



pennsylvania
DEPARTMENT OF EDUCATION



**PENNSYLVANIA
KEYSTONE EXAMS**

Algebra I
Item and Scoring Sampler



2023–2024

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INTRODUCTION

General Introduction

The Pennsylvania Department of Education (PDE) provides districts and schools with tools to assist in delivering focused instructional programs aligned with the Pennsylvania Core Standards (PCS). These tools include the standards, Assessment Anchor documents, Keystone Exams Test Definition, Classroom Diagnostic Tool, Standards Aligned System, and content-based item and scoring samplers. This 2023 Algebra I Item and Scoring Sampler is a useful tool for Pennsylvania educators in preparing students for the Keystone Exams by providing samples of test item types and scored student responses. The item sampler is not designed to be used as a pretest, a curriculum, or any other benchmark for operational testing.

This Item and Scoring Sampler 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 (AAEC). 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 used¹ as samples of item types that students will encounter in operational testing. Classroom teachers may find it beneficial to have students respond to the constructed-response items in this sampler. Educators may then use the sampler as a guide to score the responses either independently or together with colleagues within a school or district.

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

ABOUT THE KEYSTONE EXAMS

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

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Alignment

The Algebra I Keystone Exam consists of 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.

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 DOK is the cognitive expectation demanded by standards, curricular activities, and assessment tasks. Webb’s DOK includes four levels, from the lowest (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 DOK, please visit the PDE website at [http://static.pdesas.org/content/documents/Keystone Exams Understanding Depth of Knowledge and Cognitive Complexity.pdf](http://static.pdesas.org/content/documents/Keystone_Exams_Understanding_Depth_of_Knowledge_and_Cognitive_Complexity.pdf).

Exam Format

The Keystone Exams are delivered in a paper-and-pencil format as well as in a computer-based online format. The multiple-choice items require students to select the best answer from four possible answer options and record their answers in the spaces provided. The correct answer for each multiple-choice item is worth one point. The constructed-response items require students to develop and write (or construct) their responses. Constructed-response items in Algebra I are scored using item-specific scoring guidelines based on a 0–4-point scale. Each multiple-choice item is designed to take about one to one and a half minutes to complete. Each constructed-response item is designed to take about ten minutes to complete. The estimated time to respond to a test question is the same for both test formats. During an official 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 percentage² 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 item 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. The student responses in this item and scoring sampler are actual student responses; however, the handwriting has been changed to protect the students’ identities and to make the item and scoring sampler accessible to as many people as possible.

Example Multiple-Choice Item Information Table

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

Example Constructed-Response Item Information Table

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

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

ALGEBRA I EXAM DIRECTIONS

Directions:

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

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

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

There are two types of questions in each module.

Multiple-Choice Questions

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

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

Constructed-Response Questions

These questions will require you to write your response.

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

INFORMATION ABOUT ALGEBRA I

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

- Do not look ahead at the questions in Module 2 [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 these directions 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. The 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.

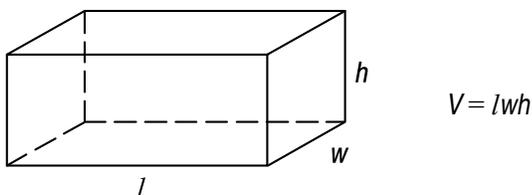
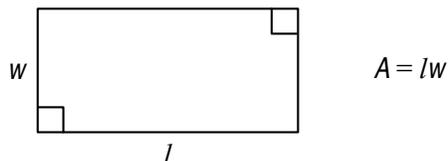
0 Points

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

FORMULA SHEET

ALGEBRA I FORMULA SHEET

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



Linear Equations

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

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

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

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

Arithmetic Properties

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

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

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

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

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

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

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

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

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

ALGEBRA I MODULE 1**MULTIPLE-CHOICE ITEMS**

1. Which monomial is the greatest common factor (GCF) of x^4y^8 and x^6y^4 ?
- A. x^2y^4
 - B. x^4y^4
 - C. x^6y^8
 - D. $x^{12}y^8$

Item Information	
Alignment	A1.1.1.2.1
Answer Key	B
Depth of Knowledge	1
p-value A	33%
p-value B	48% (correct answer)
p-value C	10%
p-value D	9%
Option Annotations	<p>A student could determine the correct answer, option B, by recognizing that each expression consists of at least 4 factors of x (x^4) and at least 4 factors of y (y^4), resulting in a greatest common factor of x^4y^4.</p> <p>A student could arrive at an incorrect answer by finding the greatest common factor of the given exponents or by confusing how to find the greatest common factor with how to find the least common multiple (LCM). For example, a student could arrive at option A either by finding the greatest common factor of the exponents for x (4 and 6 have a greatest common factor of 2) and the greatest common factor of the exponents for y (8 and 4 have a greatest common factor of 4) OR by finding the difference between the exponents for x ($6 - 4 = 2$) and the difference between the exponents for y ($8 - 4 = 4$).</p>

2. Wyatt incorrectly simplified the expression $\frac{\sqrt[3]{x^6y^{12}}}{\sqrt{x^{10}y^4}}$ to $\frac{y^4}{x^2}$. His work is shown below.

given:
$$\frac{\sqrt[3]{x^6y^{12}}}{\sqrt{x^{10}y^4}}$$

line 1:
$$\frac{x^{6 \div 2}y^{12 \div 2}}{x^{10 \div 2}y^{4 \div 2}}$$

line 2:
$$\frac{x^3y^6}{x^5y^2}$$

line 3:
$$\frac{y^{6-2}}{x^{5-3}}$$

line 4:
$$\frac{y^4}{x^2}$$

What error did Wyatt make when he attempted to simplify the expression?

- A. Going from the given expression to line 1, Wyatt divided the exponents in the numerator by 2 instead of by 3.
- B. Going from the given expression to line 1, Wyatt divided all the exponents by 2 but should have subtracted 3 from the exponents in the numerator and subtracted 2 from the exponents in the denominator.
- C. Going from line 2 to line 3, Wyatt subtracted the exponents when he should have added the exponents.
- D. Going from line 2 to line 3, Wyatt put the y -term in the numerator when it should have been in the denominator and he put the x -term in the denominator when it should have been in the numerator.

Item Information	
Alignment	A1.1.1.3.1
Answer Key	A
Depth of Knowledge	2
p-value A	51% (correct answer)
p-value B	22%
p-value C	12%
p-value D	15%
Option Annotations	<p>A student could determine the correct answer, option A, by recognizing that the root in the numerator of the given expression is a cube root and that all exponents underneath the radical can be divided by 3. The root in the denominator is a square root and all exponents underneath that radical can be divided by 2.</p> <p>A student could arrive at an incorrect answer by confusing the rule for simplifying radicals with either the rule for simplifying fractions or the rule for simplifying products or by associating certain variables with certain parts of the fraction. For example, a student could arrive at option B by confusing the rule for simplifying radicals with the rule for dividing exponents and subtracting the index of the radical (3 for the cube root and 2 for the square root) from each exponent.</p>

3. A local store sells different types of fruit drinks for \$2 to \$4 each. Jon buys d fruit drinks and pays \$36.53. Which value could be the number of fruit drinks Jon buys?
- A. 6
 - B. 9
 - C. 12
 - D. 19

Item Information	
Alignment	A1.1.1.4.1
Answer Key	C
Depth of Knowledge	2
p -value A	15%
p -value B	36%
p -value C	45% (correct answer)
p -value D	4%
Option Annotations	<p>A student could determine the correct answer, option C, by dividing \$36.53 by 2 to determine the quotient 18.265, dividing \$36.53 by 4 to determine the quotient 9.1325, and then selecting a value in between those quotients.</p> <p>A student could arrive at an incorrect answer by misinterpreting the quotients or by adding the prices of the drinks. For example, a student could arrive at option B by dividing 36.53 by 4 and then rounding this quotient (9.1325) down to 9 without considering that the cost of 9 fruit drinks at the highest price \$4 (\$36) would be less than the total amount Jon spent on the drinks (\$36.53).</p>

4. A polynomial expression is shown.

$$(7x^2y - 5x + 8y^2) - (3x^2y + 2x - 6y^2)$$

Which expression is equivalent to the polynomial expression?

