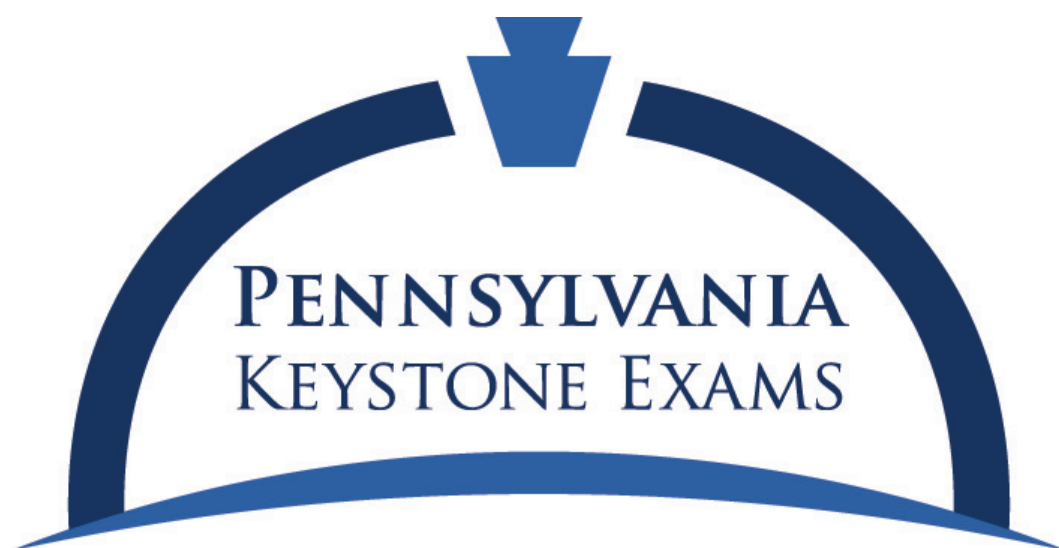




**pennsylvania**  
DEPARTMENT OF EDUCATION



ALGEBRA I

ITEM AND SCORING SAMPLER

2011

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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 state assessment system. These tools include assessment anchor documents, assessment handbooks, and content-based item and scoring samplers. This 2011 Algebra I Item and Scoring Sampler is a useful tool for Pennsylvania educators in the preparation of local instructional programs and in preparing students for the Keystone Exams.

This Item and Scoring Sampler contains multiple-choice questions and constructed-response questions that are aligned to the Keystone Assessment Anchors and Eligible Content. They provide examples of the types of questions that will appear on the operational Spring 2011 Keystone Exams. Each question has been through a rigorous review process to ensure alignment with the Assessment Anchors and Eligible Content.

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

## ABOUT THE KEYSTONE EXAMS

The Keystone Exams are end-of-course assessments designed to assess proficiency in various subject areas, including Algebra I, Algebra II, Biology, Chemistry, Civics and Government, English Composition, Geometry, Literature, U.S. History, and World History. The Keystone Exams are just one component of Pennsylvania's high school graduation requirements. Students must also earn state-specified credits, fulfill the state's service-learning and attendance requirements, and complete any additional local school system requirements to receive a Pennsylvania high school diploma.

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 Web site at [www.pdesas.org](http://www.pdesas.org).

## ALIGNMENT

The Algebra I Keystone Exam consists of exam questions arranged into **two modules**: Operations and Linear Equations & Inequalities and 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 questions 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 questions 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 questions 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 questions or stems can come from the Eligible Content, Anchor Descriptor, or Assessment Anchor statements.

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<sup>1</sup> The permission to copy and/or use these materials does not extend to commercial purposes.

**KEYSTONE EXAM FORMAT**

The Algebra I Keystone Exam includes questions that require students to select the best answer from four possible answer options. Students read each question and record their answers in the space provided. The correct answer for each multiple-choice question is worth one point.

The Algebra I Keystone Exam also includes questions that require students to write responses. Students read the question and write their responses in the spaces provided. Each constructed-response question is designed to take about ten minutes to complete. During an actual exam administration, students are given additional time as necessary to complete the exam. Each constructed-response question in Algebra I is scored using an item-specific scoring guideline based on a 0–4 point scale. In this sampler, each item-specific scoring guideline is combined with sample student responses representing each score point to form a practical, item-specific scoring guide.

The sampler also includes the General Description of Scoring Guidelines for Algebra I used to develop the item-specific scoring guidelines. These general guidelines should be used if any additional item-specific scoring guidelines are created for use within local instructional programs.

**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.

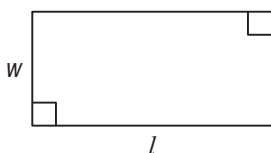
**0 POINTS**

- 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.

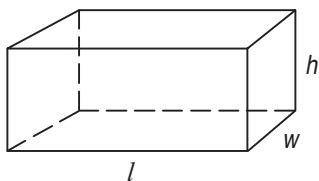
**FORMULA SHEET**

Formulas that you may need to work questions in this sampler are found below.

You may use calculator  $\pi$  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  $a \cdot c = b \cdot c$

## MULTIPLE-CHOICE QUESTIONS

## A1.1.1.1.1

1. An expression is shown below.

$$2\sqrt{51x}$$

Which value of  $x$  makes the expression equivalent to  $10\sqrt{51}$ ?

- A. 5
- B. 25 \*
- C. 50
- D. 100

A student could determine the **correct** answer, option B, by factoring  $10\sqrt{51}$  as  $2 \times 5\sqrt{51}$ , then moving the 5 inside the radical as  $2\sqrt{51} \times 5 \times 5 = 2\sqrt{51} \times 25$ .

A student could arrive at an **incorrect** answer by either using an incorrect method or by making errors in computation. For example, a student would arrive at option A if he/she failed to square 5 when he/she moved it under the radical.

## A1.1.1.3.1

2. Simplify:

$$2(2\sqrt{4})^{-2}$$

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

B.  $\frac{1}{4}$

C. 16

D. 32

A student could determine the **correct** answer, option A, by recognizing

$$2(2\sqrt{4})^{-2} = \frac{2}{2\sqrt{4} \times 2\sqrt{4}} = \frac{2}{2 \times 2 \times \sqrt{4} \times \sqrt{4}} = \frac{1}{2 \times 4} = \frac{1}{8}.$$

A student could arrive at an **incorrect** answer by failing to follow correct order of operations or by not knowing how to use radicals or negative exponents. For example, a student would arrive at option D if he/she ignored the negative exponent and treated  $2(2\sqrt{4})^{-2}$  as  $2(2\sqrt{4})^2$ .



## A1.1.1.5.1

3. A polynomial expression is shown below.

$$(mx^3 + 3)(2x^2 + 5x + 2) - (8x^5 + 20x^4)$$

The expression is simplified to  $8x^3 + 6x^2 + 15x + 6$ . What is the value of  $m$ ?

- A. -8
- B. -4
- C. 4 \*
- D. 8

A student could determine the **correct** answer, option C, by using correct order of operations and the distributive property to expand  $(mx^3 + 3)(2x^2 + 5x + 2)$  to  $2mx^5 + 5mx^4 + 2mx^3 + 6x^2 + 15x + 6$ . The student could then combine like terms and realize that  $2mx^5 - 8x^5 = 0x^5$ , so  $2m = 8$  and  $m = 4$ .

A student could arrive at an **incorrect** answer by failing to follow order of operations, making an error with the distributive property, or incorrectly combining like terms. For example, a student would arrive at option D if he/she failed to distribute and then set  $mx^3 = 8x^3$ , so  $m = 8$ .

## A1.1.1.5.2

4. Which is a factor of the trinomial  $x^2 - 2x - 15$ ?

- A.  $(x - 13)$
- B.  $(x - 5)$  \*
- C.  $(x + 5)$
- D.  $(x + 13)$

A student could determine the **correct** answer, option B, by factoring the trinomial  $x^2 - 2x - 15$  as  $(x - 5)(x + 3)$  and identifying  $(x - 5)$  as a factor.

A student could arrive at an **incorrect** answer by failing to correctly factor the trinomial. For example, a student would arrive at option C if he/she factored  $x^2 - 2x - 15$  as  $(x + 5)(x - 3)$  and identified  $(x + 5)$  as a factor.

## A1.1.1.5.3

5. Simplify:

$$\frac{x^2 - 3x - 10}{x^2 + 6x + 8} ; x \neq -4, -2$$

A.  $-\frac{1}{2}x - \frac{5}{4}$

B.  $x^2 - \frac{1}{2}x - \frac{5}{4}$

C.  $\frac{x-5}{x+4}$  \*

D.  $\frac{x+5}{x-4}$

A student could determine the **correct** answer, option C, by factoring both the numerator and denominator, then reducing  $\frac{x^2 - 3x - 10}{x^2 + 6x + 8} = \frac{(x-5)(x+2)}{(x+4)(x+2)} = \frac{x-5}{x+4}$ .

A student could arrive at an **incorrect** answer by failing to factor the numerator and denominator or by incorrectly factoring the numerator and denominator. For example, a student would arrive at option D by factoring  $\frac{x^2 - 3x - 10}{x^2 + 6x + 8}$  as  $\frac{(x+5)(x-2)}{(x-4)(x-2)}$ .

## A1.1.2.2.1

6. Anna burned 15 calories per minute running for  $x$  minutes and 10 calories per minute hiking for  $y$  minutes. She spent a total of 60 minutes running and hiking and burned 700 calories. The system of equations shown below can be used to determine how much time Anna spent on each exercise.

$$15x + 10y = 700$$

$$x + y = 60$$

What is the value of  $x$ , the minutes Anna spent running?

- A. 10
- B. 20 \*
- C. 30
- D. 40

A student could determine the **correct** answer, option B, by solving the system of equations using substitution. Solving the equation  $x + y = 60$  for  $y$  yields  $y = 60 - x$ . Substituting  $60 - x$  in the place of  $y$  in the equation  $15x + 10y = 700$  yields  $15x + 10(60 - x) = 700$ . Using the distributive property yields  $15x + 600 - 10x = 700$ . Combining like terms and subtracting 600 from both sides yields  $5x = 100$ . Dividing both sides by 5 yields  $x = 20$ .

A student could arrive at an **incorrect** answer by either using an incorrect method for solving a system of equations or by making errors in computation. For example, a student would arrive at option D by incorrectly solving for  $y$  as  $y = x + 60$  and then failing to distribute when substituting, yielding  $15x + x + 60 = 700$ . Combining like terms and subtracting 60 from both sides yields  $16x = 640$ . Dividing both sides by 16 yields  $x = 40$ .

## A1.1.2.2.2

7. Samantha and Maria purchased flowers. Samantha purchased 5 roses for  $x$  dollars each and 4 daisies for  $y$  dollars each and spent \$32 on the flowers. Maria purchased 1 rose for  $x$  dollars and 6 daisies for  $y$  dollars each and spent \$22. The system of equations shown below represents this situation.

$$5x + 4y = 32$$

$$x + 6y = 22$$

Which statement is true?

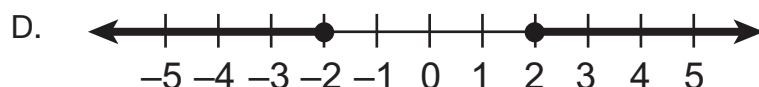
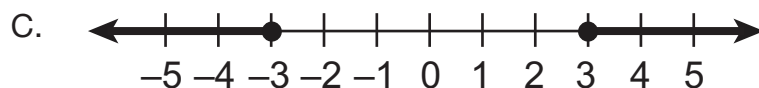
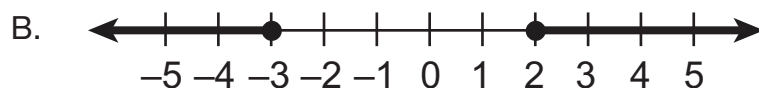
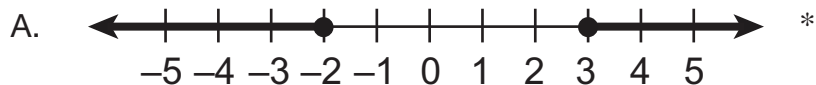
- A. A rose costs \$1 more than a daisy. \*
- B. Samantha spent \$4 on each daisy.
- C. Samantha spent more on daisies than she did on roses.
- D. Maria spent 6 times as much on daisies as she did on roses.

A student could determine the **correct** answer, option A, by solving the system of equations and correctly interpreting the solution  $x = 4$  and  $y = 3$ . The  $x$ -variable refers to the price of a rose and the  $y$ -variable refers to the price of a daisy.  $4 - 3 = 1$

A student could arrive at an **incorrect** answer by either making errors in solving the system of equations or by incorrectly interpreting the solution set. For example, a student would arrive at option B if he/she interpreted the  $x$ -value as the price of a daisy.

## A1.1.3.1.1

8. Which is a graph of the solution of the inequality  $|2x - 1| \geq 5$ ?



A student could determine the **correct** answer, option A, by simplifying the absolute value inequality.  $|2x - 1| \geq 5$  is equivalent to  $2x - 1 \geq 5$  and  $2x - 1 \leq -5$ . Solving the first inequality yields  $x \geq 3$ . Solving the second inequality yields  $x \leq -2$ .

A student could arrive at an **incorrect** answer by failing to split the absolute value inequality into simple inequalities before manipulating to solve the equation. For example, a student would arrive at option C if he/she first added 1 to each side of the absolute value inequality, divided both sides by 2, then split the absolute value inequality into simple inequalities.

## A1.1.3.1.3

9. A baseball team had \$1,000 to spend on supplies. The team spent \$185 on a new bat. New baseballs cost \$4 each. The inequality  $185 + 4b \leq 1,000$  can be used to determine the number of new baseballs ( $b$ ) that the team can purchase. Which statement about the number of new baseballs that can be purchased is true?
- A. The team can purchase 204 new baseballs.
  - B. The minimum number of new baseballs that can be purchased is 185.
  - C. The maximum number of new baseballs that can be purchased is 185.
  - D. The team can purchase 185 new baseballs, but this number is neither the maximum nor the minimum. \*

A student could determine the **correct** answer, option D, by solving the inequality and interpreting the solution  $b \leq 203.75$ . The variable  $b$  represents the number of baseballs that can be purchased. It is a true statement that  $185 \leq 203.75$ .

A student could arrive at an **incorrect** answer by either making errors in solving the system of equations or by incorrectly interpreting the solution set. For example, a student would arrive at option A if he/she switched the sign of the inequality when dividing by 4.

## A1.1.3.2.2

10. Tyreke always leaves a tip of between 8% and 20% for the server when he pays for his dinner. This can be represented by the system of inequalities shown below, where  $y$  is the amount of tip and  $x$  is the cost of dinner.

$$y > 0.08x$$

$$y < 0.2x$$

Which of the following is a true statement?

