of the coin*).

Go to the next page to finish question 13.

GO ON

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

Zack and Dave each bought some coins from Jerry online. Dave bought 5 more coins than Zack bought.

C. Explain why it is **not** necessary to know how many coins Zack bought to determine how much more Dave paid than Zack paid.

It is not necessary to know how many coins Zack bought to determine how much more Dave paid than Zack paid because we know that after the inital fee, each coin costs $32.95 so we know Dave paid (5)$32.95 more than Zack because Zack didnt buy those five coins.

The response provides a correct and complete explanation.

Jerry has a sale on his website. During the sale, Kerry bought twice as many coins as Lou bought. Kerry's total cost is twice Lou's total cost.

D. Explain how you know that Jerry charged $0 for shipping during the sale.

We know Jerry charged $0 for shipping because if they had paid for shipping, Kerry's would cost less than double what Lou bought because the shipping fee was aflat fee.

The response provides a correct and complete explanation.

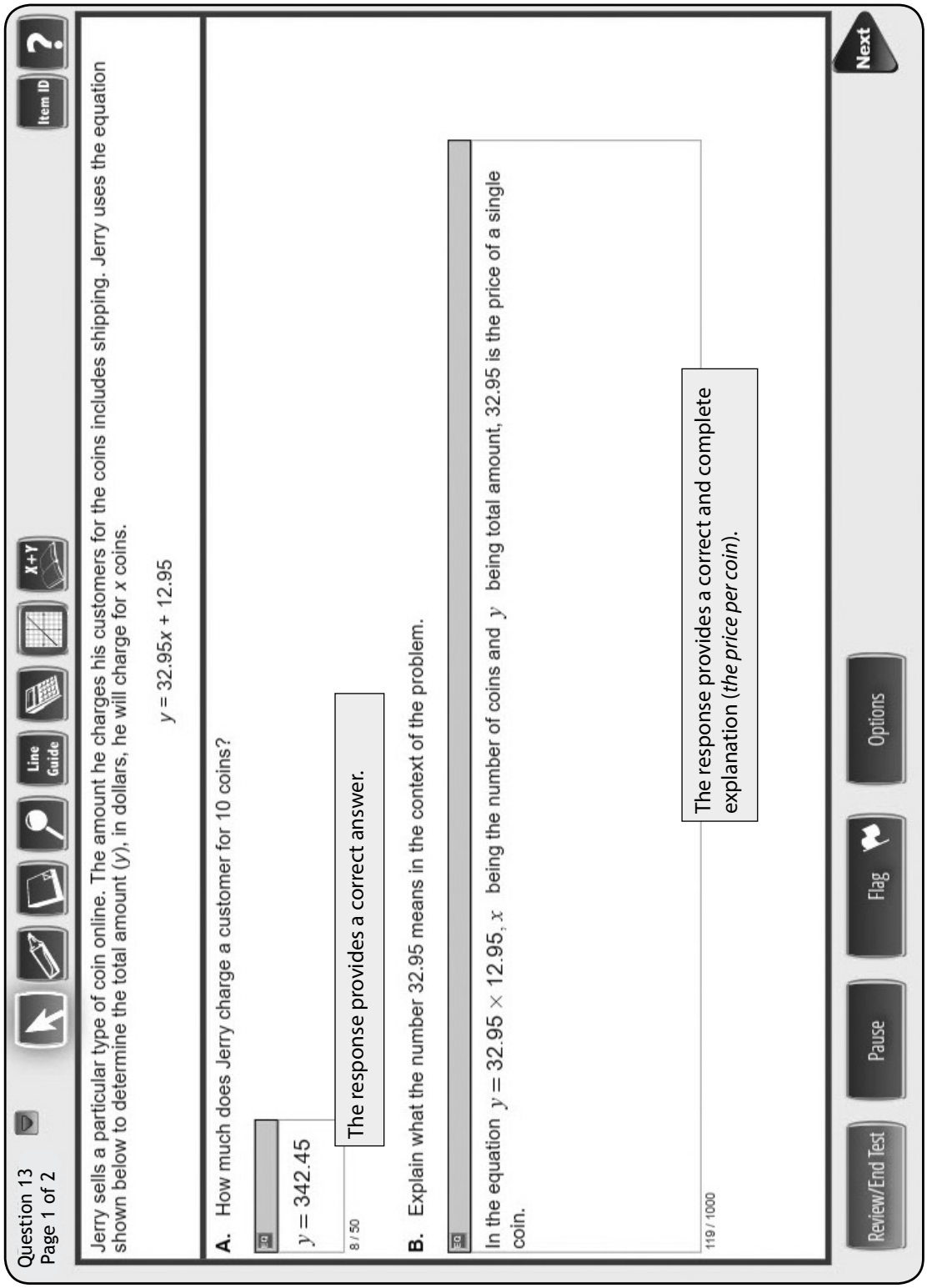
AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STOP

