pennsylvania
DEPARTMENT OF EDUCATION

Pennsylvania Keystone Exams

Algebra I

Item and Scoring Sampler

2016

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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 2016 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. 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.

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_Exam_Program_Overview.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

<table>
<tr><th colspan="5">Item Information</th><th>Option Annotations</th></tr>
<tr><td colspan="4">Alignment</td><td>Assigned AAEC</td><td rowspan="8">Brief answer option analysis or rationale</td></tr>
<tr><td colspan="4">Answer Key</td><td>Correct Answer</td></tr>
<tr><td colspan="4">Depth of Knowledge</td><td>Assigned DOK</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="5">p-values</td></tr>
<tr><td>A</td><td>B</td><td>C</td><td>D</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="4">Percentage of students who selected each option</td><td></td></tr>
</table>

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.

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ALGEBRA I EXAM 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.

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.

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 [or back at the questions in Module 1] 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

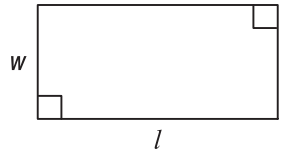
- The response demonstrates a *minimal* understanding of the mathematical concepts and procedures required by the task.

0 POINTS

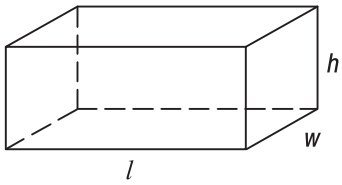
- The response has no correct answer and *insufficient* evidence to demonstrate any understanding of the mathematical concepts and procedures required by the task for that grade level.

FORMULA SHEET

Formulas that you may need to solve questions in this exam are found below.
You may use calculator π or the number 3.14.



$A = lw$



$V = lwh$

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. When $x = 2$, which expression can be completely simplified to $4\sqrt{5}$?

A. $2\sqrt{5x}$

B. $2\sqrt{10x}$

C. $5\sqrt{2x}$

D. $8\sqrt{5x}$

Item Information	
Alignment	A1.1.1.1.2
Answer Key	B
Depth of Knowledge	1

***p*-values**			
A	**B**	**C**	**D**
17%	51%	7%	25%

Option Annotations

A student could determine the **correct** answer, option B, by substituting 2 in for x. Of the given answer choices, only $2\sqrt{10x}$ expands to $2\sqrt{5 \bullet 2 \bullet 2}$, which is equivalent to $4\sqrt{5}$.

A student could arrive at an **incorrect** answer by making a simplification error. For example, a student could arrive at option D by incorrectly dividing both numerals in $8\sqrt{10}$ by 2, resulting in $4\sqrt{5}$.

2. The greatest common factor (GCF) of 2 monomials is $3x^2y$. One of the monomials is $3x^4y$. Which could be the other monomial?

A. $3xy^2$

B. $6x^2y^3$

C. $9x^6y^2$

D. $18x^6y^2$

Item Information	
Alignment	A1.1.1.2.1
Answer Key	B
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
21%	38%	35%	6%

Option Annotations

A student could determine the **correct** answer, option B, by finding a monomial in which the constant is a multiple of 3, the exponent for x is 2, and the exponent for y is any whole number. Of the given answer choices, only $6x^2y^3$ meets all of these conditions.

A student could arrive at an **incorrect** answer by incorrectly applying the GCF or by finding a monomial for which the given GCF is only a common factor and not the greatest common factor. For example, a student could arrive at option C by incorrectly multiplying the given GCF ($3x^2y$) and the given monomial ($3x^4y$), resulting in $9x^6y^2$.

3. The average distance from the Sun to Mercury is 57,909,227 km. The average distance from the Sun to Saturn is 1,426,666,422 km. Light travels at a speed of about 300,000 km per **second**. Which amount of time is the **closest estimate** of the difference between the number of **minutes** it takes light to travel from the Sun to Saturn and the number of **minutes** it takes light to travel from the Sun to Mercury?

A. 50 minutes

B. 80 minutes

C. 110 minutes

D. 140 minutes

Item Information	
Alignment	A1.1.1.4.1
Answer Key	B
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
13%	57%	17%	13%

Option Annotations

A student could determine the **correct** answer, option B, by finding the difference in the two distances, 1,368,757,195 km, and dividing by the distance light travels in 1 minute, which is 300,000 km × 60 = 18,000,000 km. Of the given answer options, 80 minutes is the closest to the actual result of 76.042.

A student could arrive at an **incorrect** answer by incorrectly rounding the difference in distances. For example, a student could arrive at option C by rounding up to the next highest billion (2,000,000,000) and dividing by 18,000,000 to get 111.11, resulting in a choice of 110 minutes.

4. Simplify:

$$(3x^2 + 2x - 8) - (-x^2 + 6x + 4)$$

A. $2x^2 + 8x - 4$

B. $2x^2 + 8x - 12$

C. $4x^2 + 8x - 4$

D. $4x^2 - 4x - 12$

Item Information	
Alignment	A1.1.1.5.1
Answer Key	D
Depth of Knowledge	1

***p*-values**			
A	**B**	**C**	**D**
19%	12%	15%	54%

Option Annotations

A student could determine the **correct** answer, option D, by subtracting $3x^2$ and $-x^2$ to get $4x^2$, subtracting $2x$ and $6x$ to get $-4x$, and subtracting -8 and 4 to get -12. Collecting these terms together results in $4x^2 - 4x - 12$.

A student could arrive at an **incorrect** answer by performing an incorrect operation. For example, a student could arrive at option A by adding the polynomials instead of subtracting, resulting in $(3x^2 + 2x - 8) + (-x^2 + 6x + 4) = 2x^2 + 8x - 4$.

5. In an experiment, a plant grows 0.05 centimeter per day. The plant had a height of 2 centimeters when the experiment started. Which equation describes the relationship between the number of days (d) the experiment lasts and the height (h), in centimeters, of the plant?

A. $h = 0.05d + 2$

B. $h = 0.05(2) + d$

C. $h = 2d + 0.05$

D. $h = 2.05d$

Item Information	
Alignment	A1.1.2.1.1
Answer Key	A
Depth of Knowledge	1

***p*-values**			
A	**B**	**C**	**D**
78%	10%	8%	4%

Option Annotations

A student could determine the **correct** answer, option A, by multiplying the number of days (d) by the daily growth in centimeters (0.05) and adding the height, in centimeters, of the plant when the experiment started (2). Setting the result equal to the height (h) gives the equation $h = 0.05d + 2$.

A student could arrive at an **incorrect** answer by combining the given information in the wrong order. For example, a student could arrive at option B by multiplying the daily growth by the starting height and then adding the number of days. This leads to the equation $h = 0.05(2) + d$.

6. Juanita used the steps shown below to correctly solve an equation. A step is missing.

$$-3(c - 6) + 4c = 5(2c + 9)$$
$$?$$
$$c + 18 = 10c + 45$$
$$c - 27 = 10c$$
$$-27 = 9c$$
$$-3 = c$$

Which shows the equation that is **most likely** a missing step **and** the property that justifies the step?

A. $-3c - 6 + 4c = 10c + 9$; associative property of addition

B. $-3c + 18 + 4c = 10c + 45$; associative property of addition

C. $-3c - 6 + 4c = 10c + 9$; distributive property

D. $-3c + 18 + 4c = 10c + 45$; distributive property

Item Information				Option Annotations
Alignment	A1.1.2.1.2			A student could determine the **correct** answer, option D, by taking both c and -6 times -3 to get $-3c + 18$, taking both $2c$ and 9 times 5 to get $10c + 45$, and identifying the property used as the distributive property. A student could arrive at an **incorrect** answer by incorrectly identifying the property that justifies the missing step. For example, a student could arrive at option B by correctly finding the missing step but incorrectly identifying the property used as the associative property of addition.
Answer Key	D			
Depth of Knowledge	2			
***p*-values**				
A	**B**	**C**	**D**	
5%	13%	10%	72%	

7. Sylvia studied a new language. The equation below describes how many words she knew (y) after studying the language for x days.

$$y = 5x + 18$$

The ordered pair (6, 48) is a solution of the equation. What does the solution represent?

A. Sylvia knew 6 words after 6 days.

B. Sylvia knew 6 words after 48 days.

C. Sylvia knew 48 words after 6 days.

D. Sylvia knew 48 words after 48 days.

Item Information	
Alignment	A1.1.2.1.3
Answer Key	C
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
3%	14%	73%	10%

Option Annotations

A student could determine the **correct** answer, option C, by recognizing that 6 is the x-coordinate, which represents the number of days, and 48 is the y-coordinate, which represents the number of words.

A student could arrive at an **incorrect** answer by incorrectly interpreting the coordinates. For example, a student could arrive at option B by incorrectly identifying 48 as x and 6 as y, leading to the conclusion that Sylvia knew 6 words after 48 days.

8. Christine sells a total of 50 tickets to a school play. Student tickets sell for $1.50 each, and adult tickets sell for $4.00 each. Christine made a total of $112.50 in ticket sales. Christine writes a system of equations to represent this information. Which statement **best** describes the solution to the system of equations?

A. Christine sells 35 student tickets and 15 adult tickets.

B. Christine would earn $200.00 by selling 50 adult tickets.

C. Christine sells a pair of tickets for between $3.00 and $8.00.

D. Christine could not earn $112.50 by selling 50 student tickets.

Item Information	
Alignment	A1.1.2.2.2
Answer Key	A
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
77%	10%	5%	8%

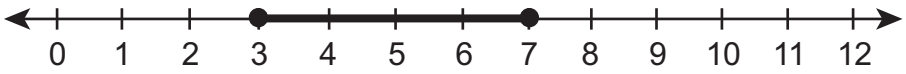
Option Annotations

A student could determine the **correct** answer, option A, by creating a system of two equations to represent the number of each type of ticket sold ($x + y = 50$) and the money earned from selling the tickets ($1.5x + 4y = 112.5$) and then solving the system of equations (for example, substituting $y = 50 - x$ into the second equation) to get $x = 35$ (students) and $y = 15$ (adults).

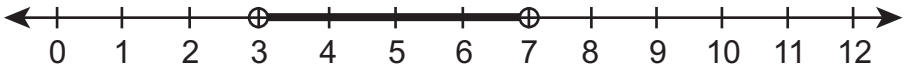
A student could arrive at an **incorrect** answer by incorrectly identifying a statement that does not represent the solution to the system of equations. For example, a student could arrive at option B by noticing that selling 50 adult tickets would result in earnings of $200 but overlooking the fact that this would not match the total sales given ($112.50).

9. A plain pizza takes 10 minutes to bake. At least 2 minutes of baking time is required for each ounce of toppings added to the pizza. The total baking time for specialty pizzas is at least 18 minutes and at most 26 minutes. Which graph shows the possible number of ounces of all the toppings on specialty pizzas?

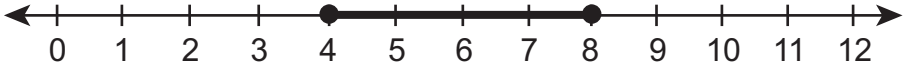
A.



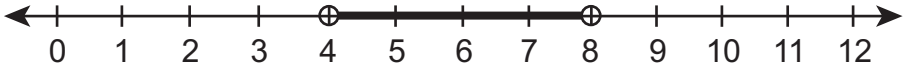
B.



C.



D.



Item Information	
Alignment	A1.1.3.1.1
Answer Key	C
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
10%	10%	63%	17%

Option Annotations

A student could determine the **correct** answer, option C, by setting up and solving the inequality $18 \leq 10 + 2x \leq 26$ and graphing the solution set of $4 \leq x \leq 8$ as a closed interval on the number line.

A student could arrive at an **incorrect** answer by incorrectly plotting the solution set. For example, a student could arrive at option D by misunderstanding that the endpoints need to be included in the solution set, leading them to graph the solution with open circles as endpoints.

10. A cleaning service offers its customers a choice between two plans.

- Plan A costs $3,000 and includes 1 year of an unlimited number of cleanings.
- Plan B costs $75 per cleaning.

Henry wants to choose the less expensive plan. He uses the inequality $3{,}000 < 75c$ to decide which plan to choose based on the number of cleanings (c) he expects to need. Based on the solution of the inequality, which statement about Henry's choice of plan is true?

A. Henry should choose Plan A only if he expects to need fewer than 40 cleanings in 1 year.

B. Henry should choose Plan A only if he expects to need more than 40 cleanings in 1 year.

C. Henry can choose either plan and pay the same amount if he expects to need fewer than 40 cleanings in 1 year.

D. Henry can choose either plan and pay the same amount if he expects to need more than 40 cleanings in 1 year.

Item Information	
Alignment	A1.1.3.1.3
Answer Key	B
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
12%	62%	16%	10%

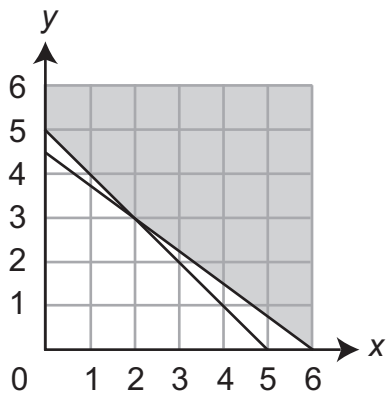
Option Annotations

A student could determine the **correct** answer, option B, by setting up and solving the inequality $3{,}000 < 75c$ and recognizing that the solution $40 < c$ represents the number of cleanings in 1 year that result in Plan A being cheaper than Plan B.