- A. $4x^2y - 3x + 2y^2$
- B. $4x^2y - 7x + 14y^2$
- C. $10x^2y - 7x + 14y^2$
- D. $10x^2y - 3x + 2y^2$

Item Information	
Alignment	A1.1.1.5.1
Answer Key	B
Depth of Knowledge	1
p-value A	24%
p-value B	55% (correct answer)
p-value C	10%
p-value D	11%
Option Annotations	<p>A student could determine the correct answer, option B, by distributing the -1 across the second set of parentheses and then combining like terms: $(7x^2y - 3x^2y) + (-5x - 2x) + (8y^2 + 6y^2)$.</p> <p>A student could arrive at an incorrect answer by performing an incorrect operation. For example, a student could arrive at option A by distributing the -1 to only the first term in the second set of parentheses and then combining like terms: $(7x^2y - 3x^2y) + (-5x + 2x) + (8y^2 - 6y^2)$.</p>

5. Kaden wants to have exactly \$600 in his bank account by the end of the next 12 months. His bank account currently has \$84 in it. The bank account does not earn interest. He decides to deposit the same amount each month for the next 12 months. Which equation can be used to find the amount of money (x), in dollars, he must deposit each month to reach his goal?
- A. $12x + 84 = 600$
- B. $12x - 84 = 600$
- C. $12x + 84 = 684$
- D. $12x - 84 = 684$

Item Information	
Alignment	A1.1.2.1.1
Answer Key	A
Depth of Knowledge	2
p -value A	82% (correct answer)
p -value B	9%
p -value C	7%
p -value D	2%
Option Annotations	<p>A student could determine the correct answer, option A, by reasoning that the total amount Kaden intends to have in his bank account (\$600) equals the amount of money, in dollars, Kaden plans to save each month (x) multiplied by the number of months he intends to save money (12) added to the amount of money currently in the bank account (\$84).</p> <p>A student could arrive at an incorrect answer by using the wrong operation with \$84 or by adding \$84 to the \$600. For example, a student could arrive at option B by subtracting 84 from $12x$ rather than adding 84 to $12x$.</p>

6. Franklin is solving an equation. His first step is shown below.

$$4x + 7 - 3x + 10 = 12$$

$$4x - 3x + 7 + 10 = 12$$

Which property justifies Franklin's first step?

- A. additive property of equality
- B. associative property of addition
- C. commutative property of addition
- D. identity property of addition

Item Information	
Alignment	A1.1.2.1.2
Answer Key	C
Depth of Knowledge	2
p-value A	16%
p-value B	28%
p-value C	41% (correct answer)
p-value D	15%
Option Annotations	<p>A student could determine the correct answer, option C, by recognizing that the order of the terms 7 and $-3x$ has changed and then correctly identifying the property used to justify this step as the commutative property of addition.</p> <p>A student could arrive at an incorrect answer by confusing which property is being applied. For example, a student could arrive at option B by confusing the associative property of addition (a change in the grouping of terms in an expression) and the commutative property of addition (a change in the order of terms in an expression).</p>

7. Fernando works at a clothing store. Each week, he earns \$120 plus a 25% commission on any clothing he sells. The equation shown below can be used to determine the total amount (y), in dollars, Fernando earns in a week during which he sells x dollars' worth of clothing.

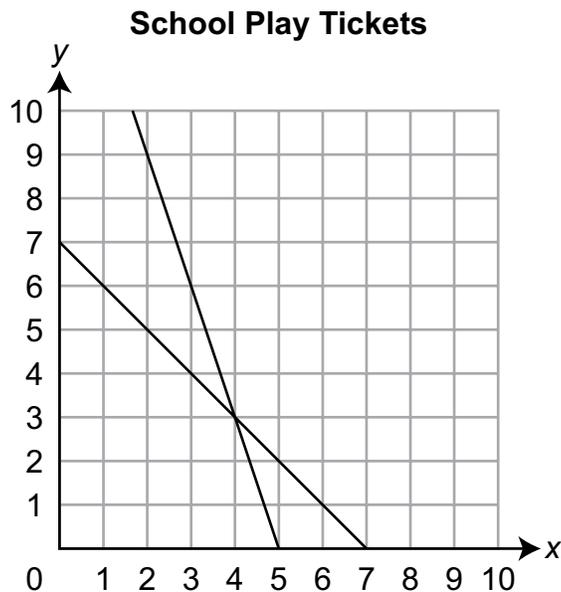
$$y = 0.25x + 120$$

The ordered pair (225, 176.25) is a solution of the equation. What does this solution represent in the context of the situation?

- A. In a week during which Fernando sells \$176.25 worth of clothing, he earns a total of \$225.
- B. In a week during which Fernando sells \$176.25 worth of clothing, he earns \$225 in commission.
- C. In a week during which Fernando sells \$225 worth of clothing, he earns a total of \$176.25.
- D. In a week during which Fernando sells \$225 worth of clothing, he earns \$176.25 in commission.

Item Information	
Alignment	A1.1.2.1.3
Answer Key	C
Depth of Knowledge	2
p -value A	14%
p -value B	14%
p -value C	57% (correct answer)
p -value D	15%
Option Annotations	<p>A student could determine the correct answer, option C, by recognizing that x represents the dollars' worth of clothing Fernando sold (\$225) and that y represents the total amount, in dollars, that Fernando earns (\$176.25).</p> <p>A student could arrive at an incorrect answer by misinterpreting the meaning of the values in the solution. For example, a student could arrive at option D by misinterpreting the y-coordinate as the amount of Fernando's commission rather than as the total amount that Fernando earns.</p>

8. Nikki and Emily are buying tickets to a school play for their families. Nikki buys 3 adult tickets and 1 student ticket for \$15. Emily buys 2 adult tickets and 2 student tickets for \$14. The coordinate plane shown below displays a graph that models this situation, but the labels for the two axes are missing.



What does the point of intersection on the coordinate plane represent?

- A. Nikki pays \$3 for each ticket, and Emily pays \$4 for each ticket.
- B. Nikki pays \$4 for each ticket, and Emily pays \$3 for each ticket.
- C. The price of each adult ticket is \$3, and the price of each student ticket is \$4.
- D. The price of each adult ticket is \$4, and the price of each student ticket is \$3.

Item Information	
Alignment	A1.1.2.2.2
Answer Key	D
Depth of Knowledge	2
p-value A	6%
p-value B	7%
p-value C	7%
p-value D	80% (correct answer)
Option Annotations	<p>A student could determine the correct answer, option D, by setting up the equation $3a + 1s = 15$ to represent Nikki's situation and then matching this equation to the steeper line in the graph, rewriting the equation as $3x + 1y = 15$, and then concluding that x represents the price of each adult ticket and y represents the price of each student ticket, which means the solution at $(4, 3)$ represents \$4 for each adult ticket and \$3 for each student ticket.</p> <p>A student could arrive at an incorrect answer by misinterpreting the meaning of each axis. For example, a student could arrive at option B by misinterpreting the x-axis as representing the amount Nikki pays for each ticket and the y-axis as representing the amount Emily pays for each ticket.</p>

9. Ingrid collects autographs.

- She started her collection with x autographs.
- Then, she doubled the number of autographs in her collection.
- Later, she received 3 additional autographs in the mail.
- She now has between 85 and 90 autographs in her collection.

Which inequality can be used to determine the number of autographs with which Ingrid started her collection?