STUDENT RESPONSE

Response Score: 3 points

PARTS A AND B



STUDENT RESPONSE

PARTS C AND D

STUDENT RESPONSE

Response Score: 2 points

13. Jerry sells a particular type of coin online. The amount he charges his customers for the coins includes shipping. Jerry uses the equation shown below to determine the total amount (y), in dollars, he will charge for x coins.

$$y = 32.95x + 12.95$$

A. How much does Jerry charge a customer for 10 coins?

$y = 32.95(10) + 12.95$

$y = 329.5 + 12.95$

$y = 342.45$

he charges
$342.45
for 10 coins

The response provides a correct answer.

B. Explain what the number 32.95 means in the context of the problem.

32.95 x number of coins

price for coins

32.95 is the price per coin

The response provides a correct and complete explanation (*the price per coin*).

Go to the next page to finish question 13.

GO ON

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

Zack and Dave each bought some coins from Jerry online. Dave bought 5 more coins than Zack bought.

C. Explain why it is **not** necessary to know how many coins Zack bought to determine how much more Dave paid than Zack paid.

We can just figure out how much he paid then using the formula we can find how many he bought. Then add 5 to get what Dave bought.

The response provides an incorrect explanation.

Jerry has a sale on his website. During the sale, Kerry bought twice as many coins as Lou bought. Kerry's total cost is twice Lou's total cost.

D. Explain how you know that Jerry charged $0 for shipping during the sale.

Because Kerry payed twice Lou

The response provides an incorrect explanation.

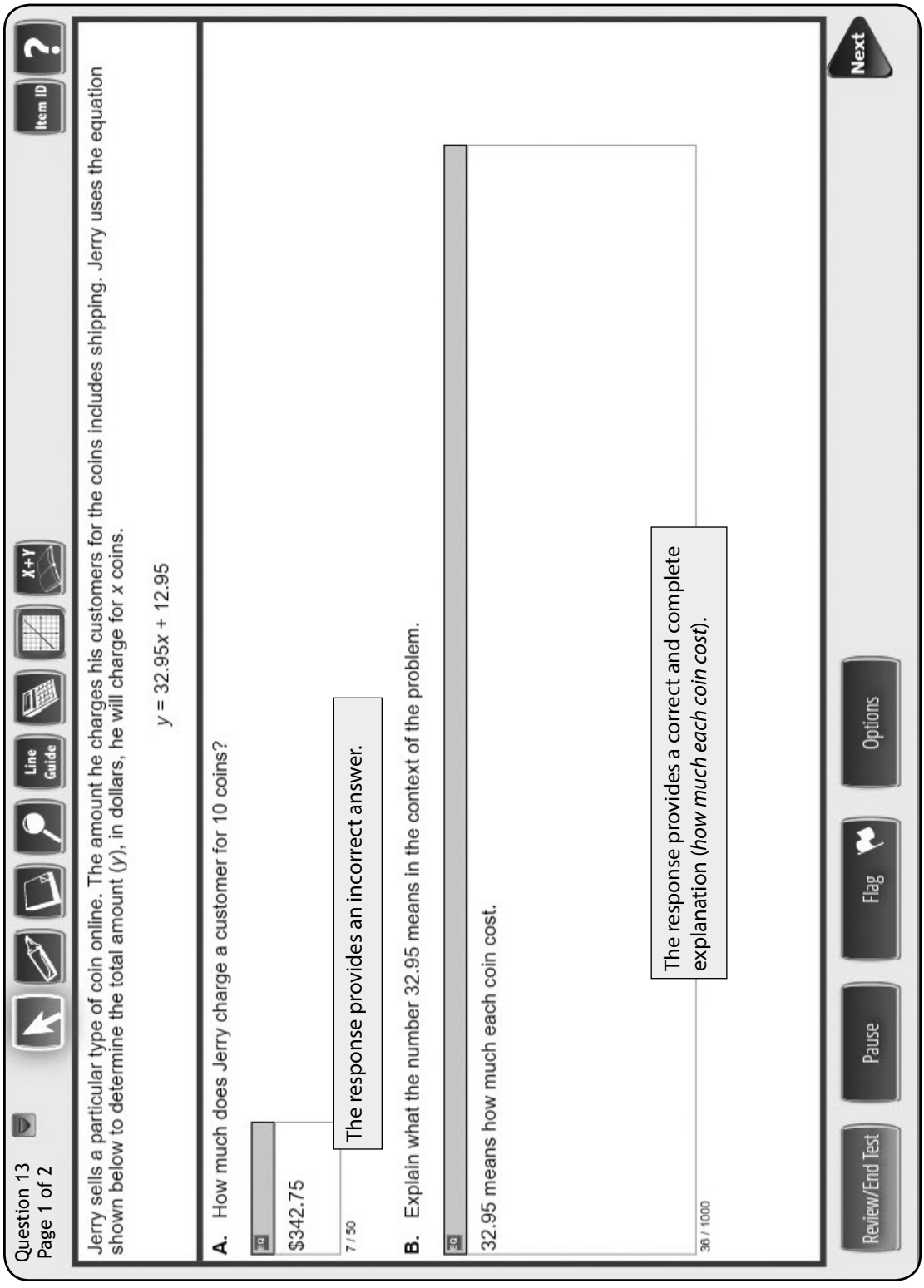
AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STOP