- A. When the cost of dinner,  $x$ , is \$10 the amount of tip,  $y$ , must be between \$2 and \$8.
- B. When the cost of dinner,  $x$ , is \$15 the amount of tip,  $y$ , must be between \$1.20 and \$3.00. \*
- C. When the tip,  $y$ , is \$3, the cost of dinner,  $x$ , must be between \$11 and \$23.
- D. When the tip,  $y$ , is \$2.40, the cost of dinner,  $x$ , must be between \$3 and \$6.

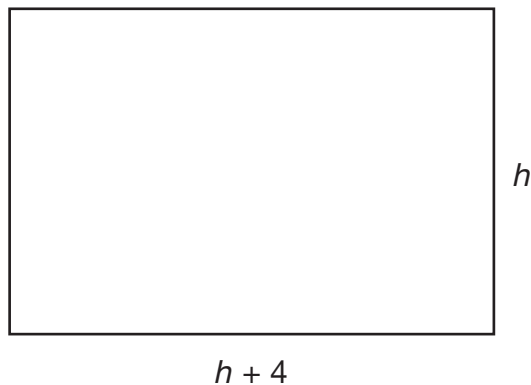
A student could determine the **correct** answer, option B, by interpreting the system of inequalities in the context of the problem situation. When 15 is substituted for the  $x$ -variable,  $y > 0.08(15)$  or  $y > 1.2$  and  $y < 0.2(15)$  or  $y < 3$ .

A student could arrive at an **incorrect** answer by either making errors in computation or in interpretation of the system of inequalities. For example, a student would arrive at option A if he/she incorrectly calculated  $0.08(10)$  as 8 and switched the signs of both inequalities.

## CONSTRUCTED-RESPONSE QUESTIONS

## A1.1.1

11. Keng creates a painting on a rectangular canvas with a width that is four inches longer than the height, as shown in the diagram below.



- A. Write a polynomial expression, in simplified form, that represents the area of the canvas.

Keng adds a 3-inch-wide frame around all sides of his canvas.

- B. Write a polynomial expression, in simplified form, that represents the **total area** of the canvas and the frame.

**Go to the next page to finish question 11.**



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

Keng is unhappy with his 3-inch-wide frame, so he decides to put a frame with a different width around his canvas. The total area of the canvas and the new frame is given by the polynomial  $h^2 + 8h + 12$ , where  $h$  represents the height of the canvas.

- C.** Determine the width of the new frame. Show all your work. Explain why you did each step.

**ITEM-SPECIFIC SCORING GUIDELINE****ITEM # 11, MODULE 1****Assessment Anchor:**

This item is reported under **A1.1.1 Operations with Real Numbers and Expressions**

**Specific Eligible Content addressed by this item:**

A1.1.1.5.1– Add, subtract, and/or multiply polynomial expressions (express answers in simplest form).

A1.1.1.5.2– Factor algebraic expressions, including difference of squares and trinomials.

**Scoring Guide:**

Score	
4	The student demonstrates a <i>thorough</i> 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 <i>general</i> 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 <i>partial</i> 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 <i>minimal</i> 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 Response:**

Part A: What?	Why?
$h^2 + 4h$ OR equivalent	

**(1 score point)**

1 point for correct expression

Part B: What?	Why?
$h^2 + 16h + 60$ OR equivalent	

**(1 score point)**

1 point for correct expression

Part C: What?	Why?
1 inch	<p><i>Sample Explanation</i></p> <p>To do this problem, I factored <math>h^2 + 8h + 12</math> into <math>(h + 6)(h + 2)</math> to find the length and height of the canvas and frame. The new height, <math>h + 2</math>, is 2 more than the height of the canvas, <math>h</math>, so the new frame must add a total of 2 inches, 1 inch on each side.</p>

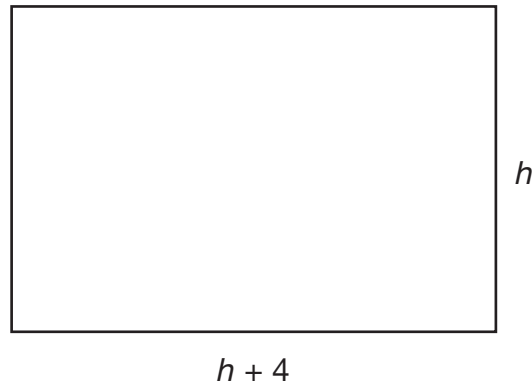
**(2 score points)**

1 point for correct answer

1 point for correct work and explanation

## A1.1.1 Response Score: 4 points

11. Keng creates a painting on a rectangular canvas with a width that is four inches longer than the height, as shown in the diagram below.



- A. Write a polynomial expression, in simplified form, that represents the area of the canvas.

$$A = lw = (h+4)(h) = \underline{h^2 + 4h}$$

Student has given a correct expression.

Keng adds a 3-inch-wide frame around all sides of his canvas.

- B. Write a polynomial expression, in simplified form, that represents the **total area** of the canvas and the frame.

$$\begin{aligned} lw &= (h+4+3+3)(h+3+3) = (h+10)(h+6) \\ &= h^2 + 10h + 6h + 60 = \underline{h^2 + 16h + 60} \end{aligned}$$

Student has given a correct expression.

Go to the next page to finish question 11.

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

Keng is unhappy with his 3-inch-wide frame, so he decides to put a frame with a different width around his canvas. The total area of the canvas and the new frame is given by the polynomial  $h^2 + 8h + 12$ , where  $h$  represents the height of the canvas.

- C. Determine the width of the new frame. Show all your work. Explain why you did each step.

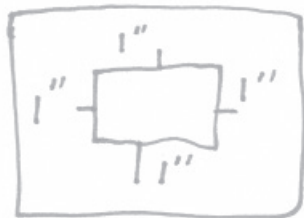
$$A = l \cdot w$$

$$h^2 + 8h + 12 = (h+6)(h+2) \quad \text{to find length + width from new area}$$

$$h+6 - (h+4)$$

$$h+6 - h - 4 = 2'' \quad \text{to find how much longer new length is on both sides of frame (same for width)}$$

$$h+2 - h = 2''$$



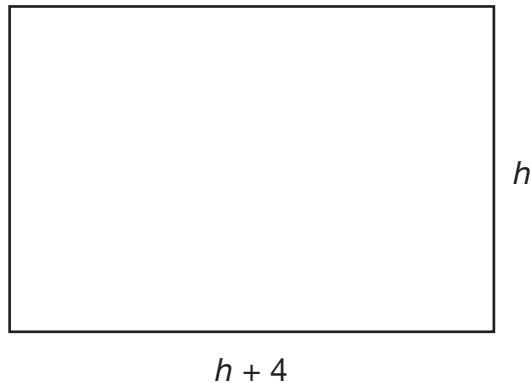
If 2 inches, then it's 1 inch on each side for new frame

Student has given a correct answer.  
Student has shown work.  
Student has given an explanation.

Based on Scoring Guidelines, 4 points is representative of a "thorough understanding."

## A1.1.1 Response Score: 3 points

11. Keng creates a painting on a rectangular canvas with a width that is four inches longer than the height, as shown in the diagram below.



- A. Write a polynomial expression, in simplified form, that represents the area of the canvas.

$$h^2 + 4h$$

Student has given a correct expression.

Keng adds a 3-inch-wide frame around all sides of his canvas.

- B. Write a polynomial expression, in simplified form, that represents the **total area** of the canvas and the frame.

$$h^2 + 16h + 60$$

Student has given a correct expression.

Go to the next page to finish question 11.

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

Keng is unhappy with his 3-inch-wide frame, so he decides to put a frame with a different width around his canvas. The total area of the canvas and the new frame is given by the polynomial  $h^2 + 8h + 12$ , where  $h$  represents the height of the canvas.

- C. Determine the width of the new frame. Show all your work. Explain why you did each step.

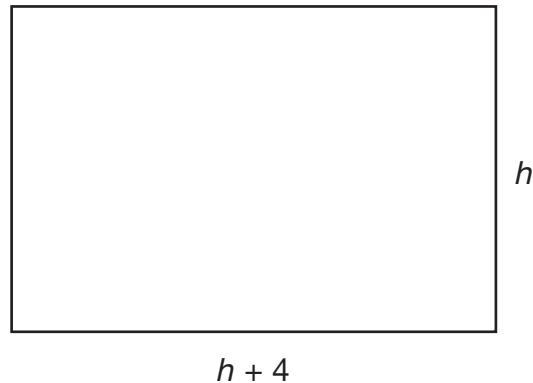
1 in

Student has given a correct answer.  
Student has shown no work.  
Student has given no explanation.

Based on Scoring Guidelines, 3 points is representative of a "general understanding."

## A1.1.1 Response Score: 3 points

11. Keng creates a painting on a rectangular canvas with a width that is four inches longer than the height, as shown in the diagram below.



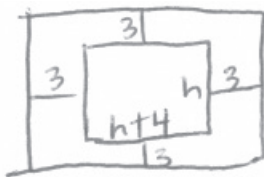
- A. Write a polynomial expression, in simplified form, that represents the area of the canvas.

$$h \times (h + 4) = h^2 + 4h$$

Student has given a correct expression.

Keng adds a 3-inch-wide frame around all sides of his canvas.

- B. Write a polynomial expression, in simplified form, that represents the **total area** of the canvas and the frame.



$$(h + 10)(h + 6) = h^2 + 16h + 60$$

Student has given a correct expression.

Go to the next page to finish question 11.



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

Keng is unhappy with his 3-inch-wide frame, so he decides to put a frame with a different width around his canvas. The total area of the canvas and the new frame is given by the polynomial  $h^2 + 8h + 12$ , where  $h$  represents the height of the canvas.

- C. Determine the width of the new frame. Show all your work. Explain why you did each step.



$$(h+2x)(h+4+2x)$$

$$h^2 + 4h + 2xh + 2xh + 8x + 4x^2$$

$$h^2 + 4h + 4xh + 8x + 4x^2 =$$

$$h^2 + 8h + 12$$

$$4h$$

I drew a picture to help me imagine it. I decided  $(h+2x)(h+4+2x)$  was equal to the area. I multiplied using the distributive property and set it equal to  $h^2 + 8h + 12$ . I solved for  $x$  to find the width of the frame but I don't know how.

$$4xh + 8x + 4x^2 = 4h + 12$$

Student has given no answer, the result of a calculation error of omission.

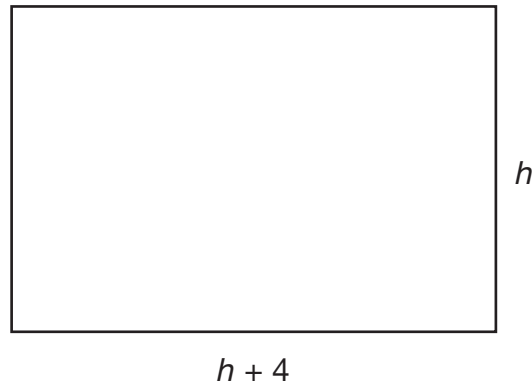
Student has correct work (all procedures necessary to solve problem are shown).

Student has correct explanation (picture helps).

Based on Scoring Guidelines, 3 points is representative of a "general understanding."

## A1.1.1 Response Score: 2 points

11. Keng creates a painting on a rectangular canvas with a width that is four inches longer than the height, as shown in the diagram below.



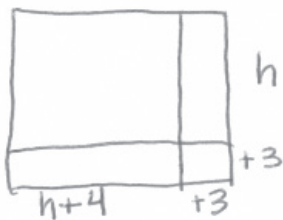
- A. Write a polynomial expression, in simplified form, that represents the area of the canvas.

$$(h+4)(h) = h^2 + 4h$$

Student has given a correct expression.

Keng adds a 3-inch-wide frame around all sides of his canvas.

- B. Write a polynomial expression, in simplified form, that represents the **total area** of the canvas and the frame.



$$(h+7)(h+3) = h^2 + 10h + 21$$

Student has given an incorrect expression. Student has failed to take into consideration that the frame is on all four sides of the figure and not just on two.

Go to the next page to finish question 11.

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

Keng is unhappy with his 3-inch-wide frame, so he decides to put a frame with a different width around his canvas. The total area of the canvas and the new frame is given by the polynomial  $h^2 + 8h + 12$ , where  $h$  represents the height of the canvas.

- C. Determine the width of the new frame. Show all your work. Explain why you did each step.

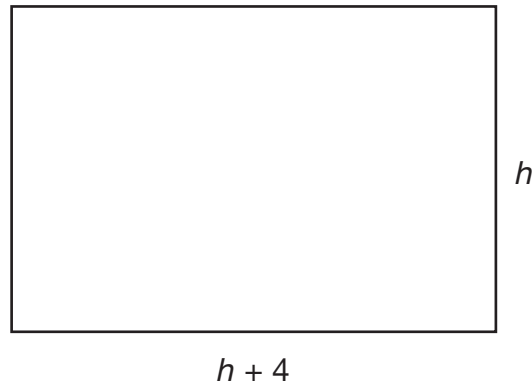
1 inch.  $h^2 + 8h + 12$  is  
less than  $h^2 + 10h + 21$   
so it has to be  
less than 3 in.

Student has given a correct answer.  
Student has shown no correct work.  
Student has given no correct explanation.

Based on Scoring Guidelines, 2 points is representative of a "partial understanding."

## A1.1.1 Response Score: 2 points

11. Keng creates a painting on a rectangular canvas with a width that is four inches longer than the height, as shown in the diagram below.



- A. Write a polynomial expression, in simplified form, that represents the area of the canvas.

$$h(h+4)$$

$$h^2 + 4h$$

Student has given a correct expression.

Keng adds a 3-inch-wide frame around all sides of his canvas.

- B. Write a polynomial expression, in simplified form, that represents the **total area** of the canvas and the frame.

$$(h+3)(h+4+3) = (h+3)(h+7)$$

$$= h^2 + 3h + 7h + 21 = h^2 + 10h + 21$$

Student has given an incorrect expression. Student has failed to take into consideration that the frame is on all four sides of the figure and not just on two.

Go to the next page to finish question 11.

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

Keng is unhappy with his 3-inch-wide frame, so he decides to put a frame with a different width around his canvas. The total area of the canvas and the new frame is given by the polynomial  $h^2 + 8h + 12$ , where  $h$  represents the height of the canvas.

- C. Determine the width of the new frame. Show all your work. Explain why you did each step.

$$h^2 + 8h + 12 = h^2 + 2h + 6h + 12$$
$$(h+2)(h+6) = (h+2)[(h+4)+2]$$

width = 2 in.