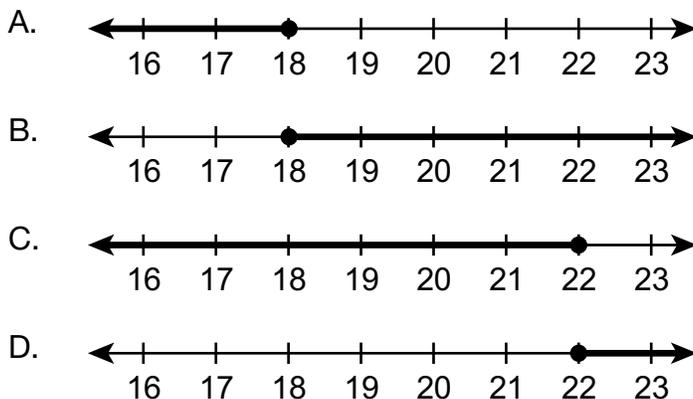
- A. $85 < x < 90$
- B. $85 < 2(x + 3) < 90$
- C. $85 < 2x + 3 < 90$
- D. $85 < 3x + 2 < 90$

Item Information	
Alignment	A1.1.3.1.1
Answer Key	C
Depth of Knowledge	2
p -value A	9%
p -value B	16%
p -value C	71% (correct answer)
p -value D	4%
Option Annotations	<p>A student could determine the correct answer, option C, by multiplying the starting number of autographs in Ingrid's collection (x) by 2 and then adding the number of autographs she received in the mail (3), resulting in the expression $2x + 3$.</p> <p>A student could arrive at an incorrect answer by misinterpreting how the values should be applied. For example, a student could arrive at option B by first adding the number of autographs she received in the mail (3) to x and then multiplying the expression $(x + 3)$ by 2.</p>

10. Rajeev unpacks 1 box that has 8 books in it. He has 4 other boxes that each have x books in them. He knows he has at least 80 books. The inequality shown below represents this situation.

$$4x + 8 \geq 80$$

Which graph **best** models all the possible numbers of books in each of Rajeev's 4 other boxes?



Item Information	
Alignment	A1.1.3.1.2
Answer Key	B
Depth of Knowledge	1
p -value A	13%
p -value B	72% (correct answer)
p -value C	6%
p -value D	9%
Option Annotations	<p>A student could determine the correct answer, option B, by first correctly solving the inequality ($4x + 8 \geq 80 \rightarrow 4x \geq 72 \rightarrow x \geq 18$) and then identifying the graph with a closed circle at 18 to represent the “equal to” part of the inequality and shading to the right of the closed circle to represent the “greater than” part of the inequality.</p> <p>A student could arrive at an incorrect answer by misapplying arithmetic properties when solving for x and/or by misinterpreting the direction of the inequality symbol. For example, a student could arrive at option A by misinterpreting the inequality symbol and shading the number line to the left of the closed circle.</p>

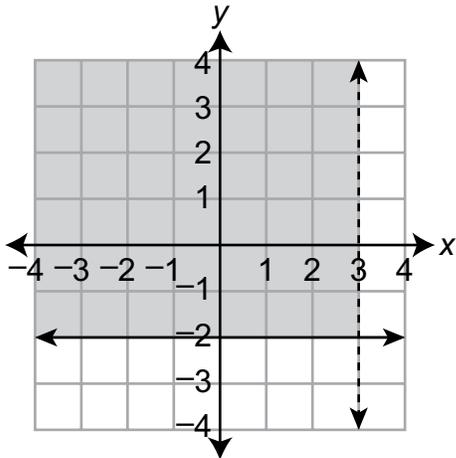
11. A system of inequalities is shown below.

$$x \geq -2$$

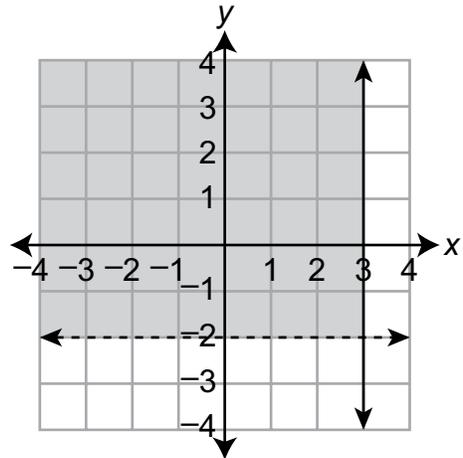
$$y < 3$$

Which graph shows the correct solution set of this system of inequalities?

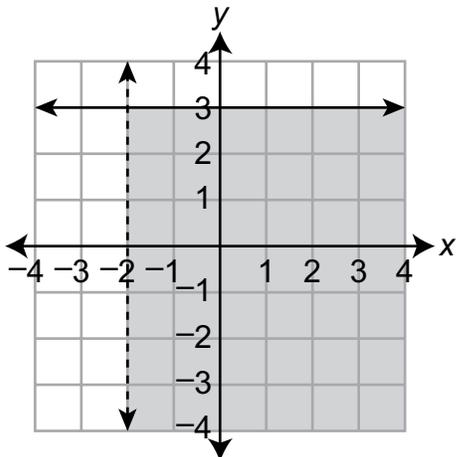
A.



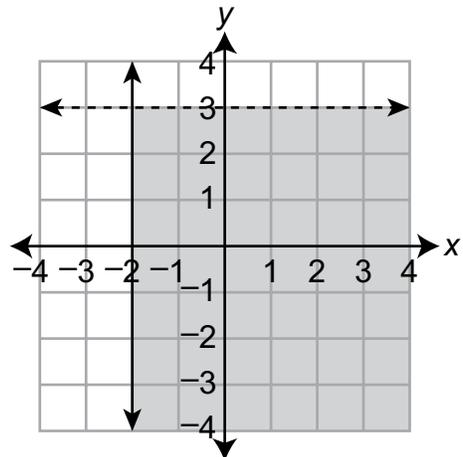
B.



C.



D.



Item Information	
Alignment	A1.1.3.2.1
Answer Key	D
Depth of Knowledge	2
p-value A	24%
p-value B	11%
p-value C	15%
p-value D	50% (correct answer)
Option Annotations	<p>A student could determine the correct answer, option D, by recognizing that the boundary line for $x \geq -2$ should be a solid vertical line containing the point $(-2, 0)$, that the boundary line for $y < 3$ should be a dashed horizontal line containing the point $(0, 3)$, and that the shaded region should be to the right of the solid vertical line (\geq) and below the dashed horizontal line ($<$).</p> <p>A student could arrive at an incorrect answer by switching which boundary should be vertical or horizontal and/or by switching which boundary line should be solid or dashed. For example, a student could arrive at option A by thinking that the boundary for $x \geq -2$ should be horizontal and that the boundary for $y < 3$ should be vertical.</p>

12. Laura is buying bottles of water and bottles of lemonade for an event at her school. She needs to buy at least 6,400 ounces of beverages between the water and lemonade. Each bottle of water is 20 ounces, and each bottle of lemonade is 32 ounces. Laura has a budget of \$600 to buy the beverages. The system of inequalities shown below represents this situation.

$$20x + 32y \geq 6,400$$

$$1.5x + 2.5y \leq 600$$

One solution to this system of inequalities is (40, 180). What does this solution represent?

- A. By buying 40 bottles of lemonade and 180 bottles of water, Laura will have at least 6,400 ounces of beverages and stay within her budget of \$600.
- B. By buying 40 bottles of water and 180 bottles of lemonade, Laura will have at least 6,400 ounces of beverages and stay within her budget of \$600.
- C. By spending \$40 on bottles of lemonade and \$180 on bottles of water, Laura will have at least 6,400 ounces of beverages and stay within her budget of \$600.
- D. By spending \$40 on bottles of water and \$180 on bottles of lemonade, Laura will have at least 6,400 ounces of beverages and stay within her budget of \$600.