STUDENT RESPONSE

Response Score: 1 point

PARTS A AND B



STUDENT RESPONSE

PARTS C AND D

STUDENT RESPONSE

Response Score: 0 points

13. Jerry sells a particular type of coin online. The amount he charges his customers for the coins includes shipping. Jerry uses the equation shown below to determine the total amount (y), in dollars, he will charge for x coins.

$$y = 32.95x + 12.95$$

A. How much does Jerry charge a customer for 10 coins?

He charges $129.50 for 10 coins

The response provides an incorrect answer.

B. Explain what the number 32.95 means in the context of the problem.

The 32.95 means the amount of money it will cost to ship.

The response provides an incorrect explanation.

Go to the next page to finish question 13.

GO ON

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

Zack and Dave each bought some coins from Jerry online. Dave bought 5 more coins than Zack bought.

C. Explain why it is **not** necessary to know how many coins Zack bought to determine how much more Dave paid than Zack paid.

It is not necessary because you can youse the same equation to find out how much Dave spent.

The response provides an incorrect explanation.

Jerry has a sale on his website. During the sale, Kerry bought twice as many coins as Lou bought. Kerry's total cost is twice Lou's total cost.

D. Explain how you know that Jerry charged $0 for shipping during the sale.

Because Kerry bought stuff that was on sale and the stuff that was on sale got free shipping,

The response provides an incorrect explanation.

AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STOP

CONSTRUCTED-RESPONSE ITEM

14. Ann records the number of different colored beads in a package in the table shown below.

Beads in the Package

Color	Number
blue	5
brown	4
green	3
orange	5
red	4
yellow	4

Ann will randomly select a bead from the package and then, without replacing it, randomly select a second bead.

A. Based on the information in the table, what is the probability Ann will first select a green bead and then an orange bead from the package?

probability: _____

Ann has a jar containing 375 colored beads. The beads in the jar have the same distribution as the one shown in the table.

B. Based on the information in the table, determine the number of red beads in Ann's jar.

answer: _____ red beads

Go to the next page to finish question 14.

GO ON

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

Ann has some marbles in five bags. Some information about the number of marbles in each of Ann's five bags is listed below.

- The fewest number of marbles in a bag is 21.
- The greatest number of marbles in a bag is 29.
- The **mean** number of marbles in the bags is 27.
- There are two **modes** for the number of marbles in a bag.