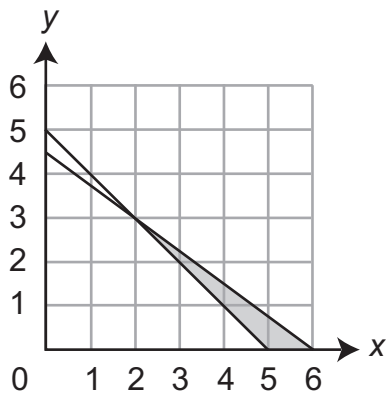
A student could arrive at an **incorrect** answer by incorrectly interpreting the meaning of the inequality. For example, a student could arrive at option C by solving for the number of cleanings ($c = 40$) with the same cost for both plans but incorrectly thinking that the equality also applies to any smaller (positive) value of c.

11. Kelly is planning a business trip to Hartford, CT, and Boston, MA. She is going to stay no more than 5 nights on the trip. She estimates each night she stays at a hotel in Hartford will cost \$90, and each night she stays at a hotel in Boston will cost \$120. She wants to spend no more than \$540 for hotel stays. Which graph represents the possible combinations of nights she can spend in Hartford (x) and nights she can spend in Boston (y)?

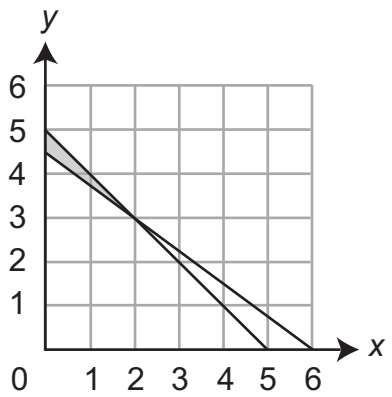
A.



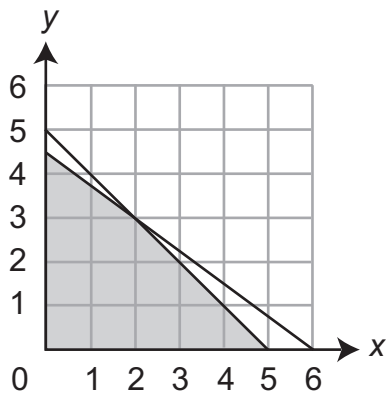
B.



C.



D.



Item Information	
Alignment	A1.1.3.2.1
Answer Key	D
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
13%	21%	15%	51%

Option Annotations

A student could determine the **correct** answer, option D, by recognizing that the lines graphed represent the maximum values for nights ($x + y = 5$) and money spent for hotel stays ($90x + 120y = 540$), thus leading the student to choose the shaded region that lies below both lines.

A student could arrive at an **incorrect** answer by incorrectly interpreting one or both of the conditions. For example, a student could arrive at option B by thinking that Kelly will stay a minimum of 5 nights, leading the student to choose the shaded region that lies below the line $90x + 120y = 540$, but above the line $x + y = 5$.

12. A baker makes two types of doughnuts. It costs \$0.25 to make each glazed doughnut and \$0.30 to make each chocolate doughnut. The baker wants to make more than 200 doughnuts for the day but can spend no more than \$60.00 making them. The system of inequalities below describes the relationship between the number of glazed doughnuts (x) and the number of chocolate doughnuts (y) the baker could make for the day.

$$0.25x + 0.30y \leq 60.00$$

$$x + y > 200$$

One solution of the system of inequalities is the ordered pair (100, 110). Which statement **best** describes the meaning of the solution?

A. The baker could make 100 glazed doughnuts and 110 chocolate doughnuts.

B. The baker could earn \$100 from glazed doughnuts and \$110 from chocolate doughnuts.

C. The baker can make a maximum of 100 glazed doughnuts and 110 chocolate doughnuts.

D. The baker will spend exactly \$60 making 100 glazed doughnuts and 110 chocolate doughnuts.

Item Information				Option Annotations
Alignment	A1.1.3.2.2			A student could determine the **correct** answer, option A, by recognizing 100 as the x-coordinate (which represents the number of glazed doughnuts) and 110 as the y-coordinate (which represents the number of chocolate doughnuts). A student could arrive at an **incorrect** answer by incorrectly interpreting the given solution. For example, a student could arrive at option C by assuming that the given solution is optimal, leading them to think that the numbers of each type of doughnut are the maximum possible.
Answer Key	A			
Depth of Knowledge	2			
***p*-values**				
A	**B**	**C**	**D**	
60%	8%	21%	11%	

CONSTRUCTED-RESPONSE ITEM

13. Perform the indicated tasks.

A. Simplify $\sqrt{120}$. Leave your answer in simplified radical form.

$\sqrt{120}$ = _____

B. Simplify b^3b^4. Give your answer with a single base and a single exponent.

b^3b^4 = _____

Go to the next page to finish question 13.

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

A list of real numbers is shown below.

$3\sqrt{7}$ $\sqrt{54}$ $(2\sqrt{2})^2$ $(\sqrt{5})^3$

C. List the real numbers shown from **least** to **greatest**.

_____ _____ _____ _____

least **greatest**

The value of d is a real number such that $\sqrt{0.8} \leq d \leq \sqrt{0.9}$. A list of expressions is shown below.

$\sqrt{d^2}$ $\sqrt{d^3}$ $2\sqrt{d}$ $d^2\sqrt{d}$

D. List the expressions shown from **least** to **greatest** for all possible values of d.

_____ _____ _____ _____

least **greatest**

SCORING GUIDE

#13 ITEM INFORMATION

Alignment	A1.1.1	**Depth of Knowledge**	2	**Mean Score**	1.49

ITEM-SPECIFIC SCORING GUIDELINE

Score	Description
4	The student demonstrates a thorough understanding of operations with real numbers and expressions by correctly solving problems.
3	The student demonstrates a general understanding of operations with real numbers and expressions by solving problems 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.
1	The student demonstrates a minimal understanding of operations with real numbers and expressions.
0	The student does not demonstrate any understanding of operations with real numbers and expressions.

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.

Responses that will receive credit:

Part A (1 point):

1 point for correct answer

What?	Why?
$2\sqrt{30}$	

Part B (1 point):

1 point for correct answer

What?	Why?
b^7	

Part C (1 point):

1 point for correct answer

What?				Why?
$\sqrt{54}$	$3\sqrt{7}$	$(2\sqrt{2})^2$	$(\sqrt{5})^3$	
least			**greatest**	

Part D (1 point):

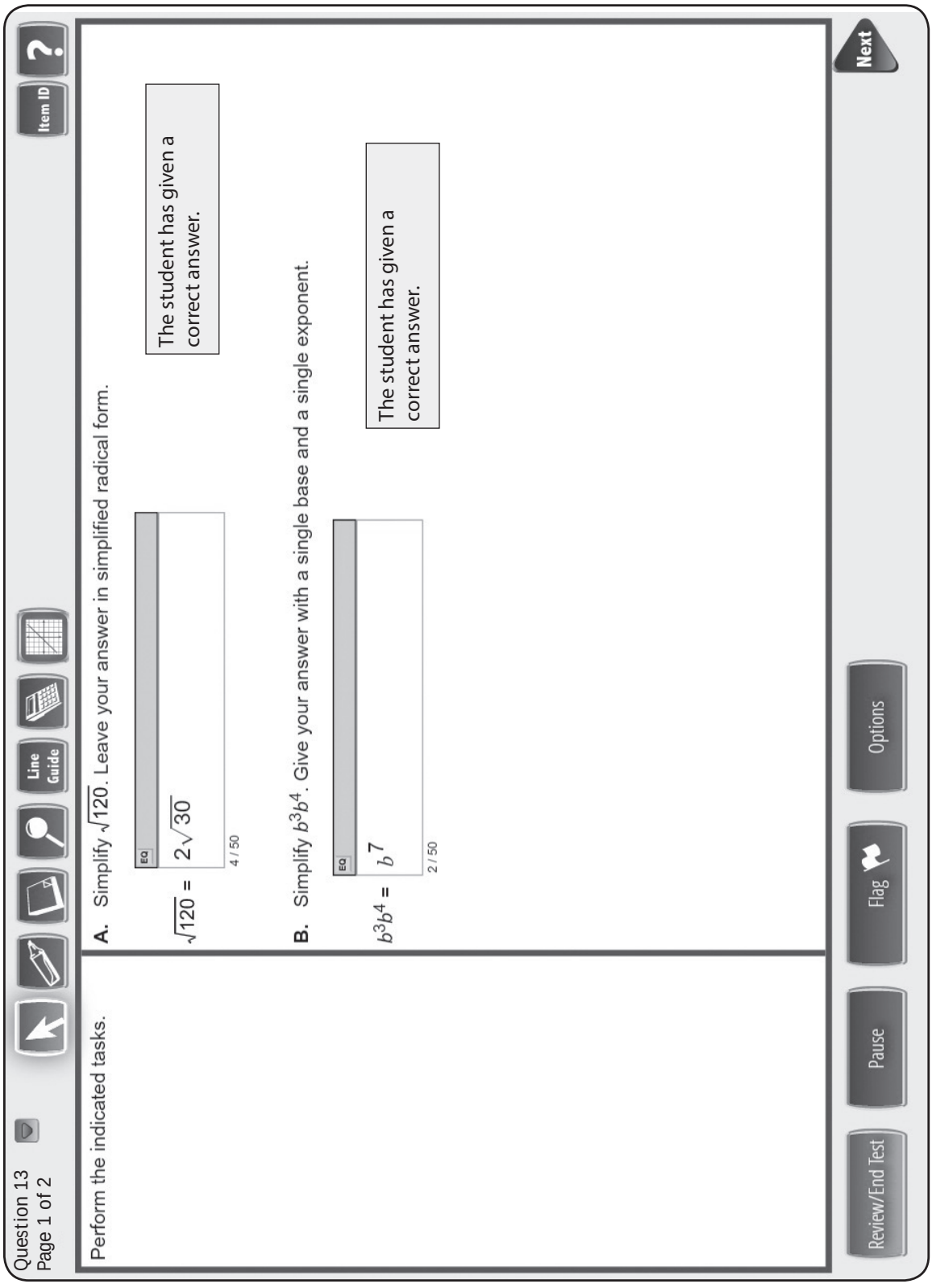
1 point for correct answer

What?				Why?
$d^2\sqrt{d}$	$\sqrt{d^3}$	$\sqrt{d^2}$	$2\sqrt{d}$	
least			**greatest**	

STUDENT RESPONSE

RESPONSE SCORE: 4 POINTS

PARTS A AND B



PARTS C AND D

Question 13
Page 2 of 2
Item ID
Perform the indicated tasks.
A list of real numbers is shown below.
$3\sqrt{7}$ $\sqrt{54}$ $(2\sqrt{2})^2$ $(\sqrt{5})^3$
C. List the real numbers shown from least to greatest.
EQ $\sqrt{54}$
EQ $3\sqrt{7}$
EQ $(2\sqrt{2})^2$
EQ $(\sqrt{5})^3$
least
greatest
The student has given a correct answer.
The value of d is a real number such that $\sqrt{0.8} \le d \le \sqrt{0.9}$. A list of expressions is shown below.
$\sqrt{d^2}$ $\sqrt{d^3}$ $2\sqrt{d}$ $d^2\sqrt{d}$
D. List the expressions shown from least to greatest for all possible values of d.
EQ $d^2\sqrt{d}$
EQ $\sqrt{d^3}$
EQ $\sqrt{d^2}$
EQ $2\sqrt{d}$
least
greatest
The student has given a correct answer.
Review/End Test
Pause
Flag
Options
Back

STUDENT RESPONSE

RESPONSE SCORE: 3 POINTS

13. Perform the indicated tasks.

A. Simplify $\sqrt{120}$. Leave your answer in simplified radical form.

$\sqrt{120}$ = $2\sqrt{30}$

The student has given a correct answer.

B. Simplify b^3b^4. Give your answer with a single base and a single exponent.

b^3b^4 = b^7

The student has given a correct answer.

Go to the next page to finish question 13.

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

A list of real numbers is shown below.

$3\sqrt{7}$ $\sqrt{54}$ $(2\sqrt{2})^2$ $(\sqrt{5})^3$

7.937 7.348 8 11.180

C. List the real numbers shown from **least** to **greatest**.

$\sqrt{54}$ $3\sqrt{7}$ $(2\sqrt{2})^2$ $(\sqrt{5})^3$

least **greatest**

The student has given a correct answer.

The value of d is a real number such that $\sqrt{0.8} \leq d \leq \sqrt{0.9}$. A list of expressions is shown below.