Item Information	
Alignment	A1.1.3.2.2
Answer Key	B
Depth of Knowledge	2
p-value A	17%
p-value B	59% (correct answer)
p-value C	11%
p-value D	13%
Option Annotations	<p>A student could determine the correct answer, option B, by recognizing that the x-coordinate (40) represents the number of bottles of water, that the y-coordinate (180) represents the number of bottles of lemonade, and that any solution represents a combination of bottles Laura can buy to have enough beverages and stay within her budget.</p> <p>A student could arrive at an incorrect answer by misinterpreting what each coordinate represents. For example, a student could arrive at option A by misinterpreting the x-coordinate as representing the number of bottles of lemonade and the y-coordinate as representing the number of bottles of water.</p>

CONSTRUCTED-RESPONSE ITEM

13. Landry is working with the expression $2\sqrt{18x}$.

- A.** Determine an integer value of x less than 10 for which $2\sqrt{18x}$ is a rational number.

integer value of x : _____

- B.** Write an expression that is equivalent to $2\sqrt{18x}$ and is in the form $a\sqrt{bx}$, where a and b are positive integers and $a \neq 2$.

expression: _____

Go to the next page to finish question 13.



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

C. What is the **largest** integer value of x for which $2\sqrt{18x} < 36$ is true?

largest integer value of x : _____

Landry is working with the three expressions shown below.

$$2\sqrt{18x} \quad x^2 \quad \frac{18}{x}$$

D. Determine **all** the integer values of x for which $2\sqrt{18x}$ is greater than x^2 **and** $2\sqrt{18x}$ is also greater than $\frac{18}{x}$.

integer values of x : _____

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



Item-Specific Scoring Guideline

#13 Item Information

Alignment	A1.1.1	Depth of Knowledge	2	Mean Score	1.25
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Assessment Anchor this item will be reported under:

A1.1.1—Operations with Real Numbers and Expressions

Specific Anchor Descriptor addressed by this item:

A1.1.1.1—Represent and/or use numbers in equivalent forms (e.g., integers, fractions, decimals, percents, square roots, and exponents).

Scoring Guide

Score	Description
4	The student demonstrates a thorough understanding of operations with real numbers and expressions by correctly solving problems with clear and complete procedures and explanations when required.
3	The student demonstrates a general understanding of operations with real numbers and expressions by solving problems and providing procedures and explanations with only minor errors or omissions.
2	The student demonstrates a partial understanding of operations with real numbers and expressions by providing a portion of the correct problem solving, procedures, and explanations.
1	The student demonstrates a minimal understanding of operations with real numbers and expressions.
0	The response has no correct answer and insufficient evidence to demonstrate any understanding of the mathematical concepts and procedures as required by the task. Response may show only information copied from the question.

Top-Scoring Student Response and Training Notes

Score	Description
4	Student earns 4 points.
3	Student earns 3 points.
2	Student earns 2 points.
1	Student earns 1 point.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.

Top-Scoring Response

Part A (1 point):

1 point for correct answer

What?	Why?
<p>Answers may vary. Accept 0, 2, 8, or any combination of 0, 2, and 8.</p> <p>Sample Responses:</p> <p>2 0, 8 0, 2, 8</p>	

Part B (1 point):

1 point for correct answer

What?	Why?
<p>$3\sqrt{8x}$</p> <p>OR</p> <p>$6\sqrt{2x}$</p> <p>OR</p> <p>$\sqrt{72x}$ (also accept $1\sqrt{72x}$)</p>	

Part C (1 point):

1 point for correct answer

What?	Why?
17	

Part D (1 point):

1 point for correct answer

What?	Why?
2, 3, 4	

STUDENT RESPONSE

Response Score: 4 points



PARTS A and B

Question 13
Page 1 of 2

Landry is working with the expression $2\sqrt{18x}$.

A. Determine an integer value of x less than 10 for which $2\sqrt{18x}$ is a rational number.

integer value of x :

B. Write an expression that is equivalent to $2\sqrt{18x}$ and is in the form $a\sqrt{bx}$, where a and b are positive integers and $a \neq 2$.

expression:

Review/End Test Pause Flag Options Next

Part A: The student provided a correct integer value of x (8). While support is not required for Part A, the student likely substituted in integers less than 10 for x and found that 8 is an integer less than 10 that, when substituted in for x in the expression $2\sqrt{18x}$, results in a rational number: $2\sqrt{18(8)} = 2\sqrt{144} = 2(12) = 24$. [1 point]

Part B: The student provided a correct expression ($\sqrt{72x}$), which is in the form $a\sqrt{bx}$ (with $a = 1$ and $b = 72$). While support is not required for Part B, the student likely squared the coefficient 2 ($2^2 = 4$) and then multiplied the $18x$ under the radical by 4, resulting in a product of $\sqrt{72x}$. [1 point]

PARTS C and D

Question 13
Page 2 of 2

Landry is working with the expression $2\sqrt{18x}$.

C. What is the **largest** integer value of x for which $2\sqrt{18x} < 36$ is true?

largest integer value of x :

Landry is working with the three expressions shown below.

$$2\sqrt{18x} \quad x^2 \quad \frac{18}{x}$$

D. Determine **all** the integer values of x for which $2\sqrt{18x}$ is greater than x^2 and $2\sqrt{18x}$ is also greater than $\frac{18}{x}$.

integer values of x :

Review/End Test Pause Flag Options Back Next

Part C: The student provided the correct largest integer value of x (17). While support is not required for Part C, the student may have squared the coefficient 2 ($2^2 = 4$), multiplied the $18x$ under the radical by 4, resulting in a product of $\sqrt{72x}$, set up the equation $\sqrt{72x} = 36$, squared both sides of the equation, resulting in $72x = 1,296$, and then solved for x by dividing each side by 72 to determine that the solution is $x = 18$. Having found the value for x that will equal 36, the student needed to select the greatest integer less than 18, which is 17. [1 point]

Part D: The student provided a correct answer (2 3 4). While support is not required, the student may have graphed the three expressions by setting each equal to y ($y = 2\sqrt{18x}$, $y = x^2$, $y = \frac{18}{x}$) and noticed that $2\sqrt{18x} > \frac{18}{x}$ for positive integer values greater than 1 and that $2\sqrt{18x} > x^2$ for positive integer values less than 5, resulting in a solution set of 2, 3, and 4. [1 point]

STUDENT RESPONSE

Response Score: 3 points

13. Landry is working with the expression $2\sqrt{18x}$.

- A. Determine an integer value of x less than 10 for which $2\sqrt{18x}$ is a rational number.

Part A: The student provided a correct integer value of x (8). While support is not required for Part A, the student likely substituted in integers less than 10 for x and found that 8 is an integer less than 10 that, when substituted in for x in the expression $2\sqrt{18x}$, results in a rational number: $2\sqrt{18(8)} = 2\sqrt{144} = 2(12) = 24$. [1 point]

integer value of x : 8

- B. Write an expression that is equivalent to $2\sqrt{18x}$ and is in the form $a\sqrt{bx}$, where a and b are positive integers and $a \neq 2$.

Part B: The student provided an incorrect expression ($4\sqrt{9x}$). No support (work or explanation) is required, so it is unclear where an error was made. The student may have factored 18 as $2 \cdot 9$ and then moved the 2 outside the radical (multiplying this 2 by the coefficient 2, resulting in $4\sqrt{9x}$) without considering that only factors that are perfect squares can be moved from under the radical by first taking the square root of that factor. [0 points]

expression: $4\sqrt{9x}$

Go to the next page to finish question 13.



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

C. What is the **largest** integer value of x for which $2\sqrt{18x} < 36$ is true?

Part C: The student provided the correct largest integer value of x (17). While support is not required for Part C, the student may have realized that $2\sqrt{18(18)} = 2(18) = 36$ and then selected the greatest integer less than 18, which is 17. [1 point]

largest integer value of x : 17

Landry is working with the three expressions shown below.

$$2\sqrt{18x} \quad x^2 \quad \frac{18}{x}$$

D. Determine **all** the integer values of x for which $2\sqrt{18x}$ is greater than x^2 **and** $2\sqrt{18x}$ is also greater than $\frac{18}{x}$.