C. How many marbles are in each of Ann's five bags?

answers: _____, _____, _____, _____, _____

AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

Item-Specific Scoring Guideline

#14 Item Information

Alignment	A1.2.3	**Depth of Knowledge**	3	**Mean Score**	1.56

Assessment Anchor this item will be reported under:

A1.2.3—Data Analysis

Specific Anchor Descriptor addressed by this item:

A1.2.3.1—Use measures of dispersion to describe a set of data.
A1.2.3.2—Use data displays in problem-solving settings and/or to make predictions.
A1.2.3.3—Apply probability to practical situations.

Scoring Guide

Score	Description
4	The student demonstrates a thorough understanding of data analysis by correctly solving problems with clear and complete procedures and explanations when required.
3	The student demonstrates a general understanding of data analysis by solving problems and providing procedures and explanations with only minor errors or omissions.
2	The student demonstrates a partial understanding of data analysis by providing a portion of the correct problem solving, procedures, and explanations.
1	The student demonstrates a minimal understanding of data analysis.
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 points.
2	Student earns 2 points.
1	Student earns 1 point.
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?
$\frac{1}{40}$ **OR** 0.025 **OR** 2.5% **OR** 1:39 **OR equivalent**	

Part B (1 point):

1 point for correct answer

What?	Why?
60 (red beads)	

Part C (2 points):

2 points for correct answer (order does **not** matter)

OR 1 point if 3 of 4 of these bullets are met using only **whole** marbles in the bags **and** there are marbles in all 5 bags:

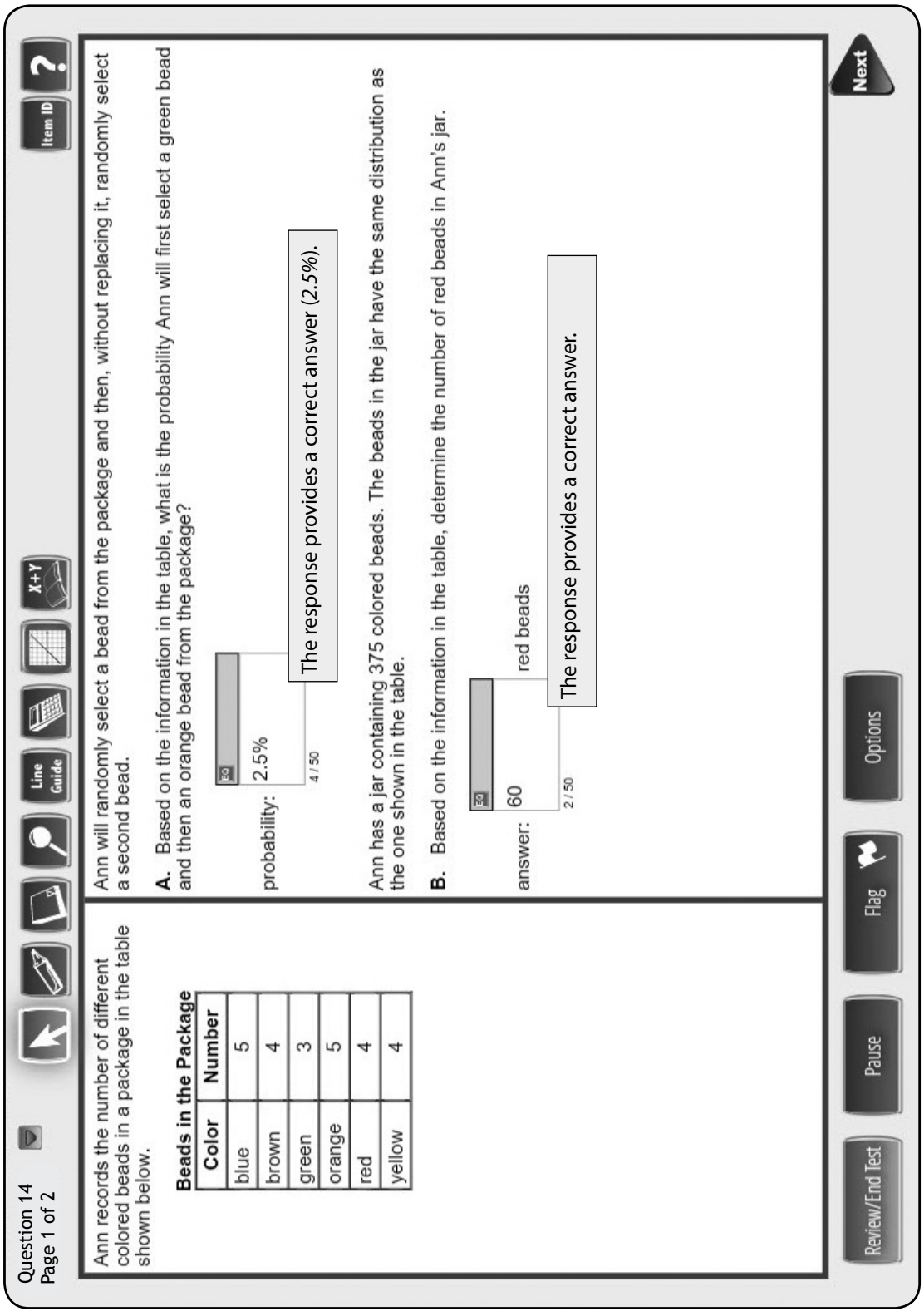
- The fewest number of marbles in a bag is 21
- The greatest number of marbles in a bag is 29
- The mean number of marbles in the bags is 27
- There are two modes for the number of marbles in a bag