$\sqrt{d^2}$ $\sqrt{d^3}$ $2\sqrt{d}$ $d^2\sqrt{d}$

1 1.5 2 1

D. List the expressions shown from **least** to **greatest** for all possible values of d.

$\sqrt{d^2}$ $d^2\sqrt{d}$ $\sqrt{d^3}$ $2\sqrt{d}$

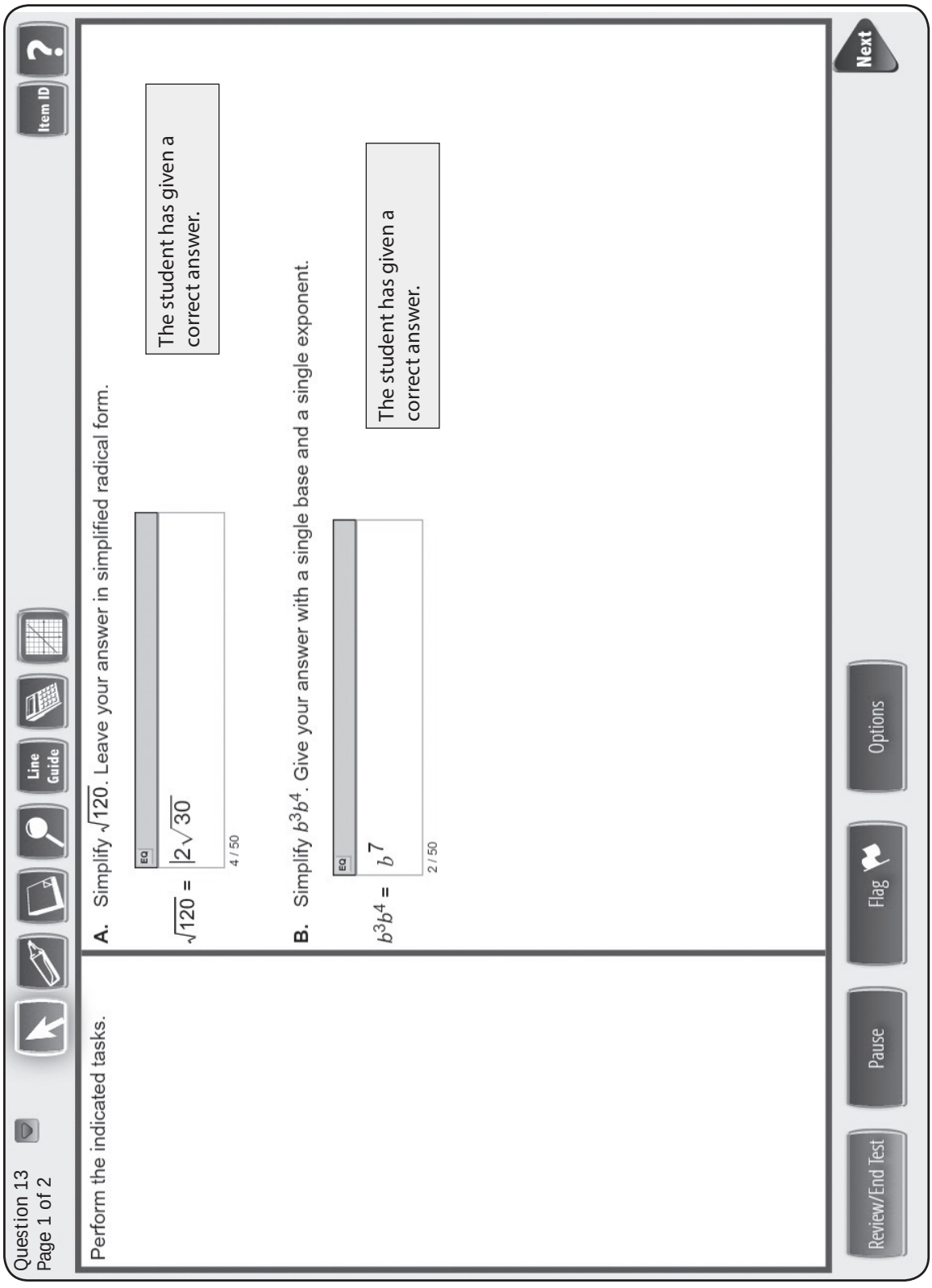
least **greatest**

The student has given an incorrect answer.

STUDENT RESPONSE

RESPONSE SCORE: 2 POINTS

PARTS A AND B



PARTS C AND D

Question 13
Page 2 of 2
Item ID
Perform the indicated tasks.
A list of real numbers is shown below.
$3\sqrt{7}$ $\sqrt{54}$ $(2\sqrt{2})^2$ $(\sqrt{5})^3$
C. List the real numbers shown from least to greatest.
EQ $2\sqrt{2}^2$
EQ $\sqrt{54}$
EQ $3\sqrt{7}$
EQ $\sqrt{5}^3$
least
greatest
The student has given an incorrect answer.
The value of d is a real number such that $\sqrt{0.8} \le d \le \sqrt{0.9}$. A list of expressions is shown below.
$\sqrt{d^2}$ $\sqrt{d^3}$ $2\sqrt{d}$ $d^2\sqrt{d}$
D. List the expressions shown from least to greatest for all possible values of d.
EQ $2\sqrt{d}$
EQ $d^2\sqrt{d}$
EQ $\sqrt{d}^2$
EQ $\sqrt{d}^3$
least
greatest
The student has given an incorrect answer.
Review/End Test
Pause
Flag
Options
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STUDENT RESPONSE

RESPONSE SCORE: 1 POINT

13. Perform the indicated tasks.

A. Simplify $\sqrt{120}$. Leave your answer in simplified radical form.

$10 \cdot 12$

$5 \cdot 2$ $\quad$ $6 \cdot 2$

$3 \cdot 2$

$\sqrt{120} =$ 10.954451l5

The student has given an incorrect answer.

B. Simplify b^3b^4. Give your answer with a single base and a single exponent.

$b+b+b \cdot b+b+b+b=b^{12}$

$b^3b^4 =$ ~~b~~ b^{12}

The student has given an incorrect answer.

Go to the next page to finish question 13.

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

A list of real numbers is shown below.

$3\sqrt{7}$ $\sqrt{54}$ $(2\sqrt{2})^2$ $(\sqrt{5})^3$

C. List the real numbers shown from **least** to **greatest**.

$3\sqrt{7} = 7.937253933$ $\sqrt{54} = 7.348469220$

$(2\sqrt{2})^2 = 4$ $(\sqrt{5})^3 = 11.18033989$

$(2\sqrt{2})^2$ $\sqrt{54}$ $3\sqrt{7}$ $(\sqrt{5})^3$

least **greatest**

The student has given an incorrect answer.

The value of d is a real number such that $\sqrt{0.8} \leq d \leq \sqrt{0.9}$. A list of expressions is shown below.

3.8 $\sqrt{d^2}$ · 3 7155417528 $\sqrt{d^3}$ 4 1.18854302 $2\sqrt{d}$ 1 · 57243340 22 $d^2\sqrt{d}$

D. List the expressions shown from **least** to **greatest** for all possible values of d.

$d^2\sqrt{d}$ $\sqrt{d^3}$ $\sqrt{d^2}$ $2\sqrt{d}$

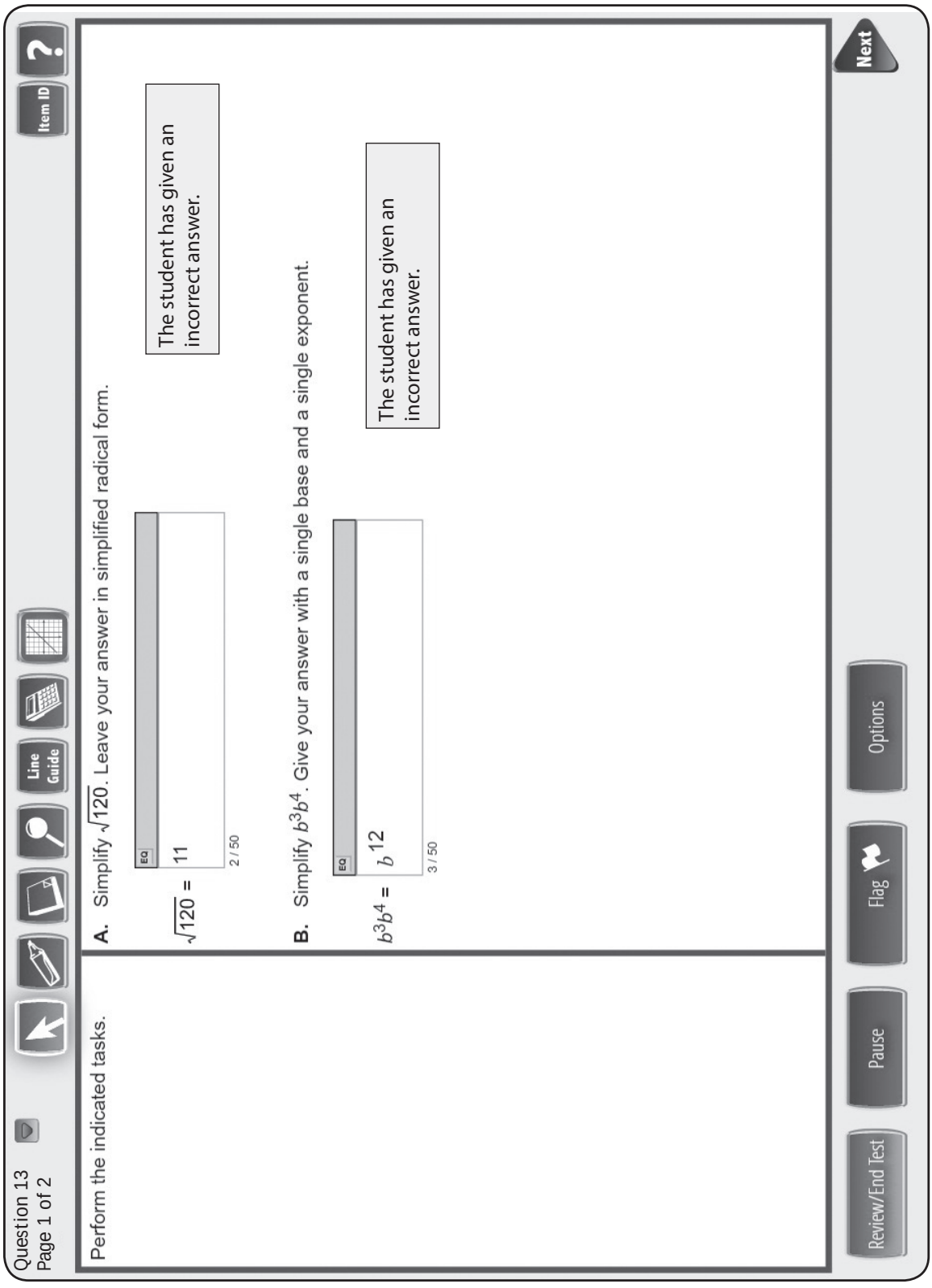
least **greatest**

The student has given a correct answer.

STUDENT RESPONSE

RESPONSE SCORE: 0 POINTS

PARTS A AND B



PARTS C AND D

Question 13
Page 2 of 2
Item ID
Perform the indicated tasks.
A list of real numbers is shown below.
$3\sqrt{7}$ $\sqrt{54}$ $(2\sqrt{2})^2$ $(\sqrt{5})^3$
C. List the real numbers shown from least to greatest.
EQ 4
EQ 8
EQ 8
EQ 27
least
greatest
The student has given an incorrect answer.
The value of d is a real number such that $\sqrt{0.8} \le d \le \sqrt{0.9}$. A list of expressions is shown below.
$\sqrt{d^2}$ $\sqrt{d^3}$ $2\sqrt{d}$ $d^2\sqrt{d}$
D. List the expressions shown from least to greatest for all possible values of d.
EQ 0.2
EQ 0.4
EQ 0.8
EQ 0.10
least
greatest
The student has given an incorrect answer.
Review/End Test
Pause
Flag
Options
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CONSTRUCTED-RESPONSE ITEM

14. At an archery competition, archers get 7 points for each arrow that lands in the bull's-eye and 4 points for each arrow that lands in the ring surrounding the bull's-eye. No points are awarded for arrows that miss both of these areas.

During the competition, Kelly had 41 arrows land in either the bull's-eye or the ring surrounding the bull's-eye. She scored a total of 206 points. To represent her performance, she wrote the system of linear equations shown below.

$$x + y = 41$$

$$4x + 7y = 206$$

A. What does the *y*-variable represent in Kelly's system of linear equations?

y-variable: _____

B. How many points did Kelly score during the competition for her arrows that landed in the ring surrounding the bull's-eye?

_____ points

Go to the next page to finish question 14.

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

A second archer, Deshaun, had 12 arrows that landed in either the bull's-eye or the ring surrounding the bull's-eye. He scored a total of 72 points.

C. Write a system of two linear equations to represent Deshaun's performance. Let *x* and *y* have the same representation as they did in Kelly's system of linear equations in **part A**.

equation 1: _____

equation 2: _____

A third archer, Lou, wrote a system of linear equations to represent his performance of scoring a total of 100 points. He solved the system of linear equations and found that the solution was (6, 8).

D. Explain how you know that Lou made a mistake in solving his system of equations.

SCORING GUIDE

#14 ITEM INFORMATION

Alignment	A1.1.2	**Depth of Knowledge**	2	**Mean Score**	2.02

ITEM-SPECIFIC SCORING GUIDELINE

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 student does not demonstrate any evidence of understanding of linear equations.

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.

Responses that will receive credit:

Part A (1 point):

1 point for correct answer

What?	Why?
the number of arrows that landed in the bull's-eye **OR equivalent**	

Part B (1 point):

1 point for correct answer

What?	Why?
108 (points)	

Part C (1 point):

$\frac{1}{2}$ point for <u>each</u> correct equation

What?	Why?
$x + y = 12$ **OR equivalent** **AND** $4x + 7y = 72$ **OR equivalent** [Note: the order of the equations does not matter.]	