Part D: The student provided a correct answer (3, 4, 2). While support is not required, the student may have substituted integer values in for x starting with 3 [for which $2\sqrt{18(3)} > 3^2$ and $2\sqrt{18(3)} > \frac{18}{3}$], proceeding up through 5 [for which $2\sqrt{18(5)} > \frac{18}{5}$ but $2\sqrt{18(5)} < 5^2$], going back to 2 [for which $2\sqrt{18(2)} > 2^2$ and $2\sqrt{18(2)} > \frac{18}{2}$], and proceeding down to 1 [for which $2\sqrt{18(1)} > 1^2$ but $2\sqrt{18(1)} < \frac{18}{1}$], noting that only the integers 3, 4, and 2 work for the given scenario. [1 point]

integer values of x : 3, 4, 2

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



STUDENT RESPONSE

Response Score: 2 points



PARTS A and B

Question 13
Page 1 of 2

Landry is working with the expression $2\sqrt{18x}$.

A. Determine an integer value of x less than 10 for which $2\sqrt{18x}$ is a rational number.

integer value of x :

B. Write an expression that is equivalent to $2\sqrt{18x}$ and is in the form $a\sqrt{bx}$, where a and b are positive integers and $a \neq 2$.

expression:

Review/End Test Pause Flag Options Next

Part A: The student provided a correct integer value of x (2). While support is not required for Part A, the student likely substituted in integers less than 10 for x and found that 2 is an integer less than 10 that, when substituted in for x in the expression $2\sqrt{18x}$, results in a rational number: $2\sqrt{18(2)} = 2\sqrt{36} = 2(6) = 12$. [1 point]

Part B: The student provided an incorrect expression ($\sqrt{12}$). No support (work or explanation) is required, so it is unclear where an error was made. [0 points]

PARTS C and D

Question 13
Page 2 of 2

Landry is working with the expression $2\sqrt{18x}$.

C. What is the **largest** integer value of x for which $2\sqrt{18x} < 36$ is true?

largest integer value of x :

Landry is working with the three expressions shown below.

$$2\sqrt{18x} \quad x^2 \quad \frac{18}{x}$$

D. Determine **all** the integer values of x for which $2\sqrt{18x}$ is greater than x^2 and $2\sqrt{18x}$ is also greater than $\frac{18}{x}$.

integer values of x :

Review/End Test Pause Flag Options Back Next

Part C: The student provided the correct largest integer value of x (17). While support is not required for Part C, the student may have divided both sides of the inequality by 2, resulting in $\sqrt{18(x)} < 18$, recognized that $\sqrt{18(18)} = 18$, and then selected the next integer less than 18, which is 17, resulting in $\sqrt{18(17)} < 18$. [1 point]

Part D: The student provided an incomplete answer (2). While support is not required for Part D, the student may have substituted integer values in for x starting with 1 [for which $2\sqrt{18(1)} > 1^2$ but $2\sqrt{18(1)} < \frac{18}{1}$] and continuing on to 2 [for which $2\sqrt{18(2)} > 2^2$ and $2\sqrt{18(2)} > \frac{18}{2}$]. Having found a possible value of x , the student may have stopped without proceeding on to find the other values of x (3 and 4) for which $2\sqrt{18x}$ is greater than x^2 and is also greater than $\frac{18}{x}$; all three values of x (2, 3, and 4) are required for credit. [0 points]

STUDENT RESPONSE

Response Score: 1 point

13. Landry is working with the expression $2\sqrt{18x}$.

- A. Determine an integer value of x less than 10 for which $2\sqrt{18x}$ is a rational number.

$2\sqrt{18 \cdot 9}$	$2\sqrt{18 \cdot 8}$
$2\sqrt{16 \cdot 2}$	$2\sqrt{14 \cdot 4}$
$2\sqrt{81 \cdot \sqrt{2}}$	$2 \cdot 12$
$2 \cdot 9\sqrt{2}$	24
$X 18\sqrt{2}$	\checkmark

Part A: The student provided an incorrect integer value (24). The student provided work, although the work is not required or assessed. Based on the work provided, the student correctly substituted the largest integer less than 10 (9) into the expression $2\sqrt{18x}$ for x and simplified the expression, resulting in a value ($18\sqrt{2}$) that is not a rational number. The student then correctly substituted the next largest integer (8) into the expression $2\sqrt{18x}$ for x and simplified the expression, resulting in a value (24) that is a rational number; however, the student then used the value of the expression (24) rather than the value that was substituted in for x (8) as the final answer. [0 points]

integer value of x : 24

- B. Write an expression that is equivalent to $2\sqrt{18x}$ and is in the form $a\sqrt{bx}$, where a and b are positive integers and $a \neq 2$.

$2\sqrt{18x}$	$6\sqrt{2(2)}$	$2\sqrt{18(2)}$
$2\sqrt{9 \cdot \sqrt{2x}}$	$6\sqrt{4}$	$2\sqrt{36}$
$2 \cdot 3\sqrt{2x}$	$6 \cdot 2$	$2 \cdot 6$
$6\sqrt{2x}$	12	12

Part B: The student provided a correct expression ($6\sqrt{2x}$), which is in the form $a\sqrt{bx}$ (with $a = 6$ and $b = 2$). The work shown is correct, though not necessary for credit. The student first factored 18 as $9 \cdot 2$ to rewrite $2\sqrt{18x}$ as $2\sqrt{9 \cdot \sqrt{2x}}$, recognized that $\sqrt{9} = 3$ to rewrite the expression as $2 \cdot 3\sqrt{2x}$, and then multiplied the 2 and 3 together, resulting in the expression $6\sqrt{2x}$. The student also provided a check of the work by substituting 2 in for x in both the student's expression [$6\sqrt{2(2)}$] and the original expression [$2\sqrt{18(2)}$], resulting in both expressions simplifying to 12. [1 point]

expression: $6\sqrt{2x}$

Go to the next page to finish question 13.



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

C. What is the **largest** integer value of x for which $2\sqrt{18x} < 36$ is true?

$$\begin{array}{l} 2\sqrt{18 \cdot 8} \\ 2\sqrt{144} \\ 2 \cdot 12 \\ 24 \end{array}$$

largest integer value of x : 8

Part C: The student provided an incorrect integer value of x (8). The student provided work, although the work is not required or assessed. Based on the work provided, the student correctly substituted the integer 8 into the expression $2\sqrt{18x}$ for x and simplified the expression, resulting in a value (24) that is less than 36; however, 8 is not the largest value of x for which $2\sqrt{18x} < 36$ is true and receives no credit. [0 points]

Landry is working with the three expressions shown below.

$$2\sqrt{18x} \quad x^2 \quad \frac{18}{x}$$

D. Determine **all** the integer values of x for which $2\sqrt{18x}$ is greater than x^2 **and**

$2\sqrt{18x}$ is also greater than $\frac{18}{x}$.

$$\begin{array}{ll} 2\sqrt{18 \cdot 8} & 2\sqrt{18 \cdot 2} \\ 2\sqrt{144} & 2\sqrt{36} \\ 2 \cdot 12 & 2 \cdot 6 \\ 24 & 12 \\ (8)^2 = 64 & (2)^2 = 4 \\ \times & \checkmark \\ & \frac{18}{2} = 9 \end{array}$$

integer values of x : 2

Part D: The student provided an incomplete answer (2). The student provided work, although the work is not required or assessed. Based on the work provided, the student started with 8 as a value of x [$2\sqrt{18 \cdot 8}$ simplifies to 24 and $(8)^2 = 64$], which does not satisfy the given scenario since 24 is not greater than 64. The student then tried 2 as a value of x [$2\sqrt{18 \cdot 2}$ simplifies to 12, $(2)^2 = 4$, and $\frac{18}{2} = 9$], which does satisfy the given scenario since $12 > 4$ and $12 > 9$. Having found a possible value of x , the student stopped without proceeding on to find the other values of x (3 and 4) for which $2\sqrt{18x}$ is greater than x^2 and is also greater than $\frac{18}{x}$; all three values of x (2, 3, and 4) are required for credit. [0 points]

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



STUDENT RESPONSE

Response Score: 0 points



PARTS A and B

Question 13
Page 1 of 2

Landry is working with the expression $2\sqrt{18x}$.