What?	Why?
21, 28, 28, 29, 29	

STUDENT RESPONSE

Response Score: 4 points

PARTS A AND B



STUDENT RESPONSE

PART C

STUDENT RESPONSE

Response Score: 3 points

14. Ann records the number of different colored beads in a package in the table shown below.

Beads in the Package

Color	Number
blue	5
brown	4
green	3
orange	5
red	4
yellow	4

Ann will randomly select a bead from the package and then, without replacing it, randomly select a second bead.

A. Based on the information in the table, what is the probability Ann will first select a green bead and then an orange bead from the package?

$\frac{3}{25} \cdot \frac{5}{24}$

probability: $\frac{1}{40}$

The response provides a correct answer (*1/40*).

Ann has a jar containing 375 colored beads. The beads in the jar have the same distribution as the one shown in the table.

B. Based on the information in the table, determine the number of red beads in Ann's jar.

answer: $\frac{62}{375}$ red beads

The response provides an incorrect answer.

Go to the next page to finish question 14.

GO ON

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

Ann has some marbles in five bags. Some information about the number of marbles in each of Ann's five bags is listed below.

- The fewest number of marbles in a bag is 21.
- The greatest number of marbles in a bag is 29.
- The **mean** number of marbles in the bags is 27.
- There are two **modes** for the number of marbles in a bag.