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: The ordered pair (6, 8) is not a solution for the equation $4x + 7y = 100$. **OR** Hitting 6 rings and 8 bull's-eyes is worth only 80 points. [Note: (8, 6) is not a solution either]

STUDENT RESPONSE

RESPONSE SCORE: 4 POINTS

14. At an archery competition, archers get 7 points for each arrow that lands in the bull's-eye and 4 points for each arrow that lands in the ring surrounding the bull's-eye. No points are awarded for arrows that miss both of these areas.

During the competition, Kelly had 41 arrows land in either the bull's-eye or the ring surrounding the bull's-eye. She scored a total of 206 points. To represent her performance, she wrote the system of linear equations shown below.

$$x + y = 41$$

$$4x + 7y = 206$$

A. What does the *y*-variable represent in Kelly's system of linear equations?

the number of bull's eye Kelly shot

y-variable: number of bull's-eyes

The student has given a correct answer.

B. How many points did Kelly score during the competition for her arrows that landed in the ring surrounding the bull's-eye?

$4(\overset{x}{27}) + 7(\overset{y}{14}) = 206$

$108 + 98 = 206$

$x+y=41$

$27+14=41$

x = ring around bull's-eye

108 points

The student has given a correct answer.

Go to the next page to finish question 14.

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

A second archer, Deshaun, had 12 arrows that landed in either the bull's-eye or the ring surrounding the bull's-eye. He scored a total of 72 points.

C. Write a system of two linear equations to represent Deshaun's performance. Let *x* and *y* have the same representation as they did in Kelly's system of linear equations in **part A**.

equation 1: $x+y=12$

equation 2: $4x+7y=72$

The student has given two correct equations.

A third archer, Lou, wrote a system of linear equations to represent his performance of scoring a total of 100 points. He solved the system of linear equations and found that the solution was (6, 8).

D. Explain how you know that Lou made a mistake in solving his system of equations.

x y
(6, 8)

$4x+7y=100$

$4(6)+7(8)=100$

$24+56=80$

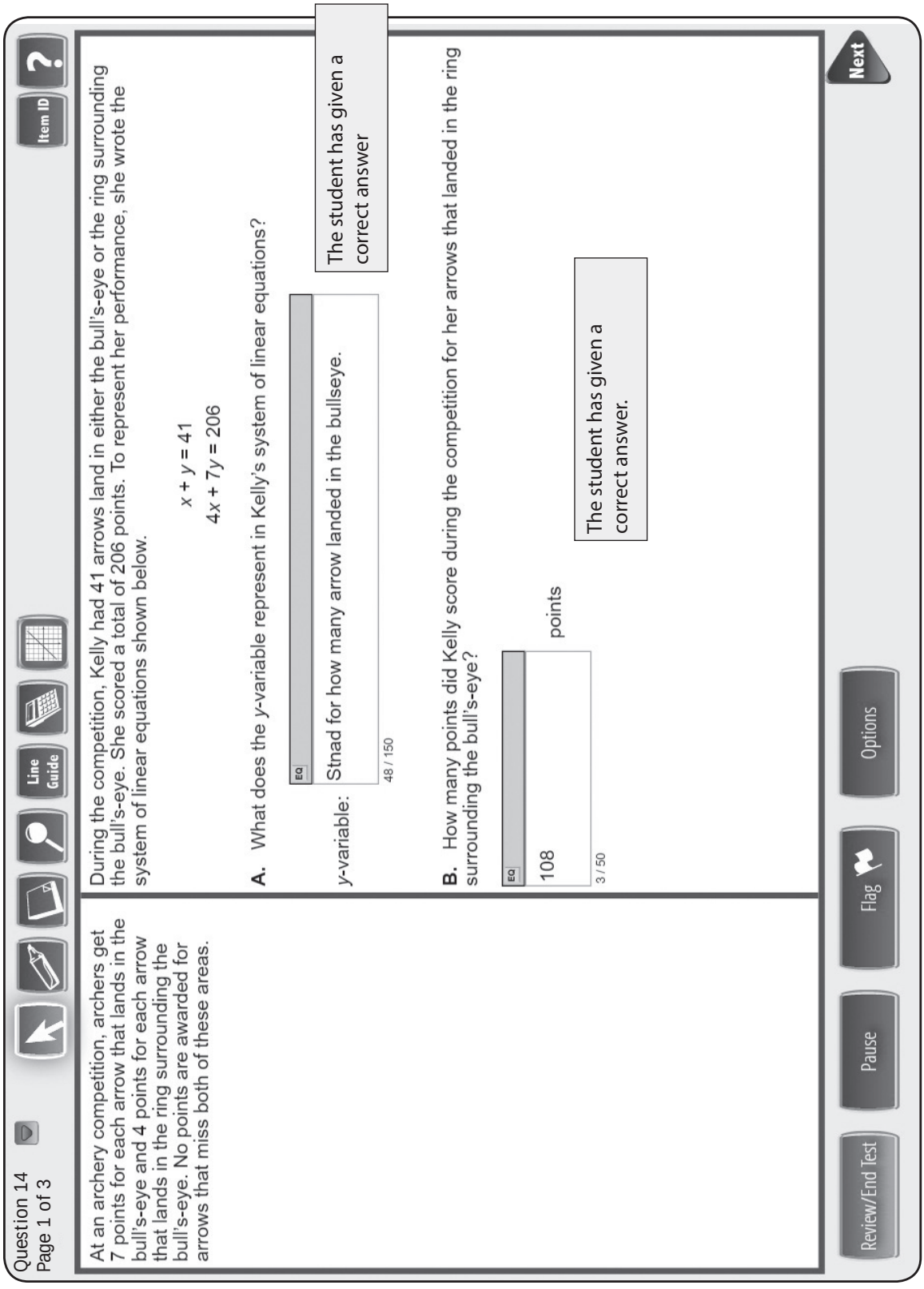
$80 \neq 100$

The student has given a complete explanation (shows that a correct solution would be 80, not 100).

STUDENT RESPONSE

RESPONSE SCORE: 3 POINTS

PARTS A AND B



PART C

Question 14
Page 2 of 3
Line Guide
Item ID
At an archery competition, archers get 7 points for each arrow that lands in the bull's-eye and 4 points for each arrow that lands in the ring surrounding the bull's-eye. No points are awarded for arrows that miss both of these areas.
A second archer, Deshaun, had 12 arrows that landed in either the bull's-eye or the ring surrounding the bull's-eye. He scored a total of 72 points.
C. Write a system of two linear equations to represent Deshaun's performance. Let x and y have the same representation as they did in Kelly's system of linear equations in part A.
EQ
equation 1: $x + y = 12$
6 / 50
EQ
equation 2: $4x + 7y = 72$
8 / 50
The student has given two correct equations.
Review/End Test
Pause
Flag
Options
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PART D

Question 14
Page 3 of 3
Item ID
At an archery competition, archers get 7 points for each arrow that lands in the bull's-eye and 4 points for each arrow that lands in the ring surrounding the bull's-eye. No points are awarded for arrows that miss both of these areas.
A third archer, Lou, wrote a system of linear equations to represent his performance of scoring a total of 100 points. He solved the system of linear equations and found that the solution was (6, 8).
D. Explain how you know that Lou made a mistake in solving his system of equations.
EQ
If you take 6*4 you get 24, if you take 8*7 you get 56. The reason why it is wrong is he did not use 2 equations.
113 / 1000
The student has given a correct but incomplete explanation (does not show that the total would be 80, or say that the total would not equal 100).
Review/End Test
Pause
Flag
Options
Back

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STUDENT RESPONSE

RESPONSE SCORE: 2 POINTS

14. At an archery competition, archers get 7 points for each arrow that lands in the bull's-eye and 4 points for each arrow that lands in the ring surrounding the bull's-eye. No points are awarded for arrows that miss both of these areas.

During the competition, Kelly had 41 arrows land in either the bull's-eye or the ring surrounding the bull's-eye. She scored a total of 206 points. To represent her performance, she wrote the system of linear equations shown below.

$$x + y = 41$$

$$4x + 7y = 206$$

A. What does the *y*-variable represent in Kelly's system of linear equations?

y-variable: the bulls-eye

The student has given a correct answer.

B. How many points did Kelly score during the competition for her arrows that landed in the ring surrounding the bull's-eye?

4 points

The student has given an incorrect answer.

Go to the next page to finish question 14.

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

A second archer, Deshaun, had 12 arrows that landed in either the bull's-eye or the ring surrounding the bull's-eye. He scored a total of 72 points.

C. Write a system of two linear equations to represent Deshaun's performance. Let *x* and *y* have the same representation as they did in Kelly's system of linear equations in **part A**.

equation 1: $x+y=12$

equation 2: $4x+8y=72$

The student has given one correct equation (equation 2 is incorrect).

A third archer, Lou, wrote a system of linear equations to represent his performance of scoring a total of 100 points. He solved the system of linear equations and found that the solution was (6, 8).

D. Explain how you know that Lou made a mistake in solving his system of equations.

Lou made a mistake because when ever he has 6 balls-eye and 8 ring surroundings the balls-eye he does not have 100 points

The student has given a correct but incomplete explanation (the student has used the ordered pair (8, 6) rather than (6, 8), but has correctly concluded that the solution would not equal 100).

STUDENT RESPONSE

RESPONSE SCORE: 1 POINT

PARTS A AND B

PART C

Question 14
Page 2 of 3
Item ID
At an archery competition, archers get 7 points for each arrow that lands in the bull's-eye and 4 points for each arrow that lands in the ring surrounding the bull's-eye. No points are awarded for arrows that miss both of these areas.
A second archer, Deshaun, had 12 arrows that landed in either the bull's-eye or the ring surrounding the bull's-eye. He scored a total of 72 points.
C. Write a system of two linear equations to represent Deshaun's performance. Let x and y have the same representation as they did in Kelly's system of linear equations in part A.
EQ
equation 1: x+y=12
12 / 50
EQ
equation 2: 4x+7y=72
16 / 50
The student has given two correct equations.
Review/End Test
Pause
Flag
Options
Back
Next

PART D

Question 14
Page 3 of 3
Item ID
At an archery competition, archers get 7 points for each arrow that lands in the bull's-eye and 4 points for each arrow that lands in the ring surrounding the bull's-eye. No points are awarded for arrows that miss both of these areas.
A third archer, Lou, wrote a system of linear equations to represent his performance of scoring a total of 100 points. He solved the system of linear equations and found that the solution was (6, 8).
D. Explain how you know that Lou made a mistake in solving his system of equations.
EQ
he didnt keep count of the score he got inside the target surounded by the bull's-eye.
86 / 1000
The student has given an incorrect explanation.
Review/End Test
Pause
Flag
Options
Back

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STUDENT RESPONSE

RESPONSE SCORE: 0 POINTS

14. At an archery competition, archers get 7 points for each arrow that lands in the bull's-eye and 4 points for each arrow that lands in the ring surrounding the bull's-eye. No points are awarded for arrows that miss both of these areas.

During the competition, Kelly had 41 arrows land in either the bull's-eye or the ring surrounding the bull's-eye. She scored a total of 206 points. To represent her performance, she wrote the system of linear equations shown below.

$$x + y = 41$$

$$4x + 7y = 206$$

A. What does the *y*-variable represent in Kelly's system of linear equations?

y-variable: y = 57x = 29.42

The student has given an incorrect answer.

B. How many points did Kelly score during the competition for her arrows that landed in the ring surrounding the bull's-eye?

7 points

The student has given an incorrect answer.

Go to the next page to finish question 14.

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

A second archer, Deshaun, had 12 arrows that landed in either the bull's-eye or the ring surrounding the bull's-eye. He scored a total of 72 points.

C. Write a system of two linear equations to represent Deshaun's performance. Let *x* and *y* have the same representation as they did in Kelly's system of linear equations in **part A**.

equation 1: $\frac{12}{75}$

equation 2: $12 \cdot 72$

The student has given no correct equations.

A third archer, Lou, wrote a system of linear equations to represent his performance of scoring a total of 100 points. He solved the system of linear equations and found that the solution was (6, 8).

D. Explain how you know that Lou made a mistake in solving his system of equations.

$\frac{1}{100}$ (6, 8)

The student has given an incorrect explanation.