A. Determine an integer value of x less than 10 for which $2\sqrt{18x}$ is a rational number.

integer value of x :

B. Write an expression that is equivalent to $2\sqrt{18x}$ and is in the form $a\sqrt{bx}$, where a and b are positive integers and $a \neq 2$.

expression:

Review/End Test Pause Flag Options Next

Part A: The student provided an incorrect integer value (9). No support (work or explanation) is required, so it is unclear where an error was made. The student may have correctly substituted the largest integer less than 10 (9) into the expression $2\sqrt{18x}$ for x and simplified the expression, resulting in the value $18\sqrt{2}$; however, this value is not a rational number, so the answer of 9 is incorrect. [0 points]

Part B: The student provided an incorrect answer ($18\sqrt{2}$). No support (work or explanation) is required, so it is unclear where an error was made. The student may have substituted 9 in for x and factored $2\sqrt{18x}$ as $2 \cdot \sqrt{9} \cdot \sqrt{2} \cdot \sqrt{9}$, resulting in $18\sqrt{2}$; however, substituting a value in for x is an incorrect step when finding an expression that is equivalent to $2\sqrt{18x}$ in the form $a\sqrt{bx}$. [0 points]

PARTS C and D

Question 13
Page 2 of 2

Landry is working with the expression $2\sqrt{18x}$.

C. What is the **largest** integer value of x for which $2\sqrt{18x} < 36$ is true?

largest integer value of x :

Landry is working with the three expressions shown below.

$$2\sqrt{18x} \quad x^2 \quad \frac{18}{x}$$

D. Determine **all** the integer values of x for which $2\sqrt{18x}$ is greater than x^2 and $2\sqrt{18x}$ is also greater than $\frac{18}{x}$.

integer values of x :

Review/End Test Pause Flag Options Back Next

Part C: The student provided an incorrect integer value (16). No support (work or explanation) is required, so it is unclear where an error was made. The student may have correctly substituted the integer 16 into the expression $2\sqrt{18x}$ for x and simplified the expression, resulting in the value $24\sqrt{2}$, which is less than 36; however, 16 is not the largest value of x for which $2\sqrt{18x} < 36$ is true and receives no credit. [0 points]

Part D: The student provided an incomplete answer (4). No support (work or explanation) is required, so it is unclear where an error was made. The student may have substituted 4 in for x in all three expressions, which does satisfy the given scenario: $2\sqrt{18(4)} \approx 16.97$, which is greater than $(4)^2 = 16$ and is also greater than $\frac{18}{4} = 4.5$. Having found a possible value of x , the student stopped without proceeding on to find the other values of x (2 and 3) for which $2\sqrt{18x}$ is greater than x^2 and is also greater than $\frac{18}{x}$; all three values of x (2, 3, and 4) are required for credit. [0 points]

CONSTRUCTED-RESPONSE ITEM

14. Dave and Jessie are both working two jobs over the summer to earn some extra money.

For his two jobs, Dave walks dogs and babysits. He earns \$7 per hour walking dogs and \$10 per hour babysitting. Dave has a weekly goal of earning more than \$150 while working no more than 18 hours.

- A. Write a system of linear inequalities that can be used to determine all the possible numbers of hours Dave can work each job and meet his weekly goals.

Show or explain whether the ordered pair (8, 8) is a possible solution to this situation.

Go to the next page to finish question 14.



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

For her two jobs, Jessie mows lawns and works at a restaurant. Like Dave, Jessie has weekly goals for the amount of money she earns and the number of hours she works. The system of linear inequalities shown below can be used to determine all the possible numbers of hours that she can mow lawns (x) and all the possible numbers of hours that she can work at the restaurant (y) and meet her weekly goals.

$$x + y < 20$$

$$12x + 6y \geq 175$$

Jessie works only a whole number of hours at each job.

- B.** Identify an ordered pair that is a solution to this system of inequalities.

Within the context of the situation, explain what each coordinate of your ordered pair represents and why this ordered pair is a solution to the system of inequalities.

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



Item-Specific Scoring Guideline

#14 Item Information

Alignment	A1.1.3	Depth of Knowledge	2	Mean Score	1.62
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Assessment Anchor this item will be reported under:

A1.1.3—Linear Inequalities

Specific Anchor Descriptor addressed by this item:

A1.1.3.2—Write, solve, and/or graph systems of linear inequalities using various methods.

Scoring Guide

Score	Description
4	The student demonstrates a thorough understanding of linear inequalities by correctly solving problems with clear and complete procedures and explanations when required.
3	The student demonstrates a general understanding of linear inequalities by solving problems and providing procedures and explanations with only minor errors or omissions.
2	The student demonstrates a partial understanding of linear inequalities by providing a portion of the correct problem solving, procedures, and explanations.
1	The student demonstrates a minimal understanding of linear inequalities.
0	The response has no correct answer and insufficient evidence to demonstrate any understanding of the mathematical concepts and procedures as required by the task. Response may show only information copied from the question.

Top-Scoring Student Response and Training Notes

Score	Description
4	Student earns 4 points.
3	Student earns 3.0–3.5 points.
2	Student earns 2.0–2.5 points.
1	Student earns 0.5–1.5 points. OR Student demonstrates minimal understanding of linear inequalities.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.

Top-Scoring Response

Part A (2 points):

$\frac{1}{2}$ point for each correct answer

1 point for correct and complete support

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

What?	Why?
<p>$x + y \leq 18$</p> <p>AND</p> <p>$7x + 10y > 150$</p> <p>[Note: variables do not have to be x and y and do not need to be defined, but they must be consistent between the two inequalities; also, the order may be switched.]</p>	<p>Sample Work:</p> <p>$8 + 8 = 16 \leq 18$ (true)</p> <p><u>$7(8) + 10(8) = 136 > 150$ (false)</u></p> <p><u>So, (8, 8) is not a possible solution for this situation.</u></p> <p>OR</p> <p>Sample Explanation:</p> <p>By working 8 hours at each job, Dave would work a total of 16 hours, which is less than (or, no more than) 18 hours. However, <u>he would earn only $7(8) + 10(8) = \\$136$, which is not more than \$150. So, (8, 8) is not a possible solution for this situation.</u></p> <p>OR equivalent</p> <p><i>Note: Only the underlined statements or an adequate explanation are necessary for full credit.</i></p>

Part B (2 points):

1 point for correctly written ordered pair

OR $\frac{1}{2}$ point for a correct solution that includes decimals

1 point for correct and complete description

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

What?	Why?
<p>Answers may vary. Accept any of the following ordered pairs:</p> <p>(11, 8) (12, 6) (12, 7) (13, 4) (13, 5) (13, 6) (14, 2) (14, 3) (14, 4) (14, 5) (15, 0) (15, 1) (15, 2) (15, 3) (15, 4) (16, 0) (16, 1) (16, 2) (16, 3) (17, 0) (17, 1) (17, 2) (18, 0) (18, 1) (19, 0)</p> <p>Sample Response:</p> <p>(15, 2)</p>	<p>Sample Description:</p> <p>Jessie can work 15 hours mowing lawns and 2 hours at the restaurant and meet her weekly goals of working less than 20 hours ($15 + 2 = 17 < 20$) and earning at least \$175 ($12 \cdot 15 + 6 \cdot 2 = 192 \geq 175$).</p> <p>OR equivalent</p>

STUDENT RESPONSE

Response Score: 4 points

14. Dave and Jessie are both working two jobs over the summer to earn some extra money.

For his two jobs, Dave walks dogs and babysits. He earns \$7 per hour walking dogs and \$10 per hour babysitting. Dave has a weekly goal of earning more than \$150 while working no more than 18 hours.

- A. Write a system of linear inequalities that can be used to determine all the possible numbers of hours Dave can work each job and meet his weekly goals.

Show or explain whether the ordered pair (8, 8) is a possible solution to this situation.

$$7x + 10y > 150$$

$$x + y \leq 18$$

$$7(8) + 10(8) > 150$$

$$56 + 80 > 150$$

$$136 > 150 \quad X$$

$$8 + 8 \leq 18$$

$$16 \leq 18$$

✓

The ordered pair (8,8) isn't a possible solution because it wouldn't earn him more than \$150, those hours would only earn him \$136.