C. How many marbles are in each of Ann's five bags?

27

135
−50
85

1
29
+21
50

answers: 21, 29, 28, 28, 29

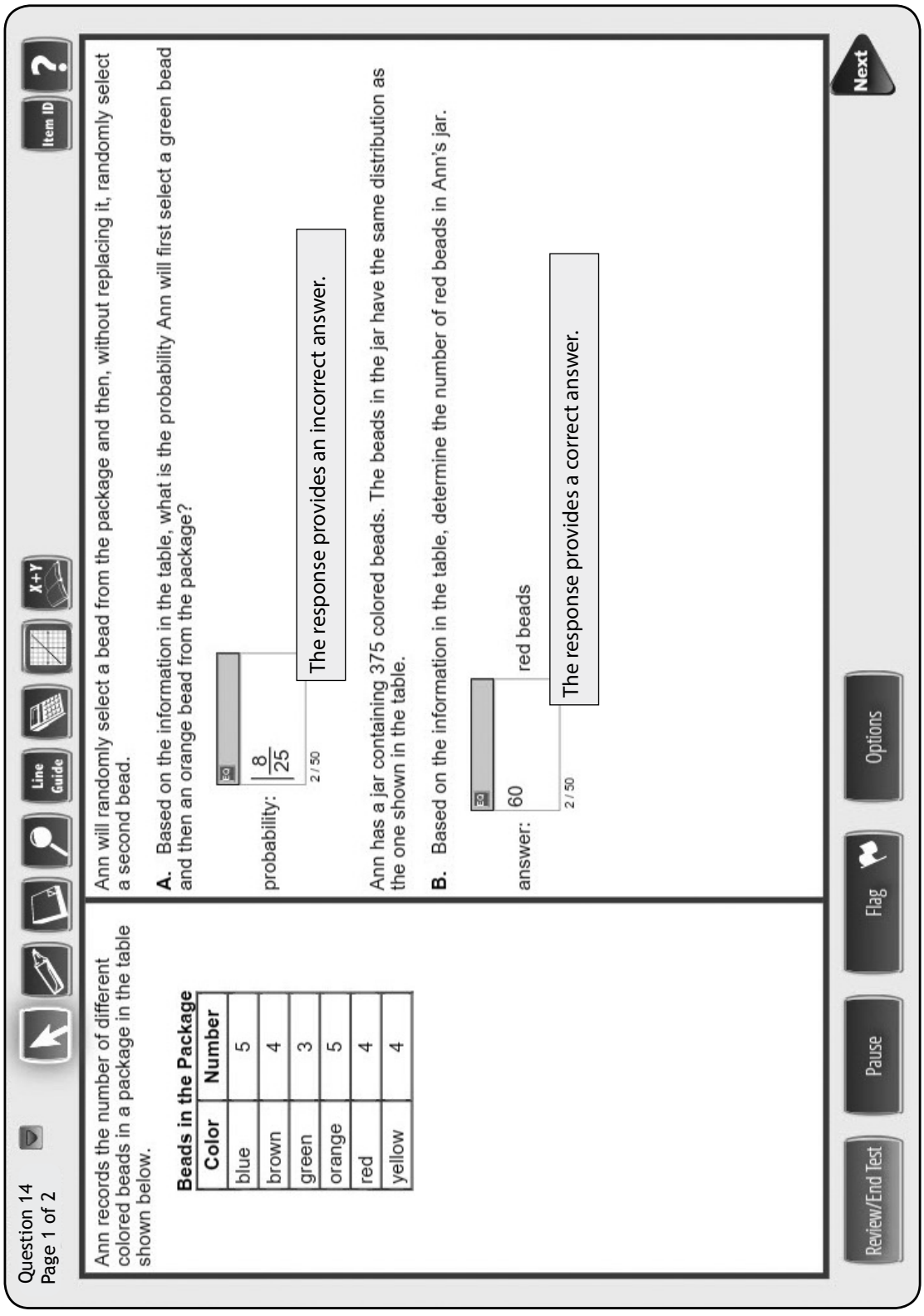
The response provides the five correct values.

AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STUDENT RESPONSE

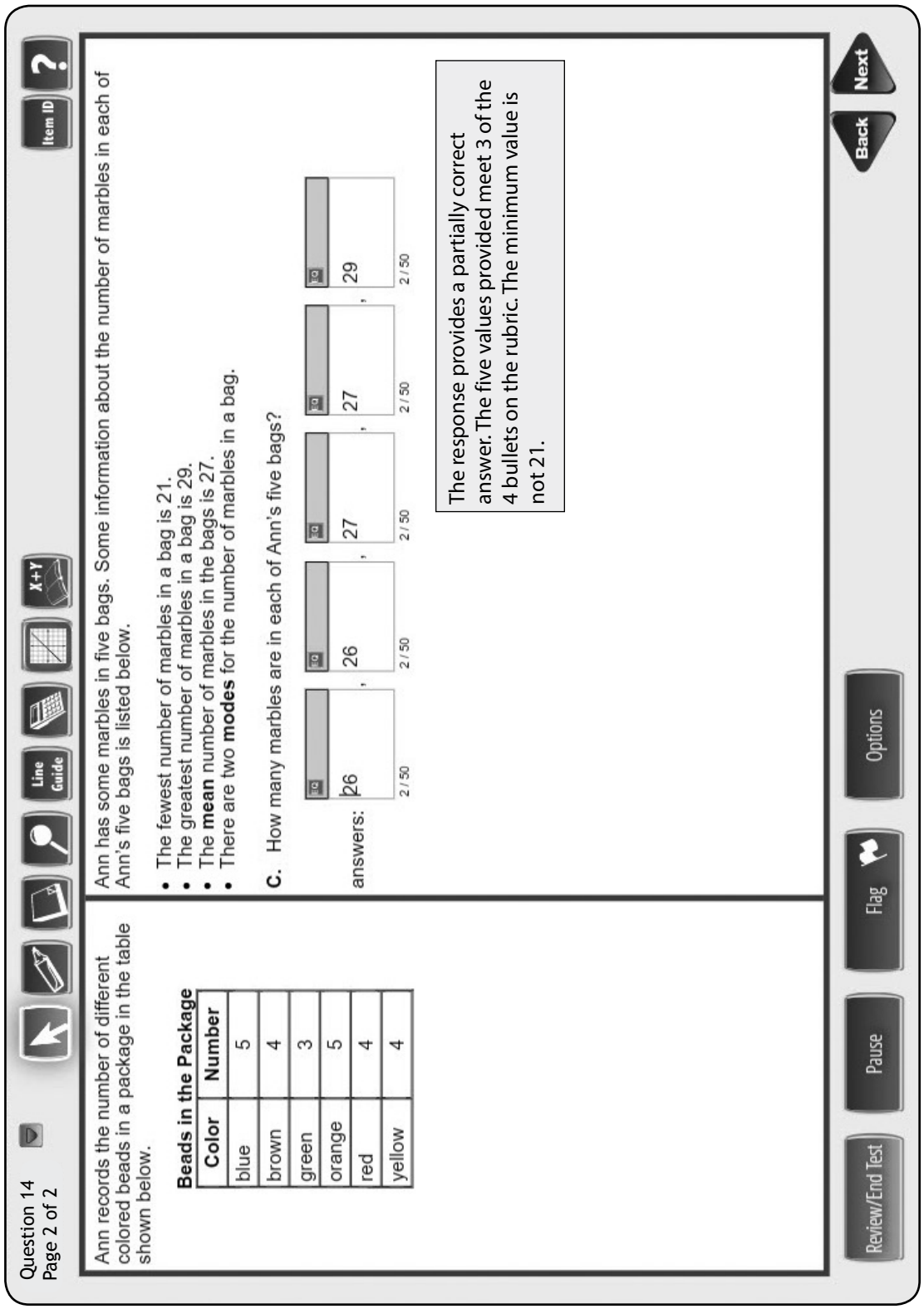
Response Score: 2 points

PARTS A AND B



STUDENT RESPONSE

PART C



The response provides a partially correct answer. The five values provided meet 3 of the 4 bullets on the rubric. The minimum value is not 21.

STUDENT RESPONSE

Response Score: 1 point

14. Ann records the number of different colored beads in a package in the table shown below.

Beads in the Package

Color	Number
blue	5
brown	4
green	3
orange	5
red	4
yellow	4

Ann will randomly select a bead from the package and then, without replacing it, randomly select a second bead.

A. Based on the information in the table, what is the probability Ann will first select a green bead and then an orange bead from the package?

The response provides an incorrect answer.

probability: $\frac{8}{25}$

Ann has a jar containing 375 colored beads. The beads in the jar have the same distribution as the one shown in the table.

B. Based on the information in the table, determine the number of red beads in Ann's jar.

The response provides a correct answer.

answer: 60 red beads

Go to the next page to finish question 14.

GO ON

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

Ann has some marbles in five bags. Some information about the number of marbles in each of Ann's five bags is listed below.

- The fewest number of marbles in a bag is 21.
- The greatest number of marbles in a bag is 29.
- The **mean** number of marbles in the bags is 27.
- There are two **modes** for the number of marbles in a bag.

C. How many marbles are in each of Ann's five bags?

The response provides an incorrect answer.