ALGEBRA I MODULE 1—SUMMARY DATA

MULTIPLE-CHOICE

Sample Number	Alignment	Answer Key	Depth of Knowledge	*p*-values			
				A	B	C	D
1	A1.1.1.1.2	B	1	17%	51%	7%	25%
2	A1.1.1.2.1	B	2	21%	38%	35%	6%
3	A1.1.1.4.1	B	2	13%	57%	17%	13%
4	A1.1.1.5.1	D	1	19%	12%	15%	54%
5	A1.1.2.1.1	A	1	78%	10%	8%	4%
6	A1.1.2.1.2	D	2	5%	13%	10%	72%
7	A1.1.2.1.3	C	2	3%	14%	73%	10%
8	A1.1.2.2.2	A	2	77%	10%	5%	8%
9	A1.1.3.1.1	C	2	10%	10%	63%	17%
10	A1.1.3.1.3	B	2	12%	62%	16%	10%
11	A1.1.3.2.1	D	2	13%	21%	15%	51%
12	A1.1.3.2.2	A	2	60%	8%	21%	11%

CONSTRUCTED-RESPONSE

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
13	A1.1.1	4	2	1.49
14	A1.1.2	4	2	2.02

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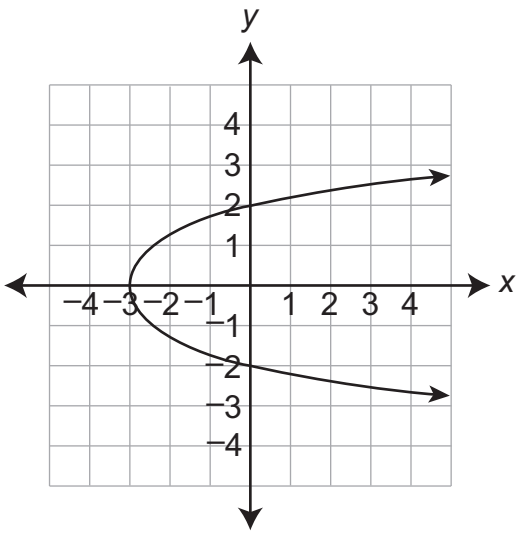
ALGEBRA I MODULE 2
MULTIPLE-CHOICE ITEMS

1. A graph of a relation is shown below.



Which statement about the relation is true?

A. The relation is not a function of *x* because all functions are linear.

B. The relation is a function of *x* because values of *x* increase toward infinity.

C. The relation is a function of *x* because each value of *y* corresponds to one value of *x*.

D. The relation is not a function of *x* because more than one value of *y* may correspond to the same value of *x*.

Item Information				Option Annotations
Alignment	A1.2.1.1.2			A student could determine the **correct** answer, option D, by recalling that a function assigns at most one *y*-value to any *x*-value and recognizing that the graph contains points with the same *x*-value but different *y*-values, such as (0, 2) and (0, −2). A student could arrive at an **incorrect** answer by incorrectly applying the definition of a function. For example, a student could arrive at option C by incorrectly reversing the roles of *x* and *y* and then noticing that for any value of *y*, only one value of *x* corresponds to a point on the graph.
Answer Key	D			
Depth of Knowledge	2			
***p*-values**				
A	**B**	**C**	**D**	
16%	18%	25%	41%	

2. A relation is shown below.

{(2, 140), (5, 350), (14, 980)}

What is the domain of the relation?

A. {2, 5, 14}

B. {140, 350, 980}

C. {all whole numbers from 2 to 14}

D. {all whole numbers from 140 to 980}

Item Information	
Alignment	A1.2.1.1.3
Answer Key	A
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
62%	18%	13%	7%

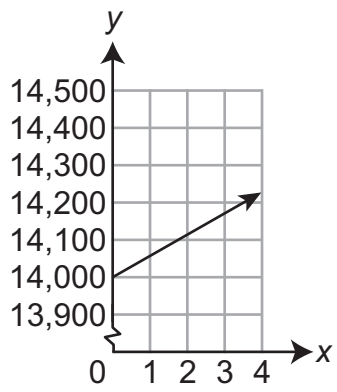
Option Annotations

A student could determine the **correct** answer, option A, by listing the *x*-coordinates from all the points in the relation, making the set {2, 5, 14}.

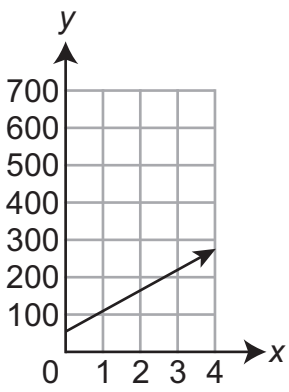
A student could arrive at an **incorrect** answer by incorrectly using the definition of domain. For example, a student could arrive at option B by listing the *y*-coordinates from all the points in the relation, {140, 350, 980}, giving the range instead of the domain.

3. At the beginning of a road trip, there are 14,000 miles on Denny's car. During the trip, Denny drives his car at an average speed of 55 miles per hour. Which graph best shows the total number of miles (y) on the car as a function of the number of hours (x) Denny drives at 55 miles per hour?

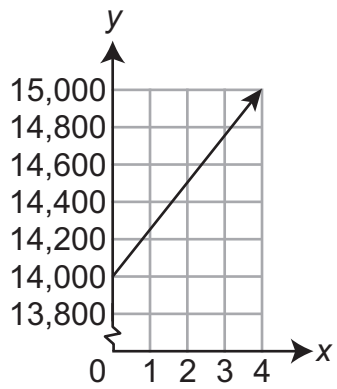
A.



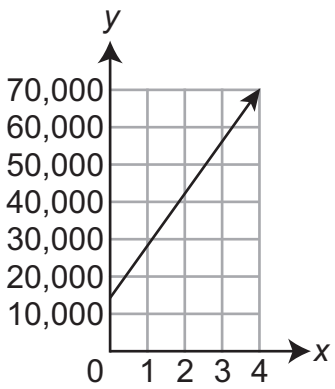
B.



C.



D.



Item Information		Option Annotations
Alignment	A1.2.1.2.1	A student could determine the **correct** answer, option A, by recognizing the beginning number of miles (14,000) as the y-intercept of the graph and the speed (55) as the slope. Option A is the only graph that matches both these conditions. A student could arrive at an **incorrect** answer by incorrectly calculating the slope or y-intercept for the given situation. For example, a student could arrive at option C by incorrectly using $\frac{14,000}{55}$ as the slope of the function.
Answer Key	A	
Depth of Knowledge	2	

***p*-values**			
A	**B**	**C**	**D**
67%	10%	18%	5%

4. Edwin drove 261 miles from city X to city Y in 4.5 hours. He continued driving at the same average speed and drove another 145 miles from city Y to city Z. What is the total amount of time Edwin spent driving from city X to city Z?

A. 4.9 hours

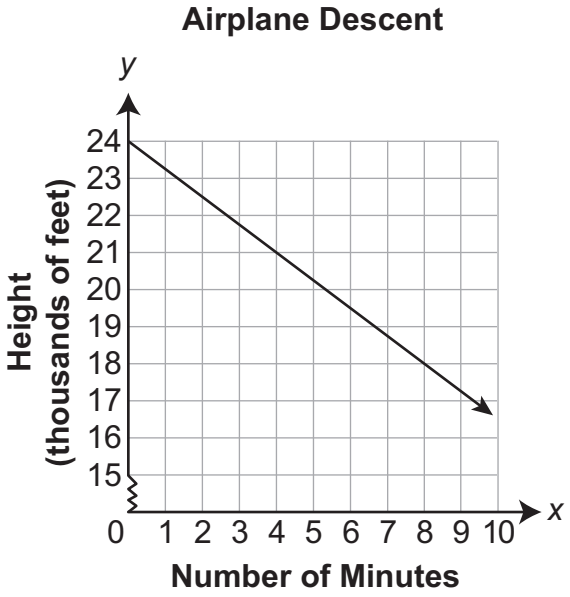
B. 6.3 hours

C. 7 hours

D. 9 hours

Item Information					Option Annotations
Alignment	A1.2.2.1.1				A student could determine the **correct** answer, option C, by dividing 261 miles by 4.5 hours to get an average speed of 58 miles per hour, dividing 145 by 58 to get 2.5 additional hours traveled, and adding 2.5 to 4.5 to get 7 total hours. A student could arrive at an **incorrect** answer by incorrectly using the number of miles or number of hours given. For example, a student could arrive at option B by dividing 261 by 145 to get 1.8 and then adding the result to 4.5 to get a total of 6.3 hours.
Answer Key	C				
Depth of Knowledge	2				
***p*-values**					
A	**B**	**C**	**D**		
8%	22%	60%	10%		

5. The graph below shows the relationship between the number of minutes (x) that have passed since an airplane began its descent and the height above ground (y), in feet, of the airplane.



Based on the graph, how long after it starts its descent will the airplane reach a height of 3,000 feet?

A. 14 minutes

B. 16 minutes

C. 28 minutes

D. 32 minutes

Item Information	
Alignment	A1.2.2.1.2
Answer Key	C
Depth of Knowledge	2

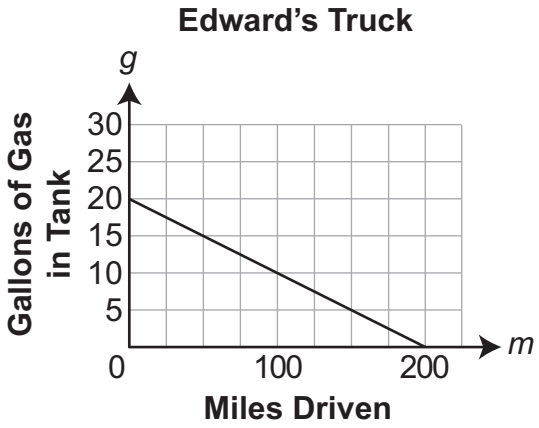
***p*-values**			
A	**B**	**C**	**D**
21%	23%	43%	13%

Option Annotations

A student could determine the **correct** answer, option C, by finding a slope of $-\frac{3}{4}$ and a y-intercept of 24 for the line and then solving the equation $3 = -\frac{3}{4}x + 24$ to find $x = 28$.

A student could arrive at an **incorrect** answer by incorrectly calculating the slope or y-intercept of the graph. For example, a student could arrive at option B by incorrectly calculating a slope of $-\frac{4}{3}$ and solving $3 = -\frac{4}{3}x + 24$ to get $x = 15.75$ and then rounding to 16.

6. The graph on the coordinate grid below shows the number of gallons of gas (g) remaining in the tank of Edward's truck based on the number of miles (m) he has driven it.



Which equation describes the graph?

A. $g = 20 - \frac{1}{10}m$

B. $g = 20 + \frac{1}{10}m$

C. $g = 200 - 10m$

D. $g = 200 + 10m$

Item Information	
Alignment	A1.2.2.1.3
Answer Key	A
Depth of Knowledge	2

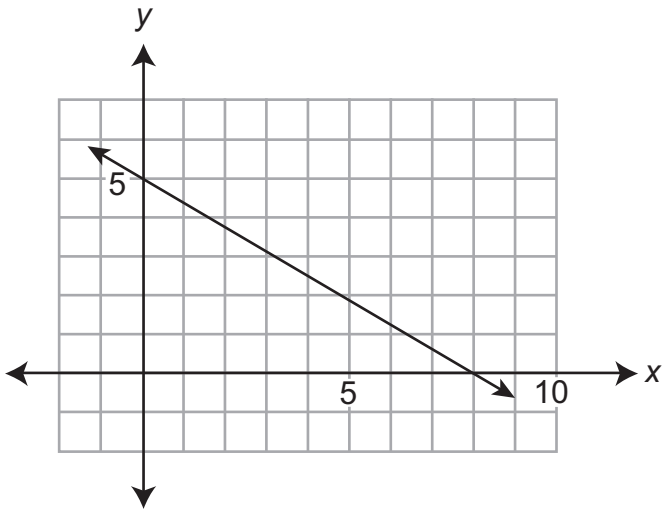
***p*-values**			
A	**B**	**C**	**D**
56%	15%	22%	7%

Option Annotations

A student could determine the **correct** answer, option A, by calculating a slope of $\frac{-20}{200} = \frac{-1}{10}$ for the line and using the y-intercept of 20 to write the linear equation $g = 20 - \frac{1}{10}m$.

A student could arrive at an **incorrect** answer by incorrectly calculating the slope or y-intercept of the graph. For example, a student could arrive at option C by reversing the roles of x and y when calculating slope and y-intercept, giving a y-intercept of 200 and slope of -10, leading to the equation $g = 200 - 10m$.

7. The graph of a line is shown below.



What is the *y*-intercept of the line?

A. $-\frac{8}{5}$

B. $-\frac{5}{8}$

C. 5

D. 8

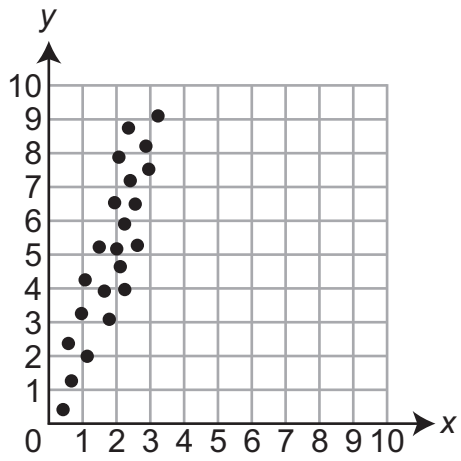
Item Information				
Alignment	A1.2.2.1.4			
Answer Key	C			
Depth of Knowledge	1			
***p*-values**				
A	**B**	**C**	**D**	
4%	9%	82%	5%	

Option Annotations

A student could determine the **correct** answer, option C, by noticing that the graph intersects the *y*-axis at 5.

A student could arrive at an **incorrect** answer by misunderstanding the definition of *y*-intercept. For example, the student could arrive at option B by confusing *y*-intercept with slope and then calculating a slope of $-\frac{5}{8}$.

8. A scatter plot is shown below.



Which equation describes the line of best fit for the scatter plot?