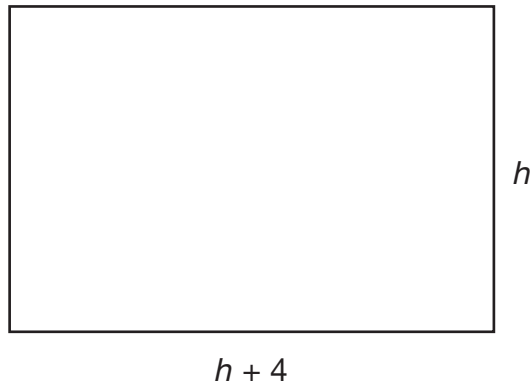
I factored to find the missing length and width. I expanded  $h+6$  to  $(h+4)+2$  to find the constant frame width added to all sides.

Student has given an incorrect answer.  
Student has shown correct work up to interpreting answer.  
Student has given correct explanation.

Based on Scoring Guidelines, 2 points is representative of a "partial understanding."

## A1.1.1 Response Score: 1 point

11. Keng creates a painting on a rectangular canvas with a width that is four inches longer than the height, as shown in the diagram below.



- A. Write a polynomial expression, in simplified form, that represents the area of the canvas.

$$h(h+4) = h^2 + 4h$$

Student has given a correct expression.

Keng adds a 3-inch-wide frame around all sides of his canvas.

- B. Write a polynomial expression, in simplified form, that represents the **total area** of the canvas and the frame.

$$(h+3)(h+(4+3)) = (h+3)(h+7) = h^2 + 7h + 3h + 21$$

$$= h^2 + 10h + 21$$

Student has given an incorrect expression.

Go to the next page to finish question 11.

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

Keng is unhappy with his 3-inch-wide frame, so he decides to put a frame with a different width around his canvas. The total area of the canvas and the new frame is given by the polynomial  $h^2 + 8h + 12$ , where  $h$  represents the height of the canvas.

- C. Determine the width of the new frame. Show all your work. Explain why you did each step.

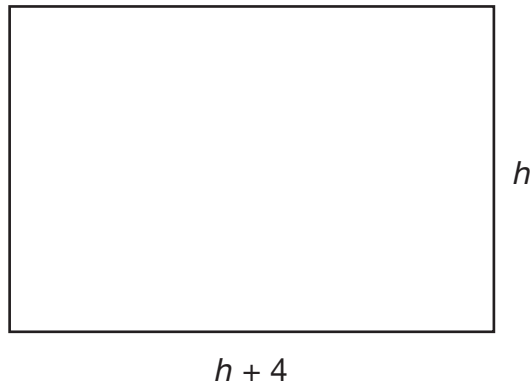
2 in.  $h^2 + 8h + 12$  is smaller than  
 $h^2 + 10h + 21$  so the new  
frame was smaller than  
3 in.

Student has given an incorrect answer.  
Student has shown no correct work.  
Student has given no correct explanation.

Based on Scoring Guidelines, 1 point is representative of a "minimal understanding."

## A1.1.1 Response Score: 1 point

11. Keng creates a painting on a rectangular canvas with a width that is four inches longer than the height, as shown in the diagram below.



- A. Write a polynomial expression, in simplified form, that represents the area of the canvas.

$$h^2 + 4h$$

Student has given a correct expression.

Keng adds a 3-inch-wide frame around all sides of his canvas.

- B. Write a polynomial expression, in simplified form, that represents the **total area** of the canvas and the frame.

$$h^2 + 7h$$

Student has given an incorrect expression.

Go to the next page to finish question 11.



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

Keng is unhappy with his 3-inch-wide frame, so he decides to put a frame with a different width around his canvas. The total area of the canvas and the new frame is given by the polynomial  $h^2 + 8h + 12$ , where  $h$  represents the height of the canvas.

- C. Determine the width of the new frame. Show all your work. Explain why you did each step.

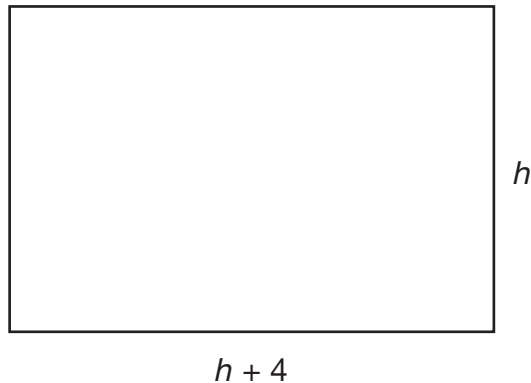
$$6 + 2$$

Student has given an incorrect answer.  
Student has shown no correct work.  
Student has given no correct explanation.

Based on Scoring Guidelines, 1 point is representative of a "minimal understanding."

## A1.1.1 Response Score: 0

11. Keng creates a painting on a rectangular canvas with a width that is four inches longer than the height, as shown in the diagram below.



- A. Write a polynomial expression, in simplified form, that represents the area of the canvas.

$$h^2 + 4$$

Student has given an incorrect expression.

Keng adds a 3-inch-wide frame around all sides of his canvas.

- B. Write a polynomial expression, in simplified form, that represents the **total area** of the canvas and the frame.

$$h^2 + 7$$

Student has given an incorrect expression.

Go to the next page to finish question 11.

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

Keng is unhappy with his 3-inch-wide frame, so he decides to put a frame with a different width around his canvas. The total area of the canvas and the new frame is given by the polynomial  $h^2 + 8h + 12$ , where  $h$  represents the height of the canvas.

- C. Determine the width of the new frame. Show all your work. Explain why you did each step.

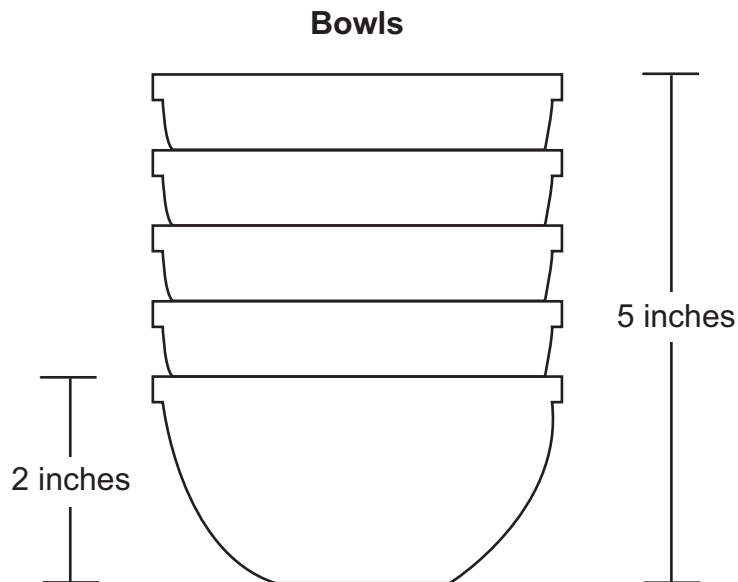
(4, 3)

Student has given an incorrect answer.  
Student has shown no correct work.  
Student has given no correct explanation.

Based on Scoring Guidelines, 0 points is representative of “no understanding.”

## A1.1.2

12. The diagram below shows 5 identical bowls stacked one inside the other.



The height of 1 bowl is 2 inches. The height of a stack of 5 bowls is 5 inches.

- A.** Write an equation using  $x$  and  $y$  to find the height of a stack of bowls based on any number of bowls.

equation: \_\_\_\_\_

- B.** Describe what the  $x$  and  $y$  variables represent.

$x$ -variable: \_\_\_\_\_

$y$ -variable: \_\_\_\_\_

**Go to the next page to finish question 12.**

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

C. What is the height, in inches, of a stack of 10 bowls?

height: \_\_\_\_\_ inches

**ITEM-SPECIFIC SCORING GUIDELINE****ITEM # 12, MODULE 1****Assessment Anchor:**

**This item is reported under A1.1.2 Linear Equations**

**Specific Eligible Content addressed by this item:**

A1.1.2.1.1– Write, solve, and/or apply a linear equation (including problem situations).

A1.1.2.1.3– Interpret solutions to problems in the context of the problem situation (linear equations only).

**Scoring Guide:**

Score	
4	The student demonstrates a <i>thorough</i> understanding of linear equations by correctly solving problems.
3	The student demonstrates a <i>general</i> understanding of linear equations by solving problems with only minor errors or omissions.
2	The student demonstrates a <i>partial</i> understanding of linear equations by providing a portion of the correct problem solving.
1	The student demonstrates a <i>minimal</i> understanding of linear equations.
0	The student does not demonstrate any understanding of linear equations.

**Top Scoring Response:**

<b>Part A: What?</b>	<b>Why?</b>
$y = 0.75x + 1.25$ <b>OR equivalent</b>	

**(1 score point)**

1 point for correct equation

<b>Part B: What?</b>	<b>Why?</b>
x-variable: the number of bowls y-variable: the height of the stack of bowls <b>OR equivalent</b>	

**(2 score points)**1 point for correct description of  $x$ -variable1 point for correct description of  $y$ -variable

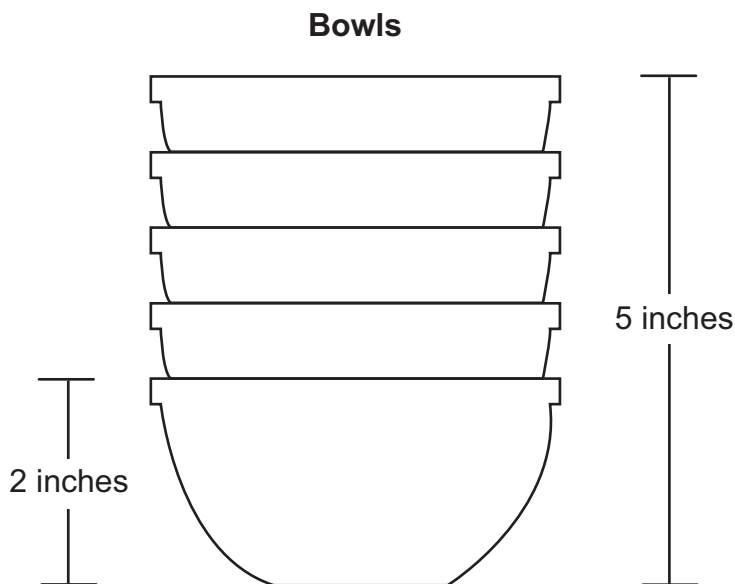
<b>Part C: What?</b>	<b>Why?</b>
8.75 inches <b>OR equivalent</b>	

**(1 score point)**

1 point for correct answer

## A1.1.2 Response Score: 4 points

12. The diagram below shows 5 identical bowls stacked one inside the other.



The height of 1 bowl is 2 inches. The height of a stack of 5 bowls is 5 inches.

- A.** Write an equation using  $x$  and  $y$  to find the height of a stack of bowls based on any number of bowls.

equation:  $y = .75x + 1.25$

$$\frac{5-2}{4} = .75$$

$$5 - 5(.75)$$

$$5 - 3.75 = 1.25$$

Student has given a correct equation.

- B.** Describe what the  $x$  and  $y$  variables represent.

$x$ -variable: the number of bowls (how many)

$y$ -variable: the height (how tall) of the bowls stacked

Student has given two correct descriptions.

**Go to the next page to finish question 12.**



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

C. What is the height, in inches, of a stack of 10 bowls?

$$\begin{aligned}y &= .75(10) + 1.25 \\ &= 7.50 + 1.25 \\ &= 8.75\end{aligned}$$

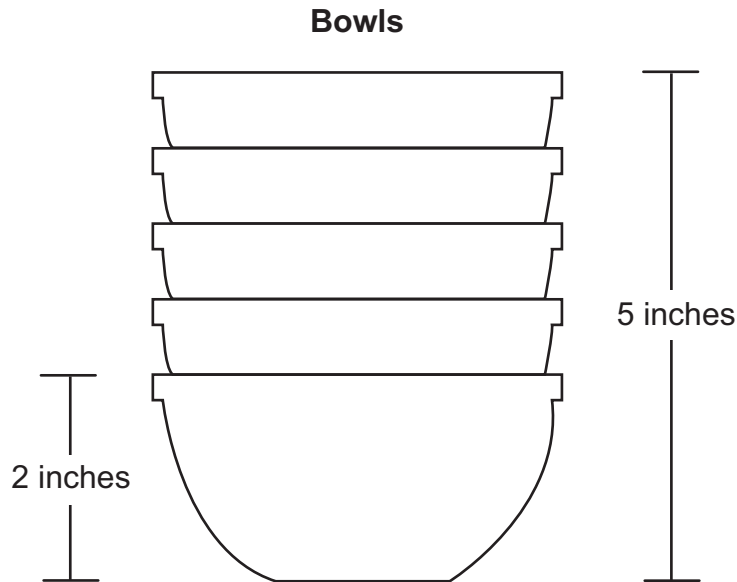
height: 8.75 inches

Student has given a correct answer.

Based on Scoring Guidelines, 4 points is representative of a "thorough understanding."

## A1.1.2 Response Score: 3 points

12. The diagram below shows 5 identical bowls stacked one inside the other.



The height of 1 bowl is 2 inches. The height of a stack of 5 bowls is 5 inches.

- A.** Write an equation using  $x$  and  $y$  to find the height of a stack of bowls based on any number of bowls.

equation:  $y = x + 2$

Student has given an incorrect equation.

- B.** Describe what the  $x$  and  $y$  variables represent.

$x$ -variable: number of bowls

$y$ -variable: total height

Student has given two correct descriptions.

**Go to the next page to finish question 12.**

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

C. What is the height, in inches, of a stack of 10 bowls?

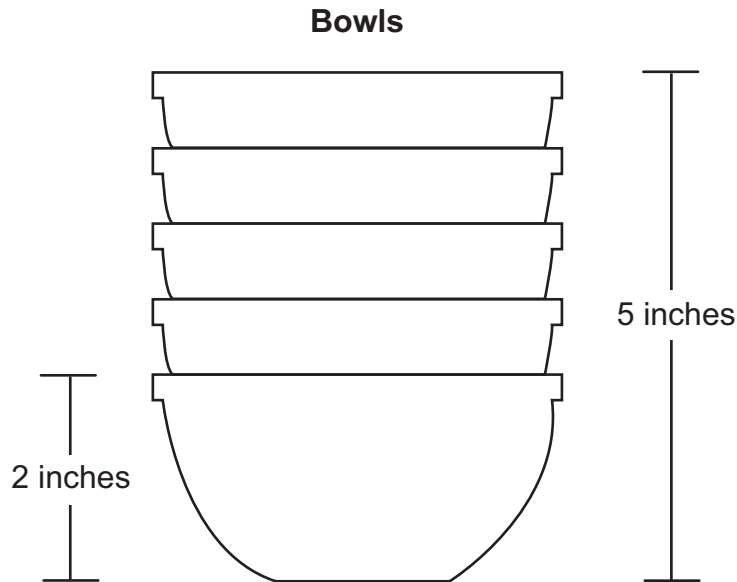
height: 12 inches

Student has given a “correct answer” based on an incorrect equation from Part A. (Error is carried through correctly, so student is not penalized twice.)