answers: 29, 29, 28, 24, 25

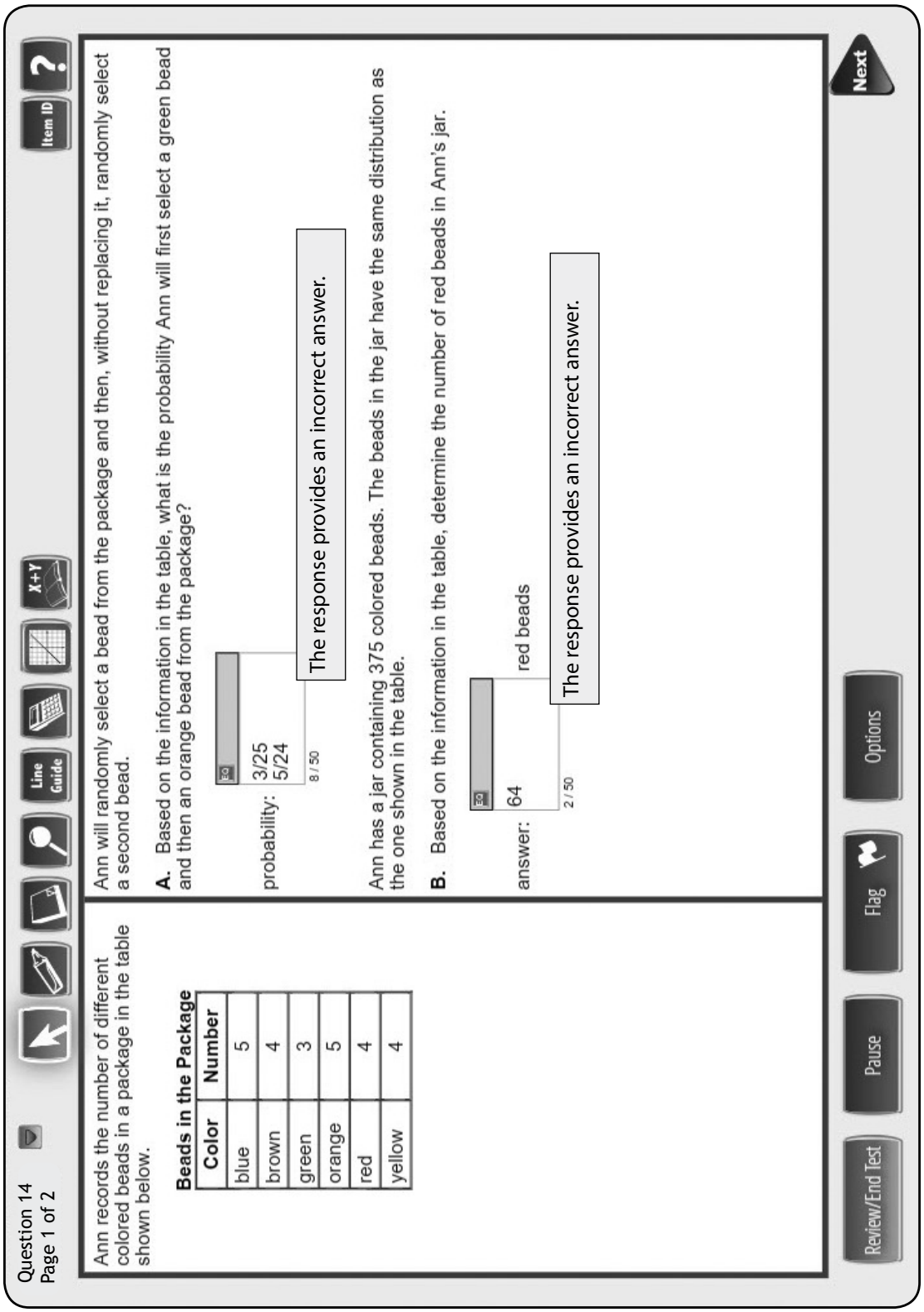
AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.

STOP

STUDENT RESPONSE

Response Score: 0 points

PARTS A AND B



STUDENT RESPONSE

PART C

ALGEBRA I MODULE 2—SUMMARY DATA

MULTIPLE-CHOICE

Sample Number	Alignment	Answer Key	Depth of Knowledge	*p*-values A	*p*-values B	*p*-values C	*p*-values D
1	A1.2.1.1.2	D	2	23%	19%	20%	38%
2	A1.2.1.1.3	B	1	12%	72%	11%	5%
3	A1.2.1.2.1	C	2	10%	9%	49%	32%
4	A1.2.1.2.2	B	2	7%	74%	13%	6%
5	A1.2.2.1.2	A	2	70%	10%	14%	6%
6	A1.2.2.1.3	D	1	28%	18%	15%	39%
7	A1.2.2.1.4	A	2	63%	6%	8%	23%
8	A1.2.2.2.1	C	2	23%	13%	46%	18%
9	A1.2.3.1.1	B	2	11%	57%	21%	11%
10	A1.2.3.2.1	D	2	17%	22%	18%	43%
11	A1.2.3.2.3	A	2	69%	15%	9%	7%
12	A1.2.3.3.1	C	2	30%	16%	38%	16%

CONSTRUCTED-RESPONSE

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
13	A1.2.2	4	3	1.76
14	A1.2.3	4	3	1.56

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Keystone Exams
Algebra I

Item and Scoring Sampler 2019

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