A. $y = 0.37x - 4$

B. $y = 0.37x$

C. $y = 2.7x - 4$

D. $y = 2.7x$

Item Information	
Alignment	A1.2.2.2.1
Answer Key	D
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
11%	29%	17%	43%

Option Annotations

A student could determine the **correct** answer, option D, by finding which equation defines a line that most closely follows the points plotted. Considering that $y = 2.7x$ goes through the points (0, 0) and (3, 8.1), option D best fits the points on the scatter plot.

A student could arrive at an **incorrect** answer by incorrectly analyzing the data or incorrectly calculating the equation. For example, the student could arrive at option B by using the points (0, 0) and (3, 8.1) but reversing x and y in the definition of slope, leading to the equation $y = 0.37x$.

9. The range of the weights, in pounds, of all the goats on a farm is 180. Which statement about the weights of the goats is **most likely** true?

A. The heaviest goat on the farm weighs 180 pounds.

B. Exactly 50% of the goats on the farm weigh less than 90 pounds.

C. Exactly 50% of the goats on the farm weigh within 180 pounds of each other.

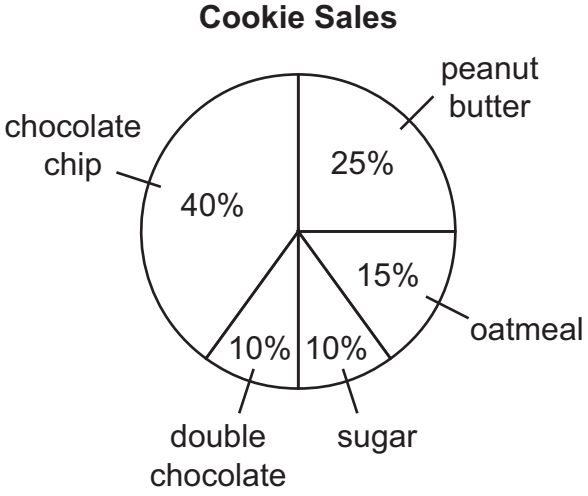
D. There is a goat on the farm that weighs 180 pounds more than another goat on the farm.

Item Information				Option Annotations
Alignment	A1.2.3.1.1			A student could determine the **correct** answer, option D, by identifying the range in this context as the difference between the highest and lowest weights of all the goats. Therefore, the heaviest goat weighs 180 pounds more than the lightest goat. A student could arrive at an **incorrect** answer by incorrectly identifying the definition of range. For example, the student could arrive at option C by confusing range with interquartile range.
Answer Key	D			
Depth of Knowledge	2			
***p*-values**				
A	**B**	**C**	**D**	
12%	21%	31%	36%	

10. The number of cookies sold at a bakery each day last week is listed below.

264 203 318 502 341 173 299

The circle graph below represents the types of cookies sold during the entire week.



Based on the data and the circle graph, how many more chocolate chip cookies than oatmeal cookies will **most likely** be sold during one day next week?

A. 25

B. 75

C. 125

D. 275

Item Information	
Alignment	A1.2.3.2.1
Answer Key	B
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
27%	43%	21%	9%

Option Annotations

A student could determine the **correct** answer, option B, by finding the mean of the daily cookie sales (2,100 ÷ 7 = 300), finding the difference in the percent of chocolate chip and percent of oatmeal cookies (40% – 15% = 25%), and then multiplying the results to get 75.

A student could arrive at an **incorrect** answer by incorrectly calculating the percent difference or incorrectly using the data for daily cookie sales. For example, the student could arrive at option A by correctly calculating the difference of 25% for chocolate chip and oatmeal cookies but ignoring the total number of cookies sold.

11. Kari asked 6 of her friends how many movies they watched during the summer. Kari determined the following measures about the number of movies watched by the 6 friends.

- mean: 9
- median: 8
- range: 16

The 3 friends who watched the most movies over the summer watched 18, 15, and 12 movies. How many movies were watched by each of the other 3 friends?

A. 1, 4, 4

B. 2, 2, 5

C. 2, 3, 4

D. 2, 4, 4

Item Information	
Alignment	A1.2.3.2.2
Answer Key	C
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
13%	19%	51%	17%

Option Annotations

A student could determine the **correct** answer, option C, by using the range to find a minimum value of 2 (18 – 2 = 16); using the median to find that the third lowest value is 4 (the average of 4 and 12 is 8); and using the mean to find that the sum of all the values is 54 (9 × 6), so the remaining value is 3.

A student could arrive at an **incorrect** answer by not using all of the given measures correctly. For example, the student could arrive at option B by finding the minimum value of 2, using the mean to find that the remaining three numbers must have a sum of 9 (9 × 6 – 18 – 15 – 12), then selecting option B without checking to see that it leads to a median of 8.5 rather than 8.

12. A clothing store employee opens a box containing 20 brown, 15 gray, 15 blue, and 10 white shirts. The employee randomly selects 3 shirts from the box to place on a store shelf. Which expression could be used to determine the probability that the employee selects 3 brown shirts?

A. $\frac{20}{60} \cdot \frac{19}{60} \cdot \frac{18}{60}$

B. $\frac{20}{60} \cdot \frac{19}{59} \cdot \frac{18}{58}$

C. $\frac{20}{60} \cdot \frac{20}{60} \cdot \frac{20}{60}$

D. $\frac{20}{60} \cdot \frac{20}{59} \cdot \frac{20}{58}$

Item Information	
Alignment	A1.2.3.3.1
Answer Key	B
Depth of Knowledge	2

***p*-values**			
A	**B**	**C**	**D**
20%	53%	19%	8%

Option Annotations

A student could determine the **correct** answer, option B, by finding the total number of shirts (20 + 15 + 15 + 10 = 60) and recognizing that the number of brown shirts and the total number of shirts both decrease by 1 each time a brown shirt is drawn. Only option B gives the correct product of the probabilities at each step.

A student could arrive at an **incorrect** answer by incorrectly finding the number of shirts or number of brown shirts at each step. For example, the student could arrive at option A by decreasing the number of brown shirts at each step but not decreasing the total number of shirts.

CONSTRUCTED-RESPONSE ITEM

13. Kent listed the coordinates of all the light poles in his town, relative to the center of town. Kent notes that the poles located at the points (2, 6), (4, 10), (2, 8), and (1, 4) need repairs.

A. What is the domain of this relation?

domain: _____

B. Which pole should Kent remove from his list in order to have the remaining poles lie in a straight line?

pole coordinates: _____

Go to the next page to finish question 13.

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

Kent would like a pole to be placed at coordinates (x, 0).

C. What should be the value of x in order for this pole to fall in line with the other three remaining poles from **part B**?

x = _____

D. What is the equation of the line that connects the locations of these four poles?

equation: _____

SCORING GUIDE

#13 ITEM INFORMATION

Alignment	A1.2.1	**Depth of Knowledge**	3	**Mean Score**	1.67

ITEM-SPECIFIC SCORING GUIDELINE

Score	Description
4	Demonstrates a thorough understanding of how to analyze a set of data for the existence of a pattern and represent the pattern algebraically and/or graphically; identify the domain or range of a relation; and translate from one representation of a linear function to another by correctly solving problems and clearly explaining procedures.
3	Demonstrates a general understanding of how to analyze a set of data for the existence of a pattern and represent the pattern algebraically and/or graphically; identify the domain or range of a relation; and translate from one representation of a linear function to another by correctly solving problems and clearly explaining procedures with only minor errors or omissions.
2	Demonstrates a partial understanding of how to analyze a set of data for the existence of a pattern and represent the pattern algebraically and/or graphically; identify the domain or range of a relation; and translate from one representation of a linear function to another by correctly performing a significant portion of the required task.
1	Demonstrates minimal understanding of how to analyze a set of data for the existence of a pattern and represent the pattern algebraically and/or graphically; identify the domain or range of a relation; and translate from one representation of a linear function to another.
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.

Responses that will receive credit:

Part A (1 point):

1 point for correct answer

What?	Why?
{1, 2, 4}	

Part B (1 point):

1 point for correct answer

What?	Why?
(2, 8)	

Part C (1 point):

1 point for correct answer

What?	Why?
−1	

Part D (1 point):

1 point for correct answer

What?	Why?
$y = 2x + 2$ **OR equivalent**	

STUDENT RESPONSE

RESPONSE SCORE: 4 POINTS

13. Kent listed the coordinates of all the light poles in his town, relative to the center of town. Kent notes that the poles located at the points (2, 6), (4, 10), (2, 8), and (1, 4) need repairs.

A. What is the domain of this relation?

domain: {1, 2, 4, 3}

The student has given a correct answer (listing 2 in the set twice is acceptable).

B. Which pole should Kent remove from his list in order to have the remaining poles lie in a straight line?

pole coordinates: (2, 8)

The student has given a correct answer.

Go to the next page to finish question 13.

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

Kent would like a pole to be placed at coordinates (x, 0).

C. What should be the value of x in order for this pole to fall in line with the other three remaining poles from **part B**?

$x =$ (-1, 0)

The student has given a correct answer (showing the value of x in the ordered pair is acceptable).

D. What is the equation of the line that connects the locations of these four poles?

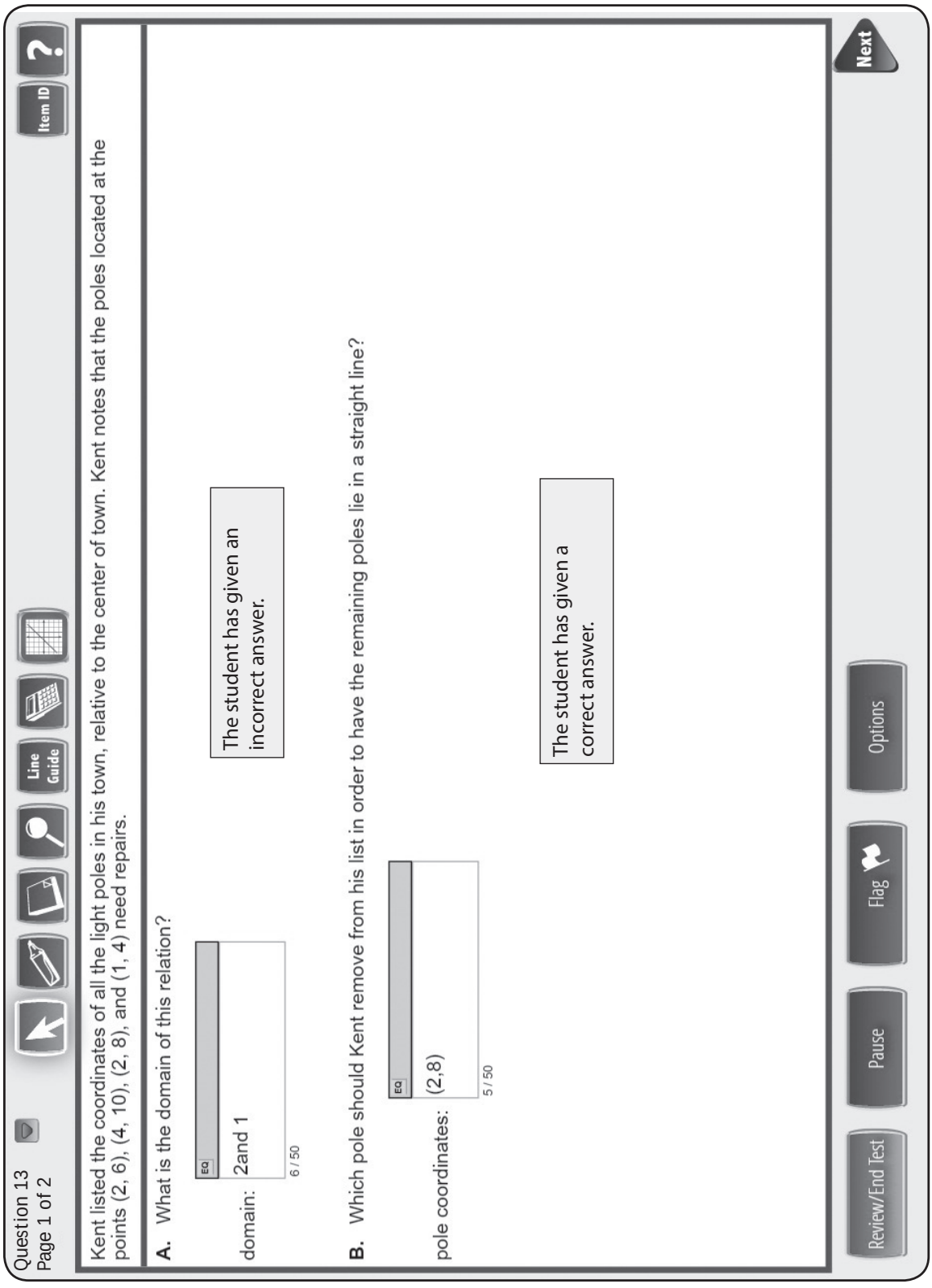
equation: $y = 2x + 2$

The student has given a correct equation.