Part A: The student provided two correct inequalities for the system of inequalities ($7x + 10y > 150$ and $x + y \leq 18$). The student also provided a correct solution process. First, the student substituted the ordered pair (8, 8) into the inequality $7x + 10y > 150$ and simplified [$7(8) + 10(8) > 150 \rightarrow 56 + 80 > 150 \rightarrow 136 > 150$]. The student included an X to denote that the inequality is not true. Next, the student substituted the ordered pair (8, 8) into the inequality $x + y \leq 18$ and simplified [$8 + 8 \leq 18 \rightarrow 16 \leq 18$]. The student included a check mark (✓) to denote that the inequality is true. The student also provided a correct explanation [*The ordered pair (8, 8) isn't a possible solution because it wouldn't earn him more than \$150, those hours would only earn him \$136.*]. [2 points]

Go to the next page to finish question 14.



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

For her two jobs, Jessie mows lawns and works at a restaurant. Like Dave, Jessie has weekly goals for the amount of money she earns and the number of hours she works. The system of linear inequalities shown below can be used to determine all the possible numbers of hours that she can mow lawns (x) and all the possible numbers of hours that she can work at the restaurant (y) and meet her weekly goals.

$$x + y < 20$$

$$12x + 6y \geq 175$$

Jessie works only a whole number of hours at each job.

- B.** Identify an ordered pair that is a solution to this system of inequalities.

Within the context of the situation, explain what each coordinate of your ordered pair represents and why this ordered pair is a solution to the system of inequalities.

The ordered pair (12, 6) is a solution to this system of inequalities

Jessie mows lawns for 12 hours
 She also works at the restaurant for 6 hours
 12 hours plus 6 hours is less than 20 hours.

\$12 times 12 hours plus \$6 times 6 hours
 is greater than \$175 because it
 equals \$180.

Part B: The student provided a correct ordered pair [*The ordered pair (12, 6) is a solution to this system of inequalities*]. The student also provided a correct and complete explanation as to why the ordered pair (12, 6) is a solution of the given set of inequalities: The student identified 12 as the number of hours mowing lawns and 6 as the number of hours working at the restaurant (*Jessie mows lawns for 12 hours She also works at the restaurant for 6 hours*). The student then explained that the ordered pair meets the first inequality requirement (*12 hours plus 6 hours is less than 20 hours*) and the second inequality requirement (*\$12 times 12 hours plus \$6 times 6 hours is greater than \$175 because it equals \$180*). [2 points]

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



STUDENT RESPONSE

Response Score: 3 points



PART A

Question 14

Page 1 of 2



Item ID



Dave and Jessie are both working two jobs over the summer to earn some extra money.

For his two jobs, Dave walks dogs and babysits. He earns \$7 per hour walking dogs and \$10 per hour babysitting. Dave has a weekly goal of earning more than \$150 while working no more than 18 hours.

A. Write a system of linear inequalities that can be used to determine all the possible numbers of hours Dave can work each job and meet his weekly goals.

Show or explain whether the ordered pair (8, 8) is a possible solution to this situation.

$$7x+10y>150$$

$$7(8)+10(8)=136>150$$

x =hour walking dogs
 y = hour babysitting

$$8+8=16$$

16 hours is no more than 18 hours.
 $(8,8) = (x,y)$

The ordered pair (8,8) is not a possible solution in this situation because the total number of hours would be 16, which is no more than 18 hours, so that would work, but the total amount of money earned would be \$136, which is not more than \$150.

375 / 1000

Review/End Test

Pause

Flag

Options

Next

Part A: The student did not provide a system of inequalities; instead, the student provided a single inequality representing the goal of earning more than \$150 ($7x+10y>150$). The student also provided correct and complete support. The student first substituted (8, 8) into the inequality $7x + 10y > 150$ and simplified [$7(8)+10(8)=136>150$]. Although the student did not provide the other correct inequality ($x + y \leq 18$), the student did demonstrate that (8, 8) does support the part of the scenario of working no more than 18 hours ($8+8=16$ and 16 hours is no more than 18 hours.). The (8, 8) is also identified as representing (x, y) . The student then provided a correct explanation [*The ordered pair (8,8) is not a possible solution in this situation because the total number of hours would be 16, which is no more than 18 hours, so that would work, but the total amount of money earned would be \$136, which is not more than \$150.*]. [1.5 points]

PART B

Question 14

Page 2 of 2



Item ID



Dave and Jessie are both working two jobs over the summer to earn some extra money.

For her two jobs, Jessie mows lawns and works at a restaurant. Like Dave, Jessie has weekly goals for the amount of money she earns and the number of hours she works. The system of linear inequalities shown below can be used to determine all the possible numbers of hours that she can mow lawns (x) and all the possible numbers of hours that she can work at the restaurant (y) and meet her weekly goals.

$$\begin{aligned}x + y &< 20 \\ 12x + 6y &\geq 175\end{aligned}$$

Jessie works only a whole number of hours at each job.

B. Identify an ordered pair that is a solution to this system of inequalities.

Within the context of the situation, explain what each coordinate of your ordered pair represents and why this ordered pair is a solution to the system of inequalities.

EQ

x = # of hours she can mow lawns
 y = # of hours she can work at the restaurant.

$12(10) + 6(9.5)$ is greater than or equal to 175.

$$12(10) + 6(9.5) = 177$$

$10 + 9.5 = 19.5$ is less than or equal to 20.

$(10, 9.5)$

Jessie mowed the lawn for 10 hours, and she worked at the restaurant for 9.5 hours.

This ordered pair is a solution to the system of inequalities because 19.5 is less than 20 and 177 is greater than or equal to 175.

417 / 1000

Review/End Test

Pause

Flag

Options

Back

Next

Part B: The student provided an ordered pair that is acceptable for partial credit $[(10, 9.5)]$; although $(10, 9.5)$ is a solution of the system of inequalities, the coordinates of the ordered pair are not both whole numbers. The student substituted the values for x and y into both inequalities [$12(10) + 6(9.5)$ is greater than or equal to 175. $12(10) + 6(9.5) = 177$ and $10 + 9.5 = 19.5$ is less than or equal to 20.]. The student also provided a correct and complete explanation (Jessie mowed the lawn for 10 hours, and she worked at the restaurant for 9.5 hours. This ordered pair is a solution to the system of inequalities because 19.5 is less than 20 and 177 is greater than or equal to 175.). [1.5 points]

STUDENT RESPONSE

Response Score: 2 points

14. Dave and Jessie are both working two jobs over the summer to earn some extra money.

For his two jobs, Dave walks dogs and babysits. He earns \$7 per hour walking dogs and \$10 per hour babysitting. Dave has a weekly goal of earning more than \$150 while working no more than 18 hours.

- A. Write a system of linear inequalities that can be used to determine all the possible numbers of hours Dave can work each job and meet his weekly goals.

Show or explain whether the ordered pair (8, 8) is a possible solution to this situation.

$$x + y \leq 18$$
$$7x + 10y > 150$$

The ordered pair (8,8) is a possible solution because $8 + 8 \leq 18$ is equal to $16 \leq 18$ and $7(8) + 10(8) > 150$ is equal to $136 > 150$. And 136 represents number of hrs per day.

Part A: The student provided two correct inequalities for the system of inequalities ($x + y \leq 18$ and $7x + 10y > 150$). The student provided an explanation with an incorrect conclusion [*The ordered pair (8, 8) is a possible solution because $8 + 8 \leq 18$ is equal to $16 \leq 18$ and $7(8) + 10(8) > 150$ is equal to $136 > 150$. And 136 represents number of hrs per day.*]. The student's conclusion that (8, 8) is a possible solution is incorrect because 136 is not greater than 150. [1.5 points]

Go to the next page to finish question 14.