Based on Scoring Guidelines, 3 points is representative of a “general understanding.”

## A1.1.2 Response Score: 3 points

12. The diagram below shows 5 identical bowls stacked one inside the other.



The height of 1 bowl is 2 inches. The height of a stack of 5 bowls is 5 inches.

- A.** Write an equation using  $x$  and  $y$  to find the height of a stack of bowls based on any number of bowls.

equation:  $y = \frac{3}{4}x + \frac{5}{4}$

Student has given a correct equation in fraction form.

- B.** Describe what the  $x$  and  $y$  variables represent.

$x$ -variable: number of bowls

$y$ -variable: height of bowls

Student has given two correct descriptions.

**Go to the next page to finish question 12.**

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

C. What is the height, in inches, of a stack of 10 bowls?

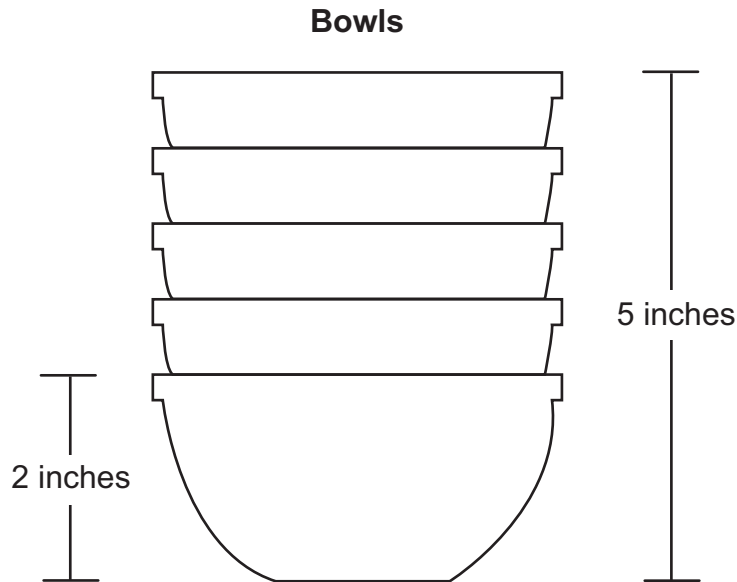
height:  $7\frac{1}{2}$  inches

Student has given an incorrect answer.

Based on Scoring Guidelines, 3 points is representative of a "general understanding."

## A1.1.2 Response Score: 2 points

12. The diagram below shows 5 identical bowls stacked one inside the other.



The height of 1 bowl is 2 inches. The height of a stack of 5 bowls is 5 inches.

- A.** Write an equation using  $x$  and  $y$  to find the height of a stack of bowls based on any number of bowls.

equation:  $y = 2x + 5$

Student has given an incorrect equation.

- B.** Describe what the  $x$  and  $y$  variables represent.

$x$ -variable: number of bowls

$y$ -variable: height of stack

Student has given two correct descriptions.

**Go to the next page to finish question 12.**

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

C. What is the height, in inches, of a stack of 10 bowls?

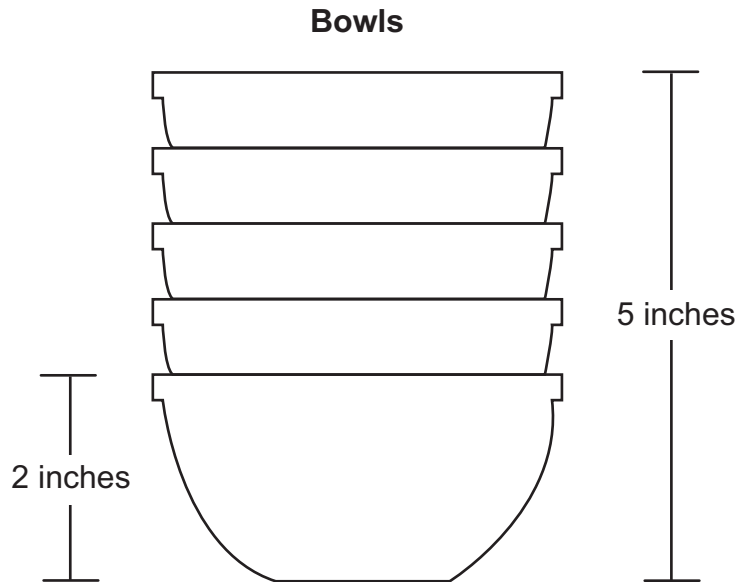
height: 10 inches

Student has given an incorrect answer.

Based on Scoring Guidelines, 2 points is representative of a “partial understanding.”

## A1.1.2 Response Score: 2 points

12. The diagram below shows 5 identical bowls stacked one inside the other.



The height of 1 bowl is 2 inches. The height of a stack of 5 bowls is 5 inches.

- A.** Write an equation using  $x$  and  $y$  to find the height of a stack of bowls based on any number of bowls.

equation:  $y = 1x + 2$

Student has given an incorrect equation.

- B.** Describe what the  $x$  and  $y$  variables represent.

$x$ -variable: width of bowls

$y$ -variable: height of bowls

Student has given one incorrect description followed by one correct description.

**Go to the next page to finish question 12.**



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

C. What is the height, in inches, of a stack of 10 bowls?

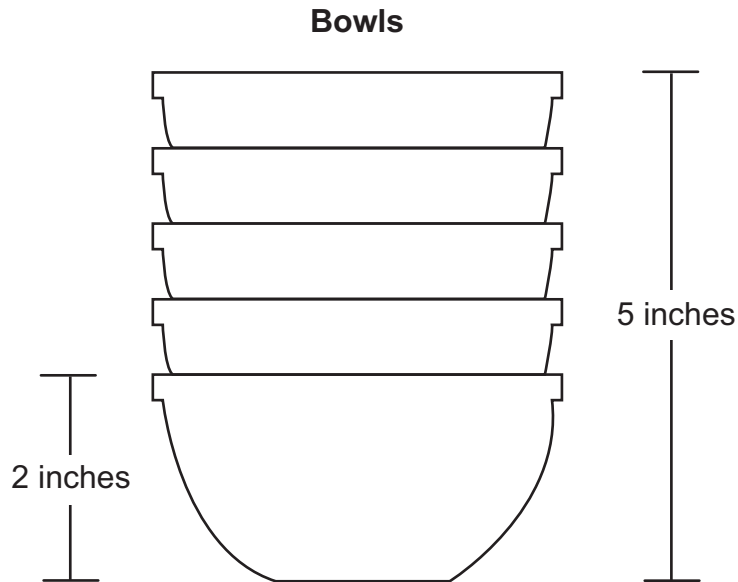
height: 12 inches

Student has given a “correct answer” based on an incorrect equation from Part A. (Error is carried through correctly, so student is not penalized twice.)

Based on Scoring Guidelines, 2 points is representative of a “partial understanding.”

## A1.1.2 Response Score: 1 point

12. The diagram below shows 5 identical bowls stacked one inside the other.



The height of 1 bowl is 2 inches. The height of a stack of 5 bowls is 5 inches.

- A.** Write an equation using  $x$  and  $y$  to find the height of a stack of bowls based on any number of bowls.

equation:  $y - 2 = 5(x - 1)$

Student has given an incorrect equation.

- B.** Describe what the  $x$  and  $y$  variables represent.

$x$ -variable: # bowls

$y$ -variable: ?

Student has given one correct description followed by one incorrect description.

**Go to the next page to finish question 12.**

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

C. What is the height, in inches, of a stack of 10 bowls?

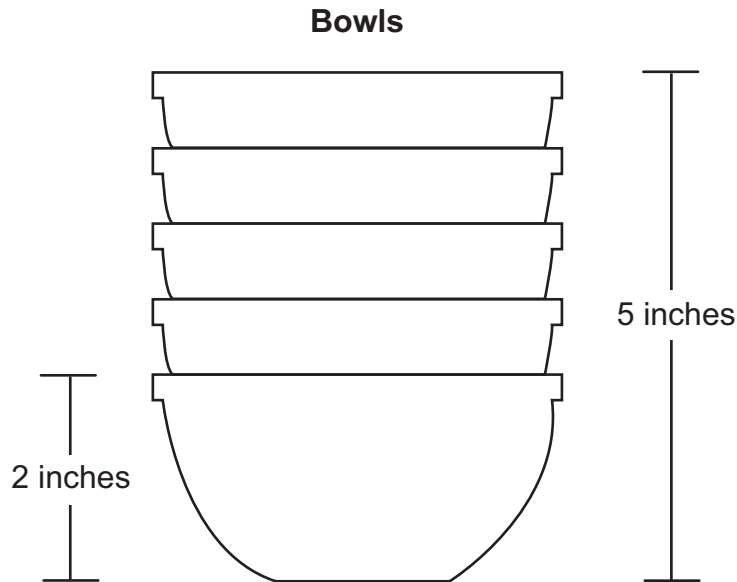
height: 7 inches

Student has given an incorrect answer.

Based on Scoring Guidelines, 1 point is representative of a “minimal understanding.”

## A1.1.2 Response Score: 1 point

12. The diagram below shows 5 identical bowls stacked one inside the other.



The height of 1 bowl is 2 inches. The height of a stack of 5 bowls is 5 inches.

- A.** Write an equation using  $x$  and  $y$  to find the height of a stack of bowls based on any number of bowls.

equation:  $y = 5x + 5$

Student has given an incorrect equation.

- B.** Describe what the  $x$  and  $y$  variables represent.

$x$ -variable: 2 inches

$y$ -variable: 5 inches

Student has given two incorrect descriptions.

**Go to the next page to finish question 12.**

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

C. What is the height, in inches, of a stack of 10 bowls?

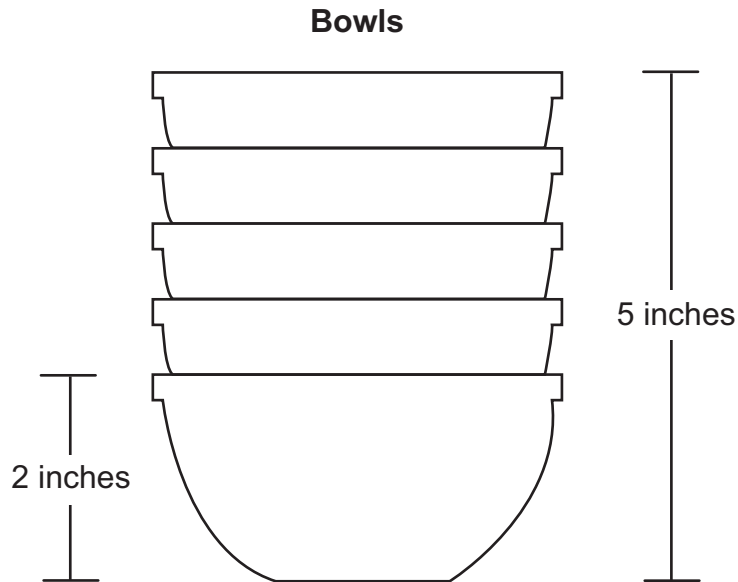
height:  $8\frac{3}{4}$  inches

Student has given a correct answer.

Based on Scoring Guidelines, 1 point is representative of a “minimal understanding.”

## A1.1.2 Response Score: 0

12. The diagram below shows 5 identical bowls stacked one inside the other.



The height of 1 bowl is 2 inches. The height of a stack of 5 bowls is 5 inches.

- A.** Write an equation using  $x$  and  $y$  to find the height of a stack of bowls based on any number of bowls.

equation: 5 + 2 = 7

Student has given an incorrect equation.

- B.** Describe what the  $x$  and  $y$  variables represent.

$x$ -variable: 5

$y$ -variable: 2

Student has given two incorrect descriptions.

**Go to the next page to finish question 12.**

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

C. What is the height, in inches, of a stack of 10 bowls?

height: 10 inches

Student has given an incorrect answer.

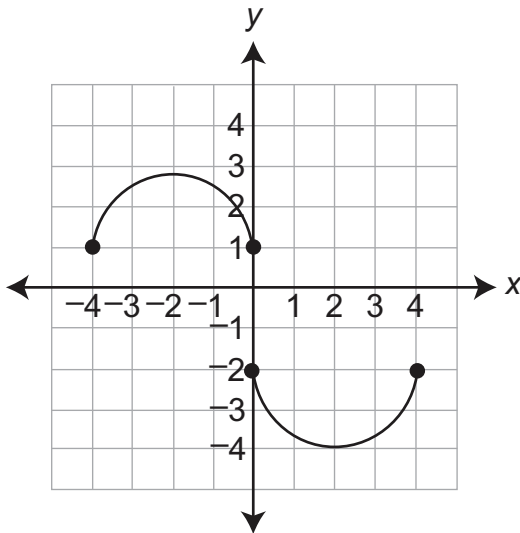
Based on Scoring Guidelines, 0 points is representative of “no understanding.”

## MULTIPLE-CHOICE QUESTIONS

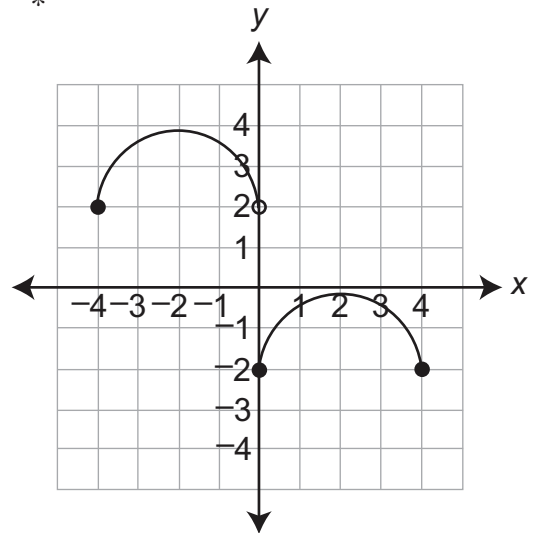
## A1.2.1.1.2

1. Which graph shows  $y$  as a function of  $x$ ?

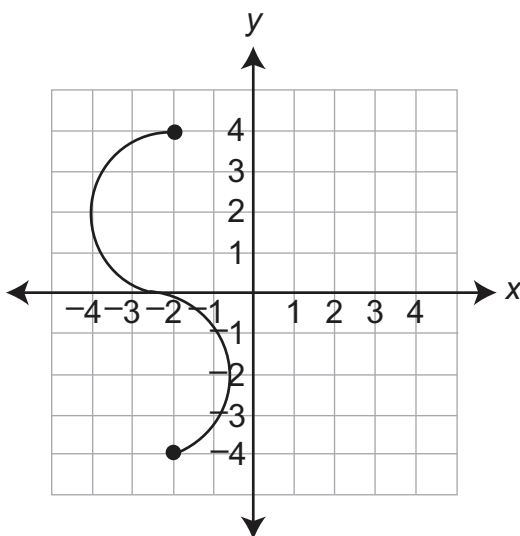
A.



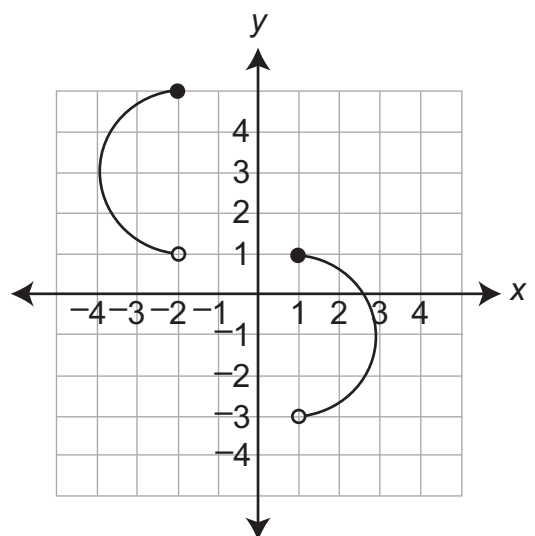
B. \*



C.



D.



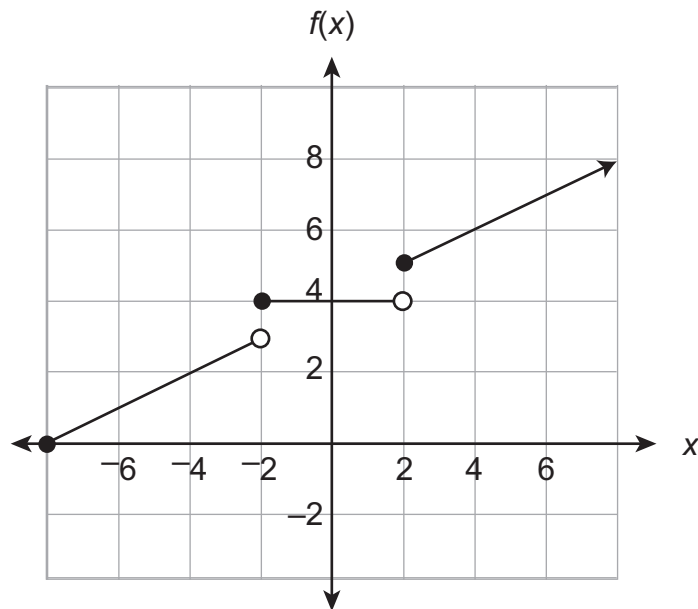
A student could determine the **correct** answer, option B, by examining the graphs of each of the relations and using the vertical line test.

A student could arrive at an **incorrect** answer by either not knowing the definition of a function or not knowing how to interpret closed and open circles. For example, a student would arrive at option C if he/she thought “function” meant “continuous”.



## A1.2.1.1.3

2. The graph of a function is shown below.



Which value is **not** in the range of the function?

- A. 0
- B. 3 \*
- C. 4
- D. 5

A student could determine the **correct** answer, option B, by examining the graph and seeing that it never intersects with the horizontal line  $y = 3$ .

A student could arrive at an **incorrect** answer by either not knowing the definition of range or not knowing how to interpret closed and open circles. For example, a student would arrive at option C if he/she thought range meant that there was only one value of  $x$  for each value of  $y$ .

## A1.2.1.2.1

3. A pizza restaurant charges for pizzas and adds a delivery fee. The cost ( $c$ ), in dollars, to have any number of pizzas ( $p$ ) delivered to a home is described by the function  $c = 8p + 3$ . Which statement is true?
- A. The cost of 8 pizzas is \$11.
  - B. The cost of 3 pizzas is \$14.
  - C. Each pizza costs \$8 and the delivery fee is \$3. \*
  - D. Each pizza costs \$3 and the delivery fee is \$8.

A student could determine the **correct** answer, option C, by interpreting the linear equation  $c = 8p + 3$  in the context of the problem situation.

A student could arrive at an **incorrect** answer by misinterpreting the linear equation  $c = 8p + 3$  in the context of the problem situation. For example, a student would arrive at option D if he/she interpreted the cost of a pizza to be the  $y$ -intercept and the delivery fee to be the slope.

## A1.2.1.2.2

4. The table below shows values of  $y$  as a function of  $x$ .

$x$	$y$
2	10
6	25
14	55
26	100
34	130

Which linear equation best describes the relationship between  $x$  and  $y$ ?

- A.  $y = 2.5x + 5$
- B.  $y = 3.75x + 2.5$  \*
- C.  $y = 4x + 1$
- D.  $y = 5x$

A student could determine the **correct** answer, option B, by identifying the linear equation which will map every value of  $x$  in the table to the corresponding value of  $y$ .

A student could arrive at an **incorrect** answer by checking only one of the  $(x, y)$  coordinate pairs in the table. For example, a student could arrive at option A if he/she only checked to see that the equation worked when  $x = 2$  and  $y = 10$ .

## A1.2.2.1.1

5. Jeff's restaurant sells hamburgers. The amount charged for a hamburger,  $h$ , is based on the cost for a plain hamburger plus an additional charge for each topping,  $t$ , as shown in the equation below.

$$h = 0.60t + 5$$

What does the number 0.60 represent in the equation?

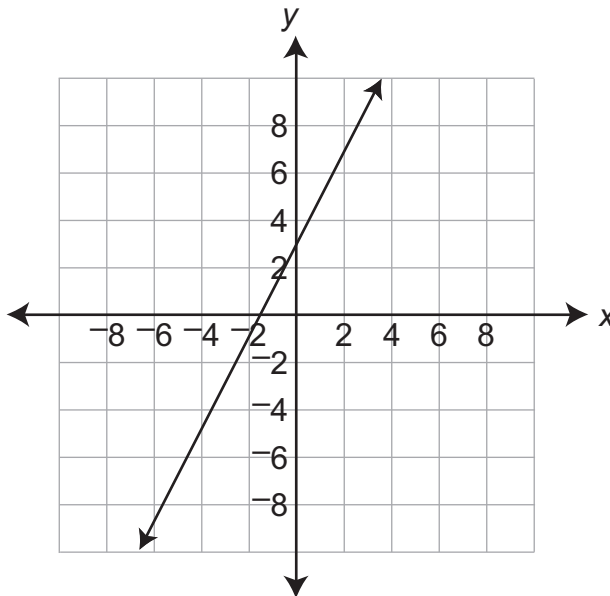
- A. the number of toppings
- B. the cost of a plain hamburger
- C. the additional cost for each topping \*
- D. the cost of a hamburger with 1 topping

A student could determine the **correct** answer, option C, by interpreting the linear equation  $h = 0.60t + 5$  in the context of the problem situation.

A student could arrive at an **incorrect** answer by misinterpreting the linear equation  $h = 0.60t + 5$  in the context of the problem situation. For example, a student would arrive at option A if he/she interpreted the number of toppings to be the rate of change.

## A1.2.2.1.3

6. A graph of a linear equation is shown below.



Which equation describes the graph?

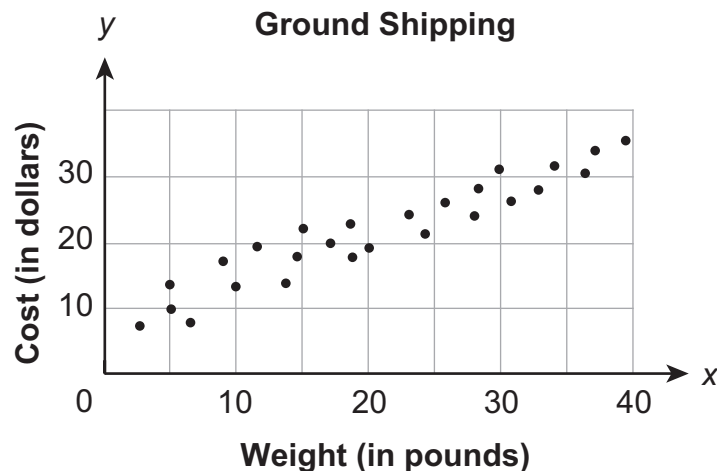
- A.  $y = 0.5x - 1.5$
- B.  $y = 0.5x + 3$
- C.  $y = 2x - 1.5$
- D.  $y = 2x + 3$  \*

A student could determine the **correct** answer, option D, by examining the graph to obtain the slope and y-intercept.

A student could arrive at an **incorrect** answer by either not knowing how to find the slope or y-intercept of a graph. For example, a student would arrive at option C if he/she used the x-intercept instead of the y-intercept.

## A1.2.2.2.1

7. The scatter plot below shows the cost,  $y$ , of ground shipping packages from Harrisburg, PA, to Minneapolis, MN, based on the package weight,  $x$ .



Which equation **best** describes the line of best fit?

- A.  $y = 0.37x + 1.57$   
 B.  $y = 0.37x + 10.11$   
 C.  $y = 0.68x + 2.32$   
 D.  $y = 0.68x + 6.61$  \*

A student could determine the **correct** answer, option D, by drawing and deriving the equation of the line of best fit.

A student could arrive at an **incorrect** answer by either not knowing how to draw a line of best fit or not knowing how to find the equation of that line. For example, a student would arrive at option C if he/she drew a line such that all of the data points are at or above the line.

## A1.2.3.1.1

8. The daily high temperatures in degrees Fahrenheit in Allentown, PA, for a period of 10 days are shown below.

76 80 89 96 98 100 98 91 89 82

Which statement correctly describes the data?

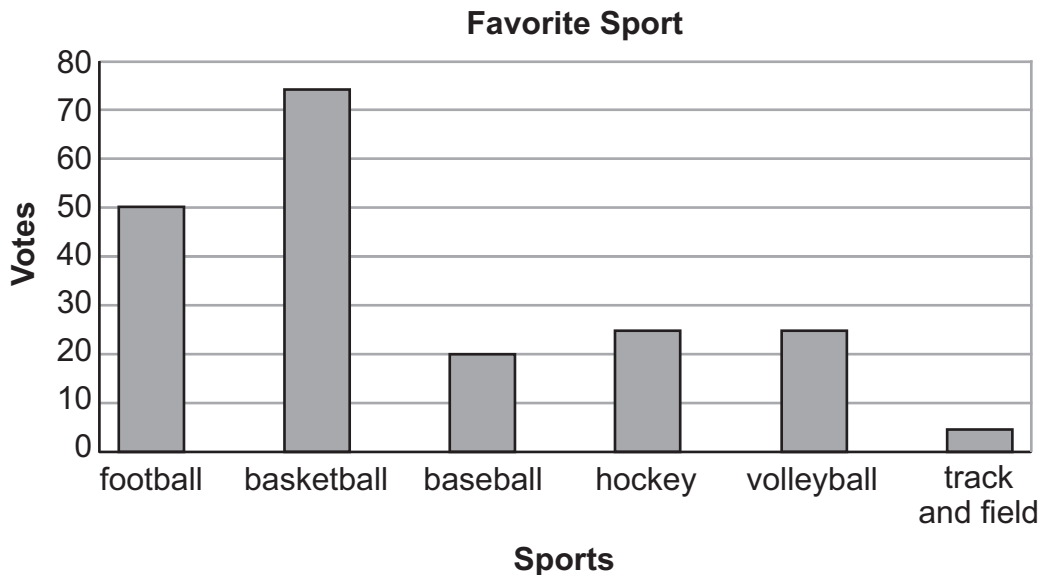
- A. The median value is 98.
- B. The interquartile range is 16. \*
- C. The lower quartile value is 76.
- D. The upper quartile value is 96.

A student could determine the **correct** answer, option B, by finding the difference between the third and first quartile. Arranging the data from lowest to highest shows that the median value is the average of 89 and 91. The third quartile value is the median of the upper half of the data, 98, and the first quartile value is the median of the lower half of the data, 82.  $98 - 82 = 16$ .

A student could arrive at an **incorrect** answer by not knowing how to use or compute median or interquartile range. For example, a student would arrive at option A if he/she confused median and mode.

## A1.2.3.2.1

9. Vy asked 200 students to select their favorite sport and then recorded the results in the bar graph below.



Vy will ask another 80 students to select their favorite sport. Based on the information in the bar graph, how many more students of the next 80 asked will select basketball rather than football as their favorite sport?

- A. 10 \*
- B. 20
- C. 25
- D. 30

A student could determine the **correct** answer, option A, by using the bar graph to obtain probabilities for basketball ( $75 \div 200 = 0.375$ ) and football ( $50 \div 200 = 0.25$ ), subtract the difference in the probabilities ( $0.375 - 0.25 = 0.125$ ) and multiply by the new sample ( $0.125 \times 80 = 10$ ).

A student could arrive at an **incorrect** answer by using an incorrect method or making a computational error. For example, a student would arrive at option C if he/she multiplied the probability difference by 200 instead of 80 ( $0.125 \times 200 = 25$ ).



## A1.2.3.3.1

10. A number cube with sides labeled 1–6 is rolled two times, and the sum of the numbers that end face up is calculated. What is the probability that the sum of the numbers is 3?

- A.  $\frac{1}{18}$  \*
- B.  $\frac{1}{12}$
- C.  $\frac{1}{9}$
- D.  $\frac{1}{2}$

A student could determine the **correct** answer, option A, by realizing that the possible combinations are 2 and 1 or 1 and 2. There are 2 ways to get a number for the first number cube out of 6 possible outcomes,  $\frac{2}{6}$ , and only 1 way to get a number for the second number cube,  $\frac{1}{6}$ . Multiplying the probabilities together  $\frac{2}{6} \times \frac{1}{6} = \frac{2}{36}$  which can be reduced to  $\frac{1}{18}$ .

A student could arrive at an **incorrect** answer by using an incorrect method or making a computational error. For example, a student would arrive at option C if he/she decided the probability for picking the first number cube was  $\frac{2}{6}$  and that the second number cube was also  $\frac{2}{6}$ , then  $\frac{2}{6} \times \frac{2}{6} = \frac{4}{36}$  which can be reduced to  $\frac{1}{9}$ .

## CONSTRUCTED-RESPONSE QUESTIONS

## A1.2.1

11. Hector's family is on a car trip.

When they are 84 miles from home, Hector begins recording their distance driven each hour in the table below.

Distance by Hour

Time in Hours	Distance in Miles
0	84
1	146
2	208
3	270

The pattern continues.

- A. Write an equation to find distance driven in miles ( $d$ ) after a given number of hours ( $h$ ).

- B. Hector also kept track of the remaining gasoline. The equation shown below can be used to find the gallons of gasoline remaining ( $g$ ) after distance driven ( $d$ ).

$$g = 16 - \frac{1}{20}d$$

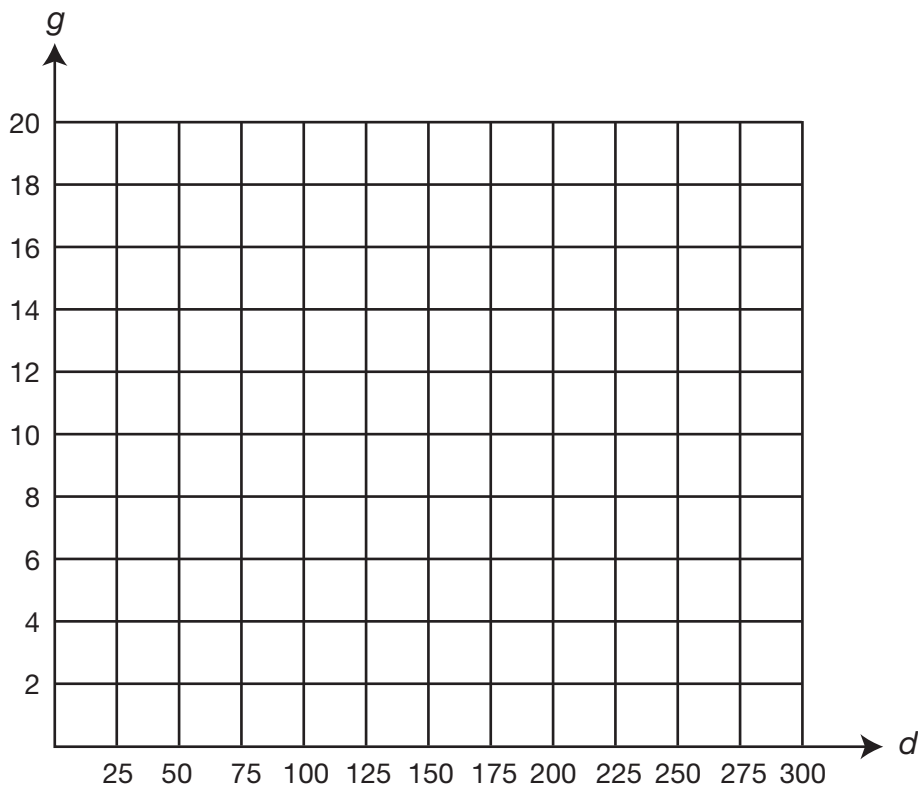
Use the equation to find the missing values for gallons of gasoline remaining.

Distance Driven in Miles ( $d$ )	Gallons of Gasoline Remaining ( $g$ )
100	
200	
300	

Go to the next page to finish question 11.

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

**C.** Draw the graph of the line formed by the points in the table from **part B**.



**D.** Explain why the slope of the line drawn in **part C** must be negative.

**ITEM-SPECIFIC SCORING GUIDELINE****ITEM # 11, MODULE 2****Assessment Anchor:**

This item is reported under **A1.2.1 Functions**

**Specific Eligible Content addressed by this item:**

A1.2.1.1.1– Analyze a set of data for the existence of a pattern and represent the pattern algebraically and/or graphically.

A1.2.1.2.1– Create, interpret, and/or use the equation, graph, or table of a linear function.

**Scoring Guide:**

Score	
4	The student demonstrates a <i>thorough</i> understanding of functions by correctly solving problems with clear and complete procedures and explanations when required.
3	The student demonstrates a <i>general</i> understanding of functions by solving problems and providing procedures and explanations with only minor errors or omissions.
2	The student demonstrates a <i>partial</i> understanding of functions by providing a portion of the correct problem solving, procedures, and explanations.
1	The student demonstrates a <i>minimal</i> understanding of functions.
0	The student does not demonstrate any understanding of functions.

Top Scoring Response:

Part A: What?	Why?
$d = 62h + 84$ OR equivalent	

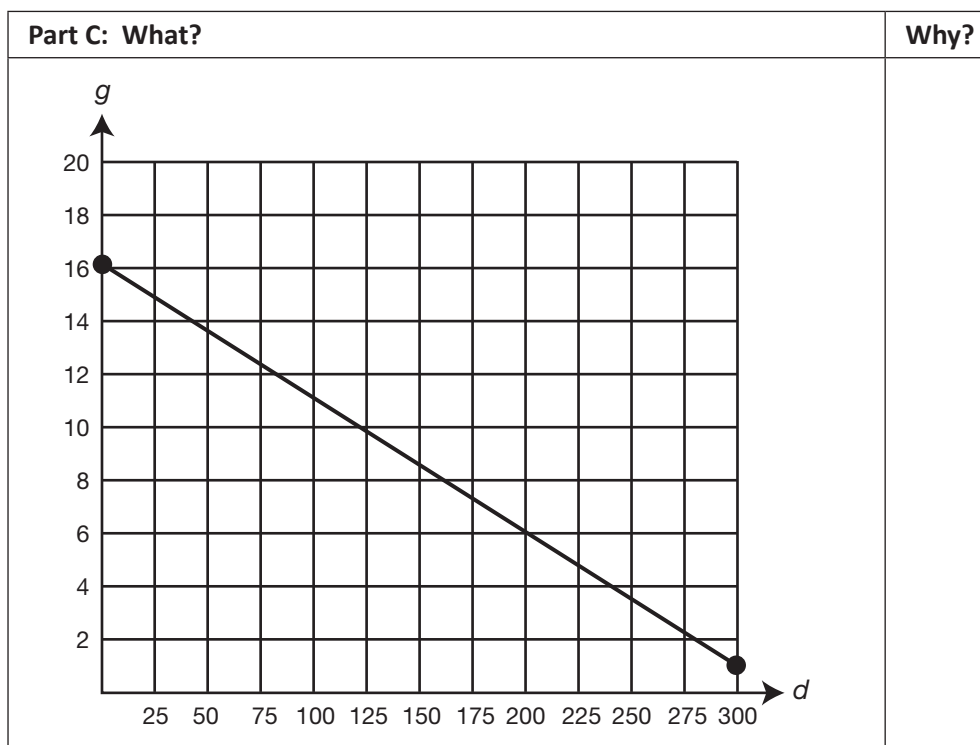
(1 score point)

1 point for correct equation

Part B: What?	Why?
11, 6, and 1	

(1 score point)

1 point for giving correct values



(1 score point)

1 point for correct graph

Part D: What?	Why?
	As the distance driven increases, the amount of gasoline remaining must decrease. <b>OR equivalent</b>

(1 score point)

1 point for correct explanation

## A1.2.1 Response Score: 4 points

11. Hector's family is on a car trip.

When they are 84 miles from home, Hector begins recording their distance driven each hour in the table below.

Distance by Hour

Time in Hours	Distance in Miles
0	84
1	146
2	208
3	270

The pattern continues.

- A. Write an equation to find distance driven in miles ( $d$ ) after a given number of hours ( $h$ ).

$$d = 62h + 84$$

$$\begin{array}{r} 146 \\ -84 \\ \hline 62 \end{array} \quad \begin{array}{r} 208 \\ -146 \\ \hline 62 \end{array} \quad \begin{array}{r} 270 \\ -208 \\ \hline 62 \end{array}$$

$$d = 62h + ? \quad 84 = 0 + ?$$

Student has given a correct equation.

- B. Hector also kept track of the remaining gasoline. The equation shown below can be used to find the gallons of gasoline remaining ( $g$ ) after distance driven ( $d$ ).

$$g = 16 - \frac{1}{20}d$$

Use the equation to find the missing values for gallons of gasoline remaining.

Distance Driven in Miles ( $d$ )	Gallons of Gasoline Remaining ( $g$ )
100	11
200	6
300	1

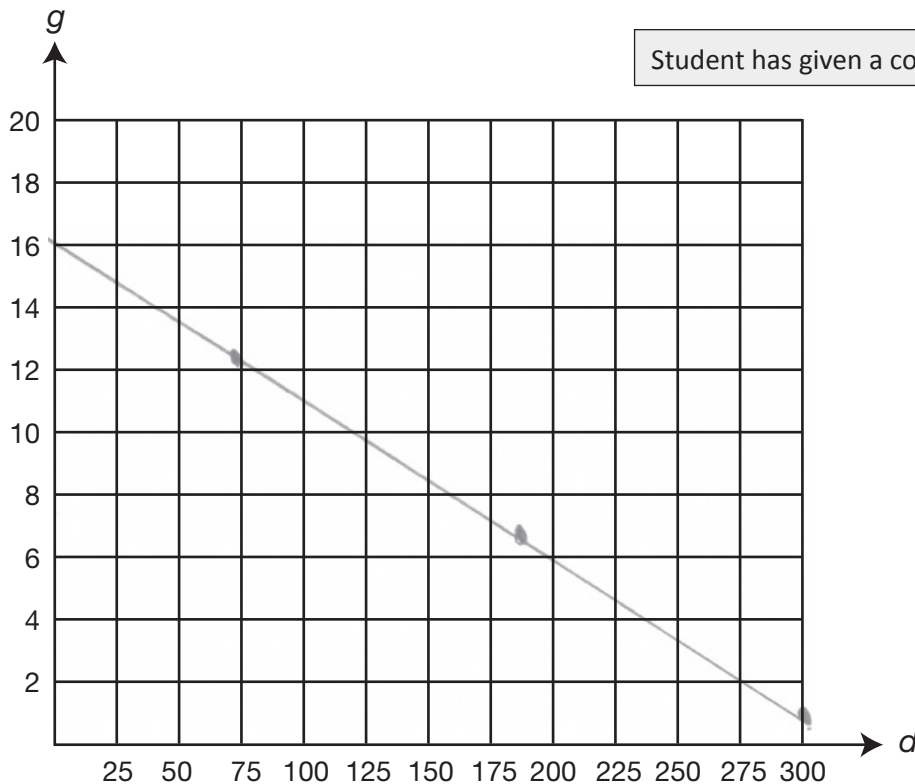
$$\begin{array}{l} 16 - 5 \\ 16 - 10 \\ 16 - 15 \end{array}$$

Student has given correct values.

Go to the next page to finish question 11.

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

C. Draw the graph of the line formed by the points in the table from **part B**.



D. Explain why the slope of the line drawn in **part C** must be negative.

When a line slopes downward to the right, it is negative. This happens when as one variable ( $d$ ) increases, the other variable ( $g$ ) decreases. The distance driven increases ( $100 \rightarrow 200 \rightarrow 300$ ) while the gallons of gas remaining decreases ( $11 \rightarrow 6 \rightarrow 1$ ). You burn up gas as you drive.

Student has given a correct explanation.

Based on Scoring Guidelines, 4 points is representative of a "thorough understanding."

## A1.2.1 Response Score: 3 points

11. Hector's family is on a car trip.

When they are 84 miles from home, Hector begins recording their distance driven each hour in the table below.

**Distance by Hour**

Time in Hours	Distance in Miles
0	84
1	146
2	208
3	270

The pattern continues.

- A.** Write an equation to find distance driven in miles ( $d$ ) after a given number of hours ( $h$ ).

$$d = 62h + 84$$

Student has given a correct equation.

- B.** Hector also kept track of the remaining gasoline. The equation shown below can be used to find the gallons of gasoline remaining ( $g$ ) after distance driven ( $d$ ).

$$g = 16 - \frac{1}{20}d$$

Use the equation to find the missing values for gallons of gasoline remaining.

Distance Driven in Miles ( $d$ )	Gallons of Gasoline Remaining ( $g$ )
100	11
200	6
300	1

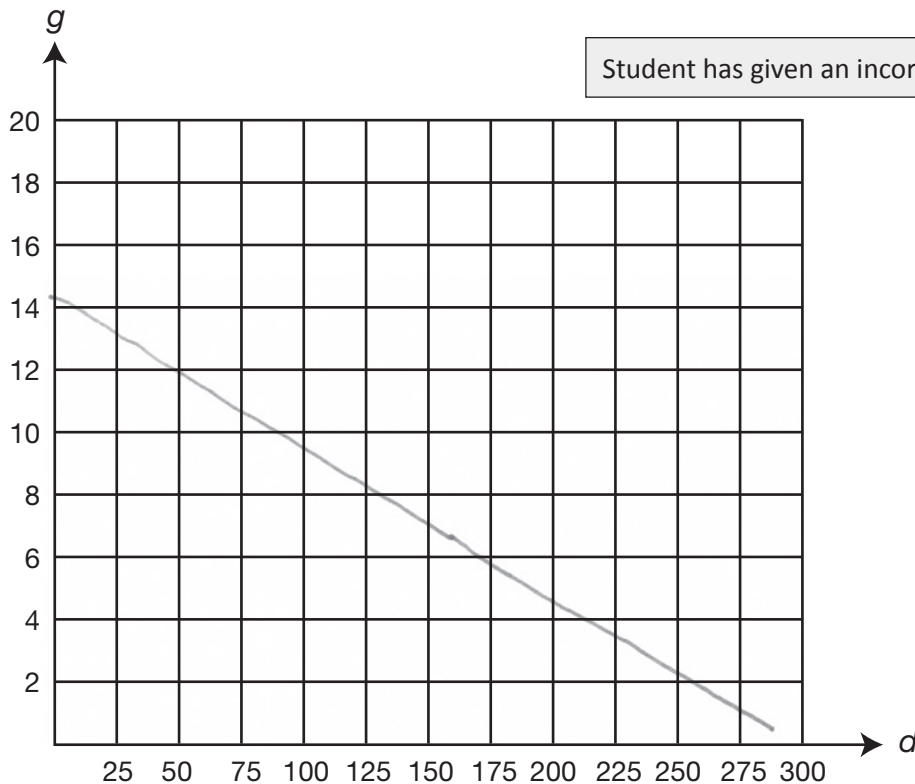
Student has given correct values.

**Go to the next page to finish question 11.**



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

**C.** Draw the graph of the line formed by the points in the table from **part B**.



**D.** Explain why the slope of the line drawn in **part C** must be negative.

*Gasoline will always be decreasing as miles driven increases.*

Student has given a correct explanation.

Based on Scoring Guidelines, 3 points is representative of a "general understanding."

## A1.2.1 Response Score: 3 points

11. Hector's family is on a car trip.

When they are 84 miles from home, Hector begins recording their distance driven each hour in the table below.

**Distance by Hour**

Time in Hours	Distance in Miles
0	84
1	146
2	208
3	270

The pattern continues.

- A. Write an equation to find distance driven in miles ( $d$ ) after a given number of hours ( $h$ ).

$$d = 62h + 84$$

Student has given a correct equation.

- B. Hector also kept track of the remaining gasoline. The equation shown below can be used to find the gallons of gasoline remaining ( $g$ ) after distance driven ( $d$ ).

$$g = 16 - \frac{1}{20}d$$

Use the equation to find the missing values for gallons of gasoline remaining.

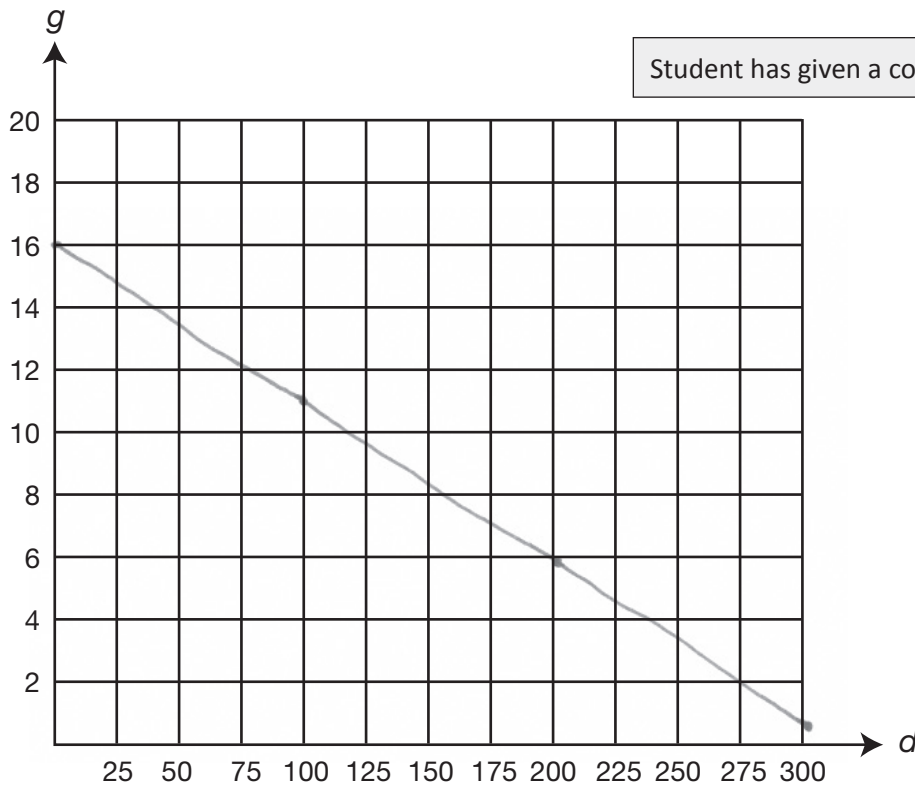
Distance Driven in Miles ( $d$ )	Gallons of Gasoline Remaining ( $g$ )
100	11
200	6
300	1

Student has given correct values.

Go to the next page to finish question 11.

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

**C.** Draw the graph of the line formed by the points in the table from **part B**.



**D.** Explain why the slope of the line drawn in **part C** must be negative.

The slope is negative because miles go up.

Student has given an incomplete explanation.

Based on Scoring Guidelines, 3 points is representative of a "general understanding."

## A1.2.1 Response Score: 2 points

11. Hector's family is on a car trip.

When they are 84 miles from home, Hector begins recording their distance driven each hour in the table below.

**Distance by Hour**

Time in Hours	Distance in Miles
0	84
1	146
2	208
3	270

The pattern continues.

- A. Write an equation to find distance driven in miles ( $d$ ) after a given number of hours ( $h$ ).

$$d = 84h + 62$$

Student has given an incorrect equation.  
Student has reversed the coefficients.

- B. Hector also kept track of the remaining gasoline. The equation shown below can be used to find the gallons of gasoline remaining ( $g$ ) after distance driven ( $d$ ).

$$g = 16 - \frac{1}{20}d$$

Use the equation to find the missing values for gallons of gasoline remaining.

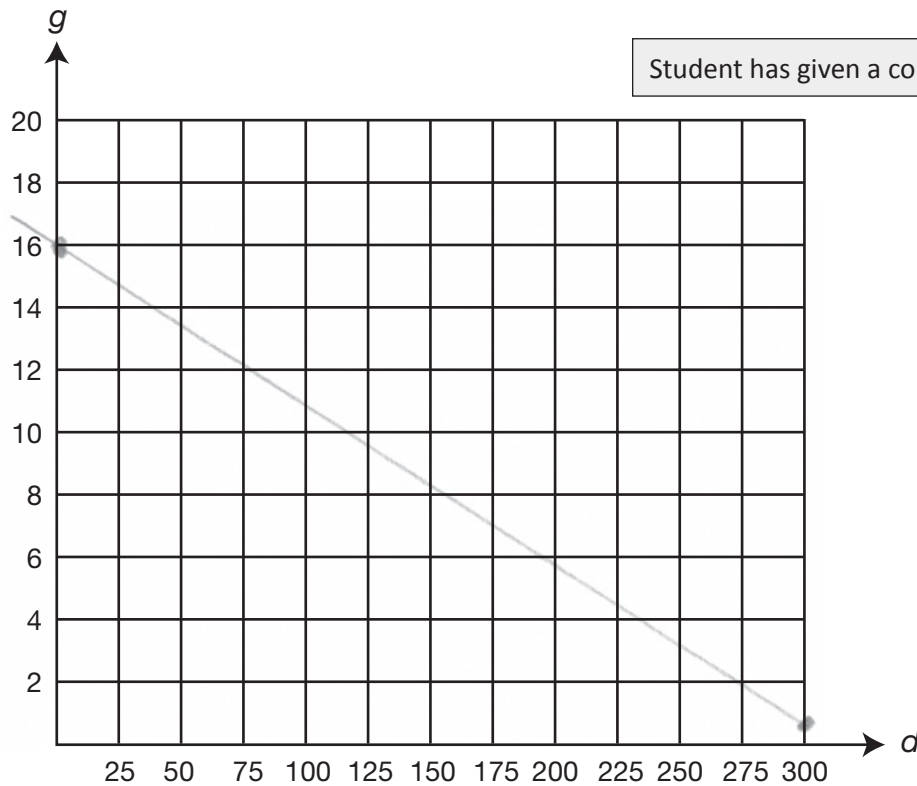
Distance Driven in Miles ( $d$ )	Gallons of Gasoline Remaining ( $g$ )
100	11
200	6
300	1

Student has given correct values.

Go to the next page to finish question 11.

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

**C.** Draw the graph of the line formed by the points in the table from **part B**.



**D.** Explain why the slope of the line drawn in **part C** must be negative.

It doesn't have to be negative.  
It just is.

Student has given an incorrect explanation.

Based on Scoring Guidelines, 2 points is representative of a "partial understanding."

## A1.2.1 Response Score: 2 points

11. Hector's family is on a car trip.

When they are 84 miles from home, Hector begins recording their distance driven each hour in the table below.

**Distance by Hour**

Time in Hours	Distance in Miles
0	84
1	146
2	208
3	270

The pattern continues.

- A.** Write an equation to find distance driven in miles ( $d$ ) after a given number of hours ( $h$ ).

$$d - 146 = 62(h - 1)$$

Student has given an equivalent equation.

- B.** Hector also kept track of the remaining gasoline. The equation shown below can be used to find the gallons of gasoline remaining ( $g$ ) after distance driven ( $d$ ).

$$g = 16 - \frac{1}{20}d$$

Use the equation to find the missing values for gallons of gasoline remaining.

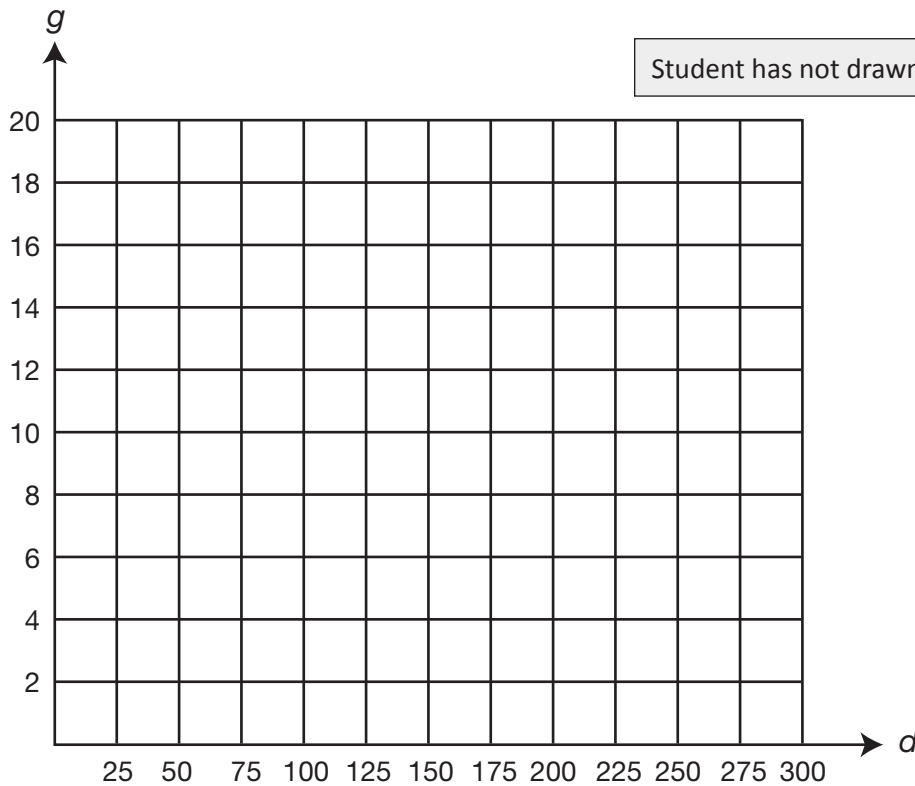
Distance Driven in Miles ( $d$ )	Gallons of Gasoline Remaining ( $g$ )
100	11
200	6
300	1

Student has given correct values.

**Go to the next page to finish question 11.**

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

**C.** Draw the graph of the line formed by the points in the table from **part B**.



**D.** Explain why the slope of the line drawn in **part C** must be negative.

*It isn't negative.*

Student has given an incorrect explanation.

Based on Scoring Guidelines, 2 points is representative of a "partial understanding."

## A1.2.1 Response Score: 1 point

11. Hector's family is on a car trip.

When they are 84 miles from home, Hector begins recording their distance driven each hour in the table below.

**Distance by Hour**

Time in Hours	Distance in Miles
0	84
1	146
2	208
3	270

The pattern continues.

- A. Write an equation to find distance driven in miles ( $d$ ) after a given number of hours ( $h$ ).

$$d = 62h + 84$$

Student has given a correct equation.

- B. Hector also kept track of the remaining gasoline. The equation shown below can be used to find the gallons of gasoline remaining ( $g$ ) after distance driven ( $d$ ).

$$g = 16 - \frac{1}{20}d$$

Use the equation to find the missing values for gallons of gasoline remaining.

Distance Driven in Miles ( $d$ )	Gallons of Gasoline Remaining ( $g$ )
100	116
200	216
300	316

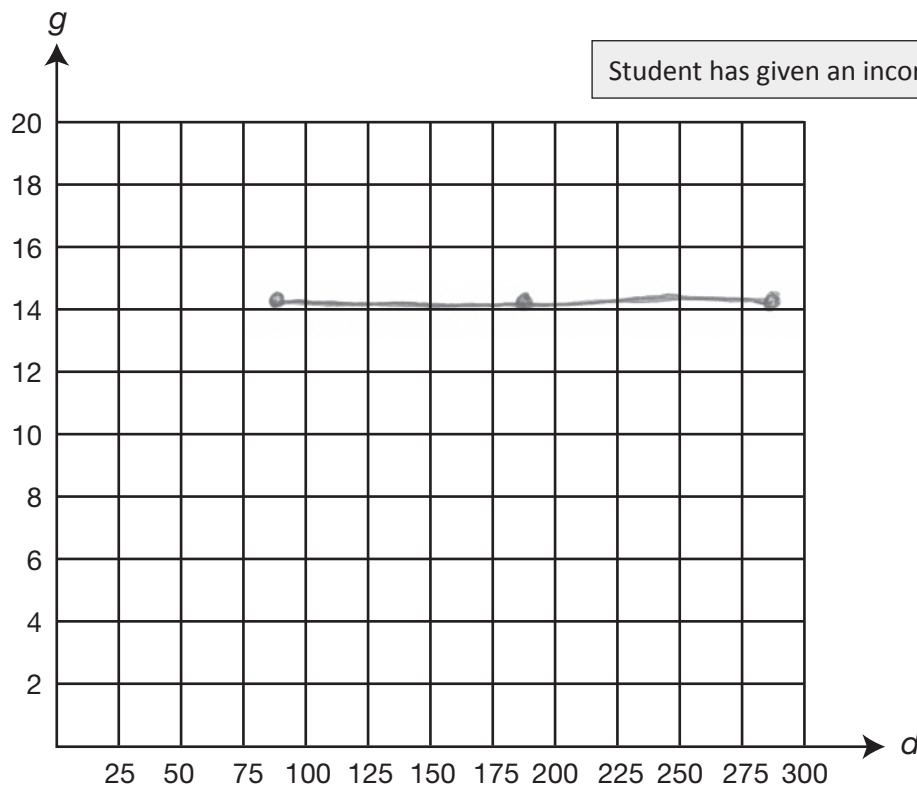
Student has given incorrect values.

Go to the next page to finish question 11.



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

**C.** Draw the graph of the line formed by the points in the table from **part B**.



**D.** Explain why the slope of the line drawn in **part C** must be negative.

It takes time to drive places.

Student has given an incorrect explanation.

Based on Scoring Guidelines, 1 point is representative of a "minimal understanding."

## A1.2.1 Response Score: 1 point

11. Hector's family is on a car trip.

When they are 84 miles from home, Hector begins recording their distance driven each hour in the table below.

**Distance by Hour**

Time in Hours	Distance in Miles
0	84
1	146
2	208
3	270

The pattern continues.

- A.** Write an equation to find distance driven in miles ( $d$ ) after a given number of hours ( $h$ ).

$$d = 84h$$

Student has given an incorrect equation.

- B.** Hector also kept track of the remaining gasoline. The equation shown below can be used to find the gallons of gasoline remaining ( $g$ ) after distance driven ( $d$ ).

$$g = 16 - \frac{1}{20}d$$

Use the equation to find the missing values for gallons of gasoline remaining.

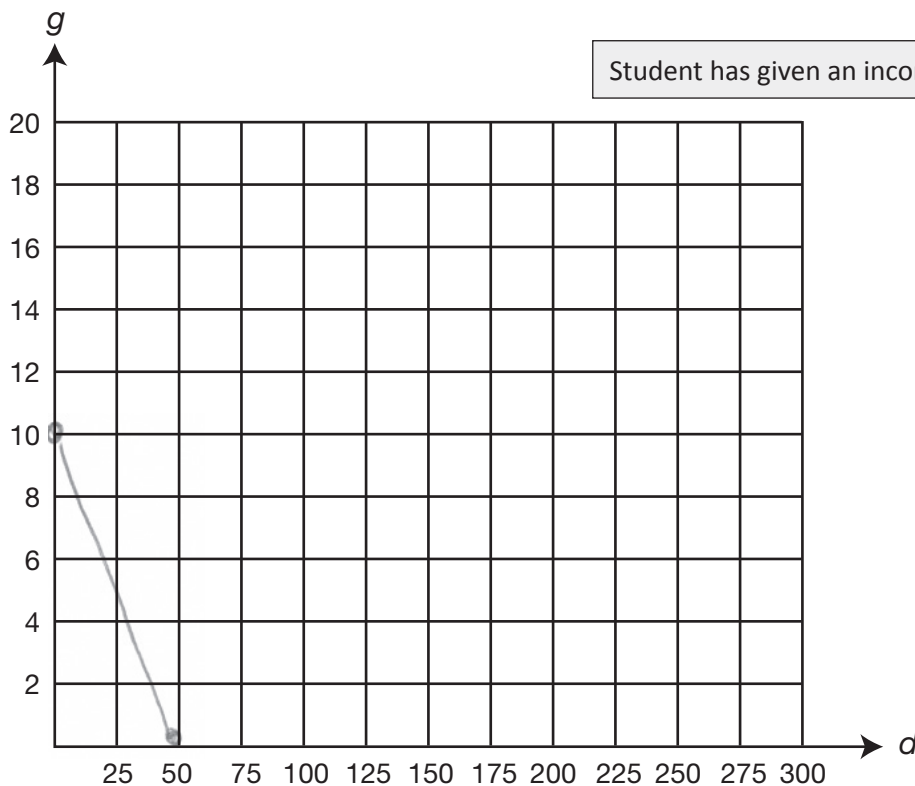
Distance Driven in Miles ( $d$ )	Gallons of Gasoline Remaining ( $g$ )
100	11
200	6
300	1

Student has given correct values.

**Go to the next page to finish question 11.**

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

**C.** Draw the graph of the line formed by the points in the table from **part B**.



**D.** Explain why the slope of the line drawn in **part C** must be negative.

It can't be positive.

Student has given an incorrect explanation.

Based on Scoring Guidelines, 1 point is representative of a "minimal understanding."

## A1.2.1 Response Score: 0

11. Hector's family is on a car trip.

When they are 84 miles from home, Hector begins recording their distance driven each hour in the table below.

**Distance by Hour**

Time in Hours	Distance in Miles
0	84
1	146
2	208
3	270

The pattern continues.

- A. Write an equation to find distance driven in miles ( $d$ ) after a given number of hours ( $h$ ).

$$h = 84d + 62$$

Student has given an incorrect equation.

- B. Hector also kept track of the remaining gasoline. The equation shown below can be used to find the gallons of gasoline remaining ( $g$ ) after distance driven ( $d$ ).

$$g = 16 - \frac{1}{20}d$$

Use the equation to find the missing values for gallons of gasoline remaining.

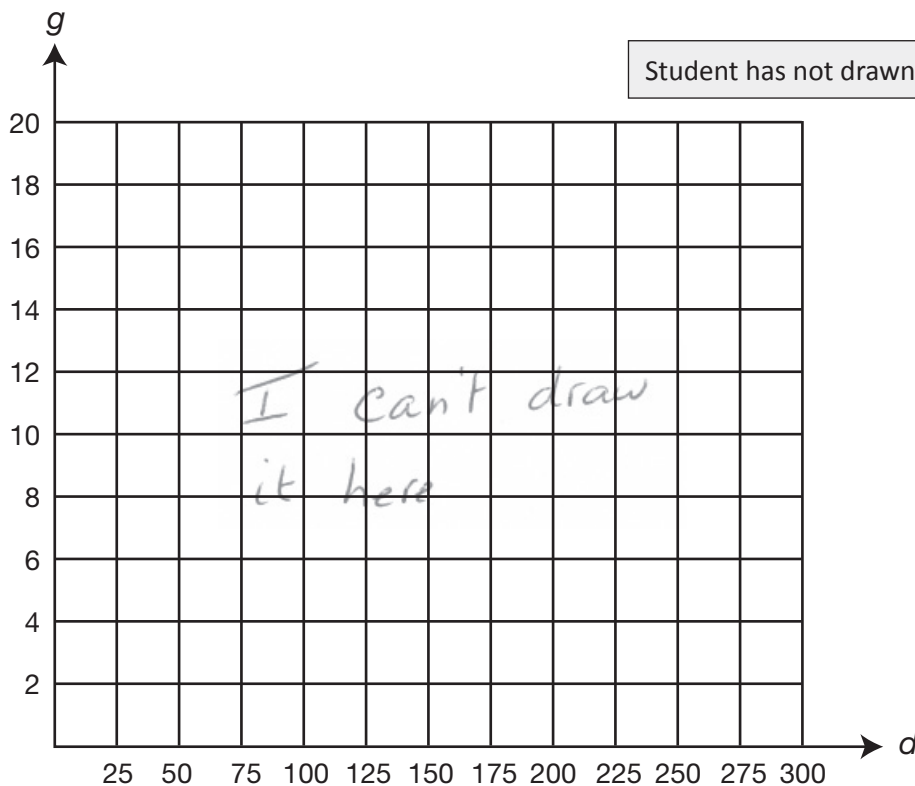
Distance Driven in Miles ( $d$ )	Gallons of Gasoline Remaining ( $g$ )
100	-84
200	-184
300	-284

Student has given incorrect values.

Go to the next page to finish question 11.

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

**C.** Draw the graph of the line formed by the points in the table from **part B**.



**D.** Explain why the slope of the line drawn in **part C** must be negative.

The answers to B are negative numbers

Student has given an incorrect explanation.

Based on Scoring Guidelines, 0 points is representative of "no understanding."

## A1.2.3

12. The weight (in pounds) of each wrestler on the high school wrestling team at the beginning of the season is listed below.

178 142 112 150 206 130

A. What is the median weight of the wrestlers?

median: \_\_\_\_\_ pounds

B. What is the mean weight of the wrestlers?

mean: \_\_\_\_\_ pounds

**Go to the next page to finish question 12.**

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

Two more wrestlers join the team during the season. The addition of these wrestlers has no effect on the mean weight of the wrestlers, but the median weight of the wrestlers increases 3 pounds.

- C.** Determine the weights of the two new wrestlers.

new wrestlers: \_\_\_\_\_ pounds and \_\_\_\_\_ pounds

**ITEM-SPECIFIC SCORING GUIDELINE****ITEM # 12, MODULE 2****Assessment Anchor:**

This item is reported under **A1.2.3 Data Analysis**

**Specific Eligible Content addressed by this item:**

A1.2.3.2.2– Analyze data, make predictions, and/or answer questions based on displayed data (box-and-whisker plots, stem-and-leaf plots, scatter plots, measure of central tendency, or other representations).

**Scoring Guide:**

Score	
4	The student demonstrates a <i>thorough</i> understanding of data analysis by correctly solving problems.
3	The student demonstrates a <i>general</i> understanding of data analysis by solving problems with only minor errors or omissions.
2	The student demonstrates a <i>partial</i> understanding of data analysis by providing a portion of the correct problem solving.
1	The student demonstrates a <i>minimal</i> understanding of data analysis.
0	The student does not demonstrate any understanding of data analysis.



**Top Scoring Response:**

Part A: What?	Why?
146	

**(1 score point)**

1 point for correct answer

Part B: What?	Why?
153	

**(1 score point)**

1 point for correct answer

Part C: What?	Why?
148 & 158	

**(2 score points)**1 point for a response that leads to correct median  
1 point for a response that leads to correct mean

## A1.2.3 Response Score: 4 points

12. The weight (in pounds) of each wrestler on the high school wrestling team at the beginning of the season is listed below.

178 142 112 150 206 130

- A. What is the median weight of the wrestlers?

median: 146 pounds

$$\begin{array}{r} \cancel{112} \ \cancel{130} \ 142 \ 150 \ \cancel{178} \ \cancel{206} \\ 150 \\ \underline{142} \\ 292 \\ 2 \overline{)292} \end{array}$$

Student has given a correct answer.

- B. What is the mean weight of the wrestlers?

mean: 153 pounds

$$\begin{array}{r} 178 + 142 + 112 + 150 + 206 + 130 = 918 \\ \underline{918} \\ 6 \end{array}$$

Student has given a correct answer.

Go to the next page to finish question 12.

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

Two more wrestlers join the team during the season. The addition of these wrestlers has no effect on the mean weight of the wrestlers, but the median weight of the wrestlers increases 3 pounds.

- C. Determine the weights of the two new wrestlers.

$$146 + 3 = 149$$

$$\begin{array}{r} ? \quad 150 \\ \vee \\ 149 \end{array}$$

$$153 + 153 = 306$$

$$306 - 148 = 158$$

new wrestlers: 148 pounds and 158 pounds

Student has given a response which leads to the correct median and mean.

Based on Scoring Guidelines, 4 points is representative of a "thorough understanding."

**A1.2.3 Response Score: 3 points**

12. The weight (in pounds) of each wrestler on the high school wrestling team at the beginning of the season is listed below.

178 142 112 150 206 130

**A.** What is the median weight of the wrestlers?

median: 146 pounds

Student has given a correct answer.

**B.** What is the mean weight of the wrestlers?

mean: 153 pounds

Student has given a correct answer.

**Go to the next page to finish question 12.**

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

Two more wrestlers join the team during the season. The addition of these wrestlers has no effect on the mean weight of the wrestlers, but the median weight of the wrestlers increases 3 pounds.

- C. Determine the weights of the two new wrestlers.

new wrestlers: 153 pounds and 153 pounds

Student has given a response that leads to a correct mean.  
Student has given a response that does not lead to a correct median.

Based on Scoring Guidelines, 3 points is representative of a “general understanding.”

**A1.2.3 Response Score: 3 points**

12. The weight (in pounds) of each wrestler on the high school wrestling team at the beginning of the season is listed below.

178 142 112 150 206 130

**A.** What is the median weight of the wrestlers?

median: 146 pounds

Student has given a correct answer.

**B.** What is the mean weight of the wrestlers?

mean: 153 pounds

Student has given a correct answer.

**Go to the next page to finish question 12.**

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

Two more wrestlers join the team during the season. The addition of these wrestlers has no effect on the mean weight of the wrestlers, but the median weight of the wrestlers increases 3 pounds.

- C. Determine the weights of the two new wrestlers.

new wrestlers: 148 pounds and 150 pounds

Student has given a response that does not lead to a correct mean.  
Student has given a response that leads to a correct median.

Based on Scoring Guidelines, 3 points is representative of a "general understanding."

**A1.2.3 Response Score: 2 points**

12. The weight (in pounds) of each wrestler on the high school wrestling team at the beginning of the season is listed below.

178 142 112 150 206 130

**A.** What is the median weight of the wrestlers?

median: 146 pounds

Student has given a correct answer.

**B.** What is the mean weight of the wrestlers?

mean: 153 pounds

Student has given a correct answer.

**Go to the next page to finish question 12.**



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

Two more wrestlers join the team during the season. The addition of these wrestlers has no effect on the mean weight of the wrestlers, but the median weight of the wrestlers increases 3 pounds.

- C. Determine the weights of the two new wrestlers.

new wrestlers: 149 pounds and 153 pounds

Student has given a response that does not lead to a correct mean.  
Student has given a response that does not lead to a correct median.

Based on Scoring Guidelines, 2 points is representative of a "partial understanding."

**A1.2.3 Response Score: 2 points**

12. The weight (in pounds) of each wrestler on the high school wrestling team at the beginning of the season is listed below.

178 142 112 150 206 130

**A.** What is the median weight of the wrestlers?

median: 131 pounds

Student has given an incorrect answer.

**B.** What is the mean weight of the wrestlers?

mean: 153 pounds

Student has given a correct answer.

**Go to the next page to finish question 12.**

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

Two more wrestlers join the team during the season. The addition of these wrestlers has no effect on the mean weight of the wrestlers, but the median weight of the wrestlers increases 3 pounds.

- C. Determine the weights of the two new wrestlers.

new wrestlers: 150 pounds and 156 pounds

Student has given a response that leads to a correct mean.  
Student has given a response that does not lead to a correct median.

Based on Scoring Guidelines, 2 points is representative of a "partial understanding."

**A1.2.3 Response Score: 1 point**

12. The weight (in pounds) of each wrestler on the high school wrestling team at the beginning of the season is listed below.

178 142 112 150 206 130

A. What is the median weight of the wrestlers?

median: 146 pounds

Student has given a correct answer.

B. What is the mean weight of the wrestlers?

mean: 154 pounds

Student has given an incorrect answer.

**Go to the next page to finish question 12.**

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

Two more wrestlers join the team during the season. The addition of these wrestlers has no effect on the mean weight of the wrestlers, but the median weight of the wrestlers increases 3 pounds.

- C. Determine the weights of the two new wrestlers.

new wrestlers: 149 pounds and 154 pounds

Student has given a response that does not lead to a correct mean.  
Student has given a response that does not lead to a correct median.

Based on Scoring Guidelines, 1 point is representative of a “minimal understanding.”

**A1.2.3 Response Score: 1 point**

12. The weight (in pounds) of each wrestler on the high school wrestling team at the beginning of the season is listed below.

178 142 112 150 206 130

**A.** What is the median weight of the wrestlers?

median: 150 pounds

Student has given an incorrect answer.

**B.** What is the mean weight of the wrestlers?

mean: 153 pounds

Student has given a correct answer.

**Go to the next page to finish question 12.**

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

Two more wrestlers join the team during the season. The addition of these wrestlers has no effect on the mean weight of the wrestlers, but the median weight of the wrestlers increases 3 pounds.

- C. Determine the weights of the two new wrestlers.

new wrestlers: 150 pounds and 153 pounds

Student has given a response that does not lead to a correct mean.  
Student has given a response that does not lead to a correct median.

Based on Scoring Guidelines, 1 point is representative of a “minimal understanding.”

**A1.2.3 Response Score: 0**

12. The weight (in pounds) of each wrestler on the high school wrestling team at the beginning of the season is listed below.

178 142 112 150 206 130

- A.** What is the median weight of the wrestlers?

median: 142 pounds

Student has given an incorrect answer.

- B.** What is the mean weight of the wrestlers?

mean: 150 pounds

Student has given an incorrect answer.

**Go to the next page to finish question 12.**



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

Two more wrestlers join the team during the season. The addition of these wrestlers has no effect on the mean weight of the wrestlers, but the median weight of the wrestlers increases 3 pounds.

- C. Determine the weights of the two new wrestlers.

new wrestlers: 145 pounds and 150 pounds

Student has given a response that does not lead to a correct mean.  
Student has given a response that does not lead to a correct median.

Based on Scoring Guidelines, 0 points is representative of “no understanding.”

KEYSTONE EXAMS  
ALGEBRA I  
2011

ITEM AND SCORING SAMPLER

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