STUDENT RESPONSE

RESPONSE SCORE: 3 POINTS

PARTS A AND B



PARTS C AND D

Question 13
Page 2 of 2
Line Guide
Item ID
Kent listed the coordinates of all the light poles in his town, relative to the center of town. Kent notes that the poles located at the points (2, 6), (4, 10), (2, 8), and (1, 4) need repairs.
Kent would like a pole to be placed at coordinates (x, 0).
C. What should be the value of x in order for this pole to fall in line with the other three remaining poles from part B?
EQ
x = -1
2 / 50
The student has given a correct answer.
D. What is the equation of the line that connects the locations of these four poles?
EQ
equation: y = 2x + 2
6 / 50
The student has given a correct equation.
Review/End Test
Pause
Flag
Options
Back

STUDENT RESPONSE

RESPONSE SCORE: 2 POINTS

13. Kent listed the coordinates of all the light poles in his town, relative to the center of town. Kent notes that the poles located at the points (2, 6), (4, 10), (2, 8), and (1, 4) need repairs.

A. What is the domain of this relation?

domain: {1, 2, and 4 3}

The student has given a correct answer.

B. Which pole should Kent remove from his list in order to have the remaining poles lie in a straight line?

pole coordinates: (2, 8)

The student has given a correct answer.

Go to the next page to finish question 13.

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

Kent would like a pole to be placed at coordinates (x, 0).

C. What should be the value of x in order for this pole to fall in line with the other three remaining poles from **part B**?

x = 0

The student has given an incorrect answer.

D. What is the equation of the line that connects the locations of these four poles?

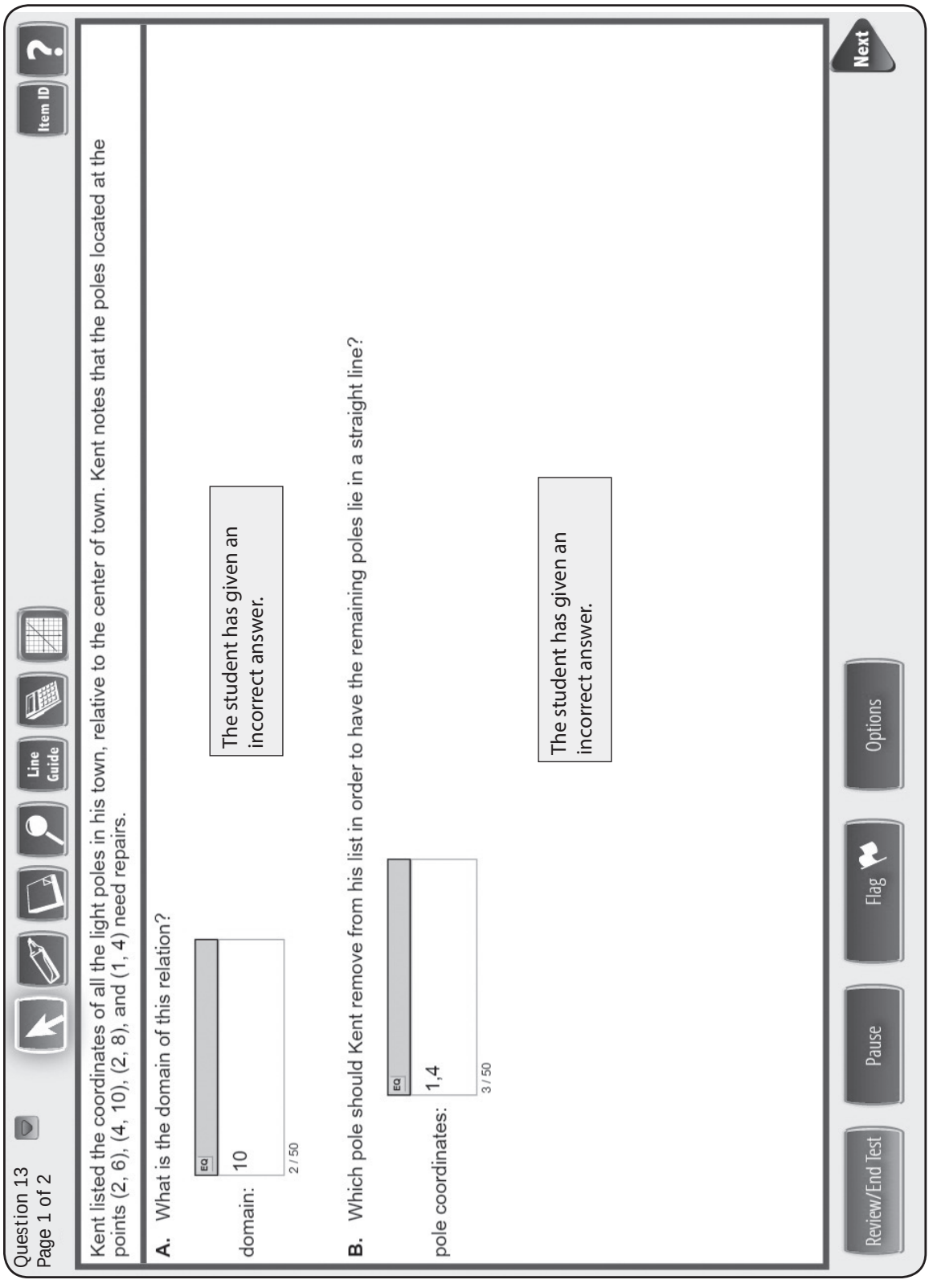
equation: $y = x \cdot x + 2$

The student has given an incorrect equation.

STUDENT RESPONSE

RESPONSE SCORE: 1 POINT

PARTS A AND B



PARTS C AND D

Question 13
Page 2 of 2
Line Guide
Item ID
Kent listed the coordinates of all the light poles in his town, relative to the center of town. Kent notes that the poles located at the points (2, 6), (4, 10), (2, 8), and (1, 4) need repairs.
Kent would like a pole to be placed at coordinates (x, 0).
C. What should be the value of x in order for this pole to fall in line with the other three remaining poles from part B?
EQ
x = 1
1 / 50
The student has given an incorrect answer (the negative sign is missing).
D. What is the equation of the line that connects the locations of these four poles?
EQ
equation: y=2x+2
6 / 50
The student has given a correct equation.
Review/End Test
Pause
Flag
Options
Back

STUDENT RESPONSE

RESPONSE SCORE: 0 POINTS

13. Kent listed the coordinates of all the light poles in his town, relative to the center of town. Kent notes that the poles located at the points (2, 6), (4, 10), (2, 8), and (1, 4) need repairs.

A. What is the domain of this relation?

domain: domain of 4 and less

The student has given an incorrect answer.

B. Which pole should Kent remove from his list in order to have the remaining poles lie in a straight line?

pole coordinates: (4,10)

The student has given an incorrect answer.

Go to the next page to finish question 13.

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

Kent would like a pole to be placed at coordinates (x, 0).

C. What should be the value of x in order for this pole to fall in line with the other three remaining poles from **part B**?

$x =$ 0

The student has given an incorrect answer.

D. What is the equation of the line that connects the locations of these four poles?

equation: x+y= 0

The student has given an incorrect equation.

CONSTRUCTED-RESPONSE ITEM

14. The list below shows the number of miles Omar rode his bike on each of six consecutive days.

8, 2, 1, 7, 2, 6

A. What are the median and mode distances, in miles, Omar rode his bike?

median: _____ mode: _____

Omar found the range of the distances of his bike rides to be 7 miles.

B. Explain why the range does **not** describe a typical length of Omar's bike rides.

Go to the next page to finish question 14.

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

C. How far does Omar need to ride his bike on day seven to have a **mean** distance of 5 miles? Show or explain all your work.

SCORING GUIDE

#14 ITEM INFORMATION

Alignment	A1.2.3	**Depth of Knowledge**	3	**Mean Score**	1.90

ITEM-SPECIFIC SCORING GUIDELINE

Score	Description
4	Demonstrates a thorough understanding of how to analyze data, make predictions, and/or answer questions based on displayed data (box-and-whisker plots, stem-and-leaf plots, scatter plots, measures of central tendency, or other representations) by correctly solving problems and clearly explaining procedures.
3	Demonstrates a general understanding of how to analyze data, make predictions, and/or answer questions based on displayed data (box-and-whisker plots, stem-and-leaf plots, scatter plots, measures of central tendency, or other representations) by correctly solving problems and clearly explaining procedures with only minor errors or omissions.
2	Demonstrates a partial understanding of how to analyze data, make predictions, and/or answer questions based on displayed data (box-and-whisker plots, stem-and-leaf plots, scatter plots, measures of central tendency, or other representations) by correctly performing a significant portion of the required task.
1	Demonstrates minimal understanding of how to analyze data, make predictions, and/or answer questions based on displayed data (box-and-whisker plots, stem-and-leaf plots, scatter plots, measures of central tendency, or other representations).
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 how to analyze data, make predictions, and/or answer questions based on displayed data (box-and-whisker plots, stem-and-leaf plots, scatter plots, measures of central tendency, or other representations).
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.

Responses that will receive credit:

Part A (1 point):

$\frac{1}{2}$ point for <u>each</u> correct answer

What?	Why?
Median: 4 (miles) Mode: 2 (miles)	

Part B (1 point):

1 point for complete explanation

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

What?	Why?
	Although the range (7 miles) is one of the distances listed, it does not describe a typical length because the range only tells how far apart the maximum and minimum distances are. The fact that the range is one of the distances listed is pure coincidence. **OR equivalent**

Part C (2 points):

1 point for correct answer

1 point for complete support

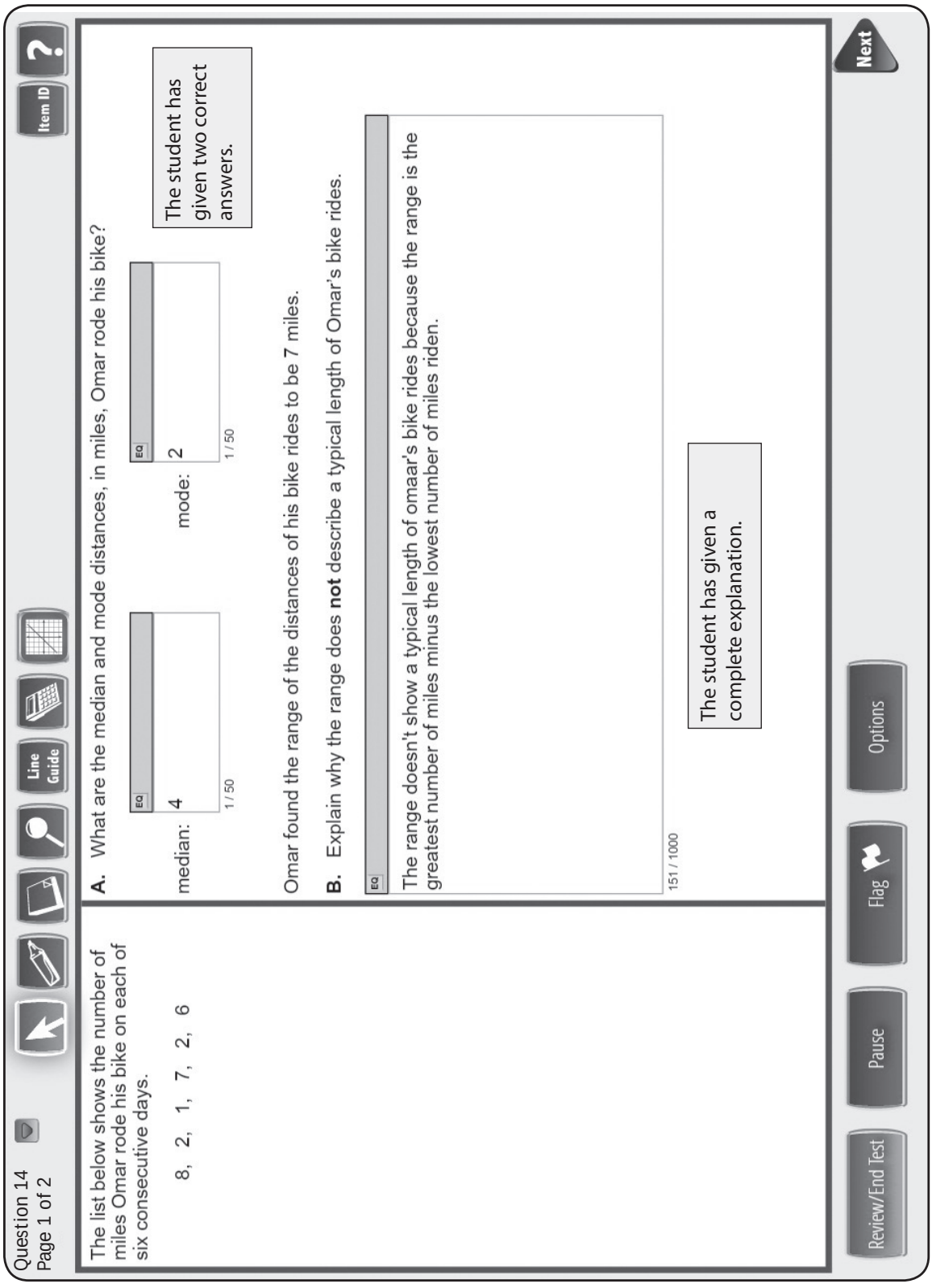
OR $\frac{1}{2}$ point for correct but incomplete support

What?	Why?
9 (miles)	$\frac{26 + x}{7} = 5$ $26 + x = 35$ $x = 9$ **OR** To find the missing value to have a mean of 5, add the current 6 values, which results in 26. Then set up the situation where you add the missing value, x, to 26 and then divide that by 7 (the new amount of total days), and the resulting equation is $\frac{26 + x}{7} = 5$. Then multiply both sides by 7 in order to work toward the value of x. The resulting equation is $26 + x = 35$. Then using the additive property of equations, add -26 to both sides, which will result in $x = 9$.