GO ON 

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

For her two jobs, Jessie mows lawns and works at a restaurant. Like Dave, Jessie has weekly goals for the amount of money she earns and the number of hours she works. The system of linear inequalities shown below can be used to determine all the possible numbers of hours that she can mow lawns (x) and all the possible numbers of hours that she can work at the restaurant (y) and meet her weekly goals.

$$x + y < 20$$

$$12x + 6y \geq 175$$

Jessie works only a whole number of hours at each job.

B. Identify an ordered pair that is a solution to this system of inequalities.

Within the context of the situation, explain what each coordinate of your ordered pair represents and why this ordered pair is a solution to the system of inequalities.

$(10, 10)$
 $x = 10$ hrs of mowing the lawn
 $y = 10$ hrs of working at the restaurant,

Part B: The student provided an incorrect ordered pair $[(10, 10)]$, since $(10, 10)$ is not a solution of the first inequality: $10 + 10 = 20$, and 20 is not less than 20. To be a solution of the system of inequalities, the ordered pair must be a solution of both inequalities. The student provided a correct but incomplete explanation. The student correctly identified the variables ($x = 10$ hrs of mowing the lawn and $y = 10$ hrs of working at the restaurant.) but did not explain why the ordered pair $(10, 10)$ is a solution of the system of inequalities. [0.5 points]

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



STUDENT RESPONSE

Response Score: 1 point



PART A

Question 14
Page 1 of 2

Line Guide

Item ID ?

Dave and Jessie are both working two jobs over the summer to earn some extra money.

For his two jobs, Dave walks dogs and babysits. He earns \$7 per hour walking dogs and \$10 per hour babysitting. Dave has a weekly goal of earning more than \$150 while working no more than 18 hours.

A. Write a system of linear inequalities that can be used to determine all the possible numbers of hours Dave can work each job and meet his weekly goals.

Show or explain whether the ordered pair (8, 8) is a possible solution to this situation.

EQ

$$7x + 10y = \$150$$

$$7(8) + 10(8) = 136$$

which wouldnt work cause it doesn't meet his goal.

86 / 1000

Review/End Test Pause Flag Options Next

Part A: The student did not provide a system of inequalities; instead, the student provided a single equation representing a goal of earning \$150 ($7x + 10y = \150). The student also provided correct and complete support. The student first substituted the ordered pair (8, 8) into the left side of the equation [$7(8) + 10(8) = 136$]. The student then correctly explained that this amount fails to meet the goal of earning more than \$150 (*which wouldnt work cause it doesn't meet his goal*). [1 point]

PART B

Question 14

Page 2 of 2



Item ID



Dave and Jessie are both working two jobs over the summer to earn some extra money.

For her two jobs, Jessie mows lawns and works at a restaurant. Like Dave, Jessie has weekly goals for the amount of money she earns and the number of hours she works. The system of linear inequalities shown below can be used to determine all the possible numbers of hours that she can mow lawns (x) and all the possible numbers of hours that she can work at the restaurant (y) and meet her weekly goals.

$$\begin{aligned}x + y &< 20 \\ 12x + 6y &\geq 175\end{aligned}$$

Jessie works only a whole number of hours at each job.

B. Identify an ordered pair that is a solution to this system of inequalities.

Within the context of the situation, explain what each coordinate of your ordered pair represents and why this ordered pair is a solution to the system of inequalities.

EQ

They add up to 175

18 / 1000

Review/End Test

Pause

Flag

Options

Back

Next

Part B: The student did not provide an ordered pair as a solution of the system of inequalities. The student provided an incorrect explanation (*They add up to 175*). The explanation is incorrect because the coordinates of the ordered pair should add up to a value that is less than 20. [0 points]

STUDENT RESPONSE

Response Score: 0 points

14. Dave and Jessie are both working two jobs over the summer to earn some extra money.

For his two jobs, Dave walks dogs and babysits. He earns \$7 per hour walking dogs and \$10 per hour babysitting. Dave has a weekly goal of earning more than \$150 while working no more than 18 hours.

- A. Write a system of linear inequalities that can be used to determine all the possible numbers of hours Dave can work each job and meet his weekly goals.

Show or explain whether the ordered pair $(8, 8)$ is a possible solution to this situation.

the ordered pair $(8, 8)$ would not work because Dave would make less than \$150.

Part A: The student did not provide a system of inequalities. The student provided an incorrect explanation. Although the student provided a conclusion that is true [*the ordered pair $(8, 8)$ would not work because Dave would make less than \$150.*], the statement by itself does not show or explain why the ordered pair $(8, 8)$ is not a possible solution. To earn full credit, the student needed to demonstrate that Dave would earn only \$136, which is not more than \$150. [0 points]

Go to the next page to finish question 14.



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

For her two jobs, Jessie mows lawns and works at a restaurant. Like Dave, Jessie has weekly goals for the amount of money she earns and the number of hours she works. The system of linear inequalities shown below can be used to determine all the possible numbers of hours that she can mow lawns (x) and all the possible numbers of hours that she can work at the restaurant (y) and meet her weekly goals.

$$x + y < 20$$

$$12x + 6y \geq 175$$

Jessie works only a whole number of hours at each job.

- B.** Identify an ordered pair that is a solution to this system of inequalities.

Within the context of the situation, explain what each coordinate of your ordered pair represents and why this ordered pair is a solution to the system of inequalities.

The order pair is (12, 8) this represents the hours for each job. this shows the possible hours she can work.

Part B: The student provided an incorrect ordered pair [*The order pair is (12, 8)*], since (12, 8) is not a solution of the first inequality: $12 + 8 = 20$, and 20 is not less than 20. To be a solution of the system of inequalities, the ordered pair must be a solution of both inequalities. The student provided an incorrect explanation (*this represents the hours for each job. this shows the possible hours she can work.*). The explanation is incorrect because the student did not provide any coordinate identification or any distinction between the two jobs. [0 points]

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



ALGEBRA I MODULE 1—SUMMARY DATA

Multiple-Choice

Sample Number	Alignment	Answer Key	Depth of Knowledge	p-value A	p-value B	p-value C	p-value D
1	A1.1.1.2.1	B	1	33%	48%	10%	9%
2	A1.1.1.3.1	A	2	51%	22%	12%	15%
3	A1.1.1.4.1	C	2	15%	36%	45%	4%
4	A1.1.1.5.1	B	1	24%	55%	10%	11%
5	A1.1.2.1.1	A	2	82%	9%	7%	2%
6	A1.1.2.1.2	C	2	16%	28%	41%	15%
7	A1.1.2.1.3	C	2	14%	14%	57%	15%
8	A1.1.2.2.2	D	2	6%	7%	7%	80%
9	A1.1.3.1.1	C	2	9%	16%	71%	4%
10	A1.1.3.1.2	B	1	13%	72%	6%	9%
11	A1.1.3.2.1	D	2	24%	11%	15%	50%
12	A1.1.3.2.2	B	2	17%	59%	11%	13%

Constructed-Response

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
13	A1.1.1	4	2	1.25
14	A1.1.3	4	2	1.62

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ALGEBRA I MODULE 2

MULTIPLE-CHOICE ITEMS

1. Clara opens a bank account with some money. After opening the account, she deposits the same amount of money each week. She does not withdraw any money from the account. The list below shows how much money Clara has in her bank account at the end of each of the first four weeks.

\$214, \$228, \$242, \$256

The pattern continues. Which expression represents how much money, in dollars, Clara has in her bank account at the end of n weeks?

- A. $200 + 14n$
- B. $214 + 14n$
- C. $200n + 14$
- D. $214n + 14$

Item Information	
Alignment	A1.2.1.1.1
Answer Key	A
Depth of Knowledge	2
p -value A	50% (correct answer)
p -value B	35%
p -value C	7%
p -value D	8%
Option Annotations	<p>A student could determine the correct answer, option A, by using the pattern to determine the rate of change (14), recognizing that the first term in the pattern represents $n = 1$, and using the equation $b + 14(1) = 214$ to find the initial value by subtracting 14 from each side, resulting in an initial value of $b = 200$, which leads to the expression $200 + 14n$.</p> <p>