STUDENT RESPONSE

RESPONSE SCORE: 4 POINTS

PARTS A AND B



PART C

Question 14
Page 2 of 2
Item ID
The list below shows the number of miles Omar rode his bike on each of six consecutive days.
8, 2, 1, 7, 2, 6
C. How far does Omar need to ride his bike on day seven to have a mean distance of 5 miles? Show or explain all your work.
EQ
Omar needs to ride 9 miles on the 7th day for the mean to equal 5 because-
1+2+2+6+7+8=26
35, which if divided by 7 wil equal 5, minus 26 is 9.
Therefore, if on the 7th day Omar rides 9 miles
1+2+2+6+7+8+9=35
35/7= 5
220 / 1000
The student has given a correct answer.
The student has given complete support.
Review/End Test
Pause
Flag
Options
Back

STUDENT RESPONSE

RESPONSE SCORE: 3 POINTS

14. The list below shows the number of miles Omar rode his bike on each of six consecutive days.

8, 2, 1, 7, 2, 6

A. What are the median and mode distances, in miles, Omar rode his bike?

1, 2, 2, 6, 7, 8

median: 6 mode: 2

The student has given one correct answer.

Omar found the range of the distances of his bike rides to be 7 miles.

B. Explain why the range does **not** describe a typical length of Omar's bike rides.

because the range doesn't prove anything its not the answer its just the max-min

The student has given a complete explanation.

Go to the next page to finish question 14.

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

C. How far does Omar need to ride his bike on day seven to have a **mean** distance of 5 miles? Show or explain all your work.

8, 2, 1, 7, 2, 6

8 + 2 + 1 + 7 + 2 + 6 = 26

7 x 5 = 35

35
- 26
9

9 miles

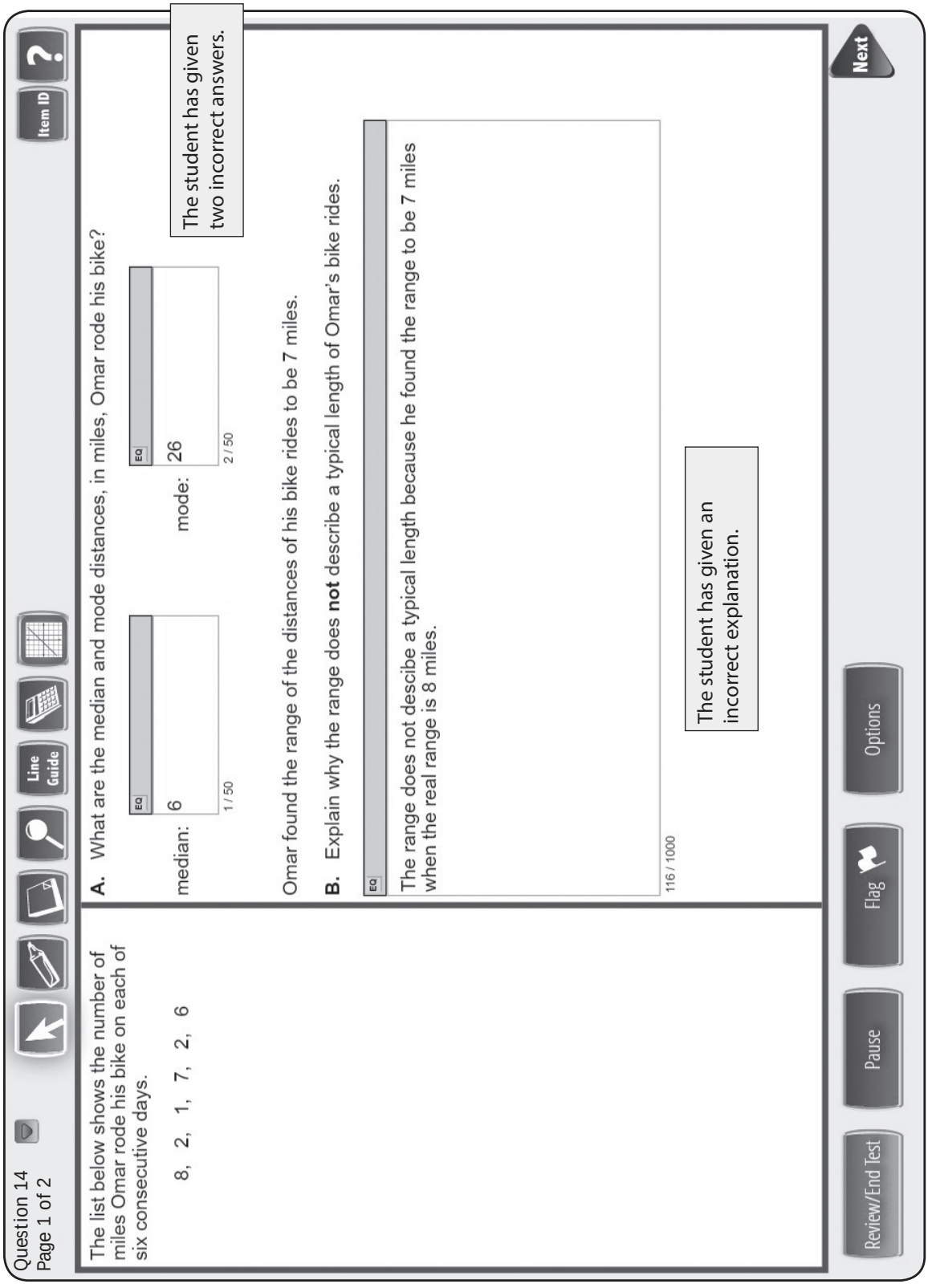
The student has given a correct answer.

The student has given complete support.

STUDENT RESPONSE

RESPONSE SCORE: 2 POINTS

PARTS A AND B



PART C

Question 14
Page 2 of 2
Item ID
The list below shows the number of miles Omar rode his bike on each of six consecutive days.
8, 2, 1, 7, 2, 6
C. How far does Omar need to ride his bike on day seven to have a mean distance of 5 miles? Show or explain all your work.
EQ
He would have to ride 9 miles to get a mean of 5 miles. I got this by adding all of the numbers and got 26. Then I figured out that it would have to a total of 35 miles to have a mean of 5 miles so I added 9 to 26 and got 35. Then to make sure it is the right mean I divided it by 7 which is the total of all the numbers and got my answer 5 miles.
347 / 1000
The student has given a correct answer.
The student has given complete support.
Review/End Test
Pause
Flag
Options
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STUDENT RESPONSE

RESPONSE SCORE: 1 POINT

14. The list below shows the number of miles Omar rode his bike on each of six consecutive days.

8, 2, 1, 7, 2, 6

A. What are the median and mode distances, in miles, Omar rode his bike?

1, 2, 2, 6, 7, 8

median: 2, 6 mode: 2

The student has given one correct answer.

Omar found the range of the distances of his bike rides to be 7 miles.

B. Explain why the range does **not** describe a typical length of Omar's bike rides.

The range does not describe atypical length of Omar's bike rides because it goes up to 8 miles 7 is less so thats not a typical length.

The student has given an incorrect explanation.

Go to the next page to finish question 14.

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

C. How far does Omar need to ride his bike on day seven to have a **mean** distance of 5 miles? Show or explain all your work.

1, 2, 2, 6, 7, 8

Omar needs to ride his bike 12 miles to get a mean of 5

Because if you add 1, 2, 2, 8 and 13 for day 7 you will get 25 divide by 5 and you get 5.

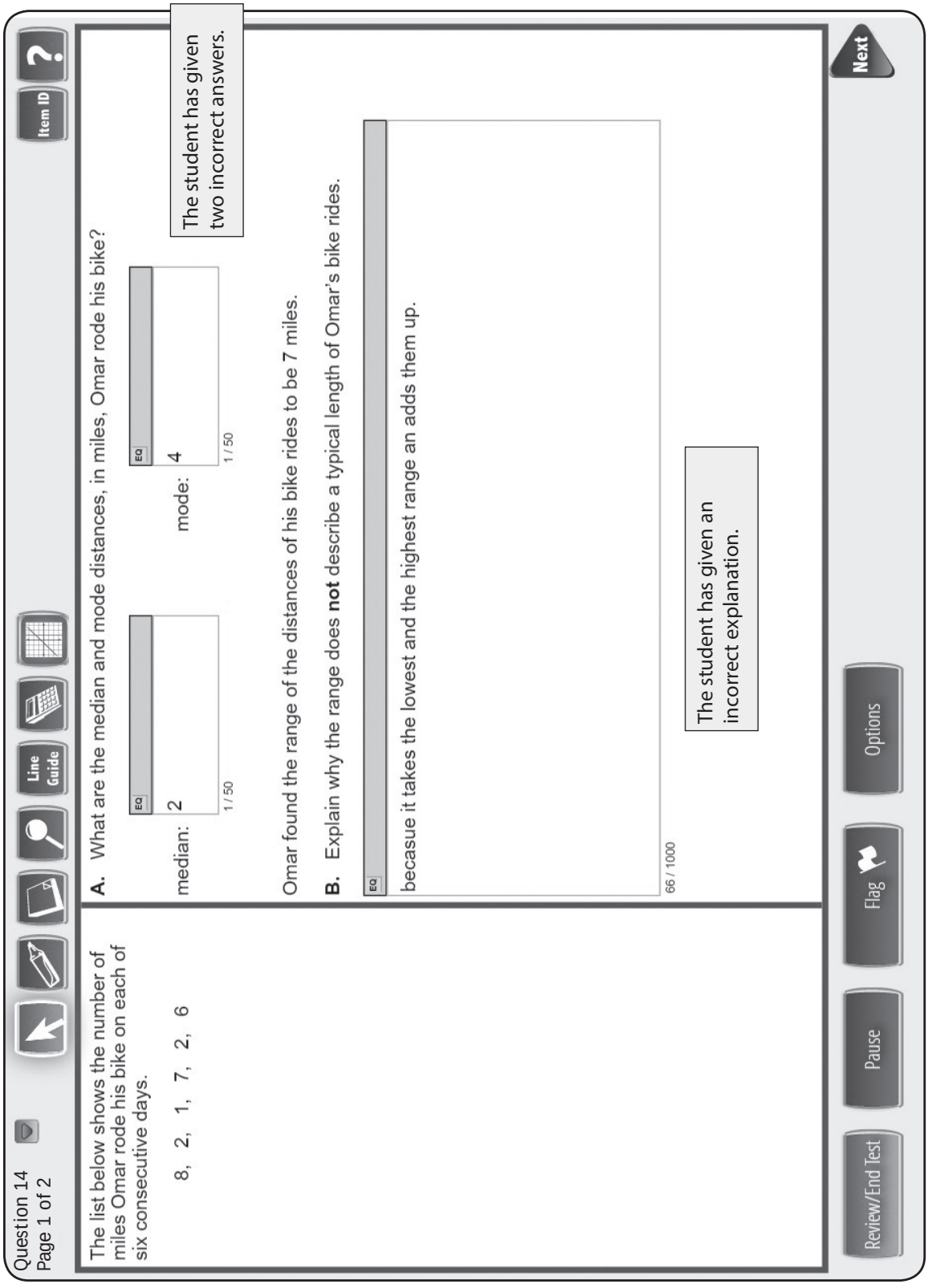
The student has given an incorrect answer.

The student has given incorrect support.

STUDENT RESPONSE

RESPONSE SCORE: 0 POINTS

PARTS A AND B



PART C

Question 14
Page 2 of 2
Item ID
The list below shows the number of miles Omar rode his bike on each of six consecutive days.
8, 2, 1, 7, 2, 6
C. How far does Omar need to ride his bike on day seven to have a mean distance of 5 miles? Show or explain all your work.
EQ
he needs to ride 4 miles
24 / 1000
The student has given an incorrect answer.
The student has given no support.
Review/End Test
Pause
Flag
Options
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ALGEBRA I MODULE 2—SUMMARY DATA

MULTIPLE-CHOICE

Sample Number	Alignment	Answer Key	Depth of Knowledge	*p*-values			
				A	B	C	D
1	A1.2.1.1.2	D	2	16%	18%	25%	41%
2	A1.2.1.1.3	A	2	62%	18%	13%	7%
3	A1.2.1.2.1	A	2	67%	10%	18%	5%
4	A1.2.2.1.1	C	2	8%	22%	60%	10%
5	A1.2.2.1.2	C	2	21%	23%	43%	13%
6	A1.2.2.1.3	A	2	56%	15%	22%	7%
7	A1.2.2.1.4	C	1	4%	9%	82%	5%
8	A1.2.2.2.1	D	2	11%	29%	17%	43%
9	A1.2.3.1.1	D	2	12%	21%	31%	36%
10	A1.2.3.2.1	B	2	27%	43%	21%	9%
11	A1.2.3.2.2	C	2	13%	19%	51%	17%
12	A1.2.3.3.1	B	2	20%	53%	19%	8%

CONSTRUCTED-RESPONSE

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
13	A1.2.1	4	3	1.67
14	A1.2.3	4	3	1.90

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Keystone Exams
Algebra I

Item and Scoring Sampler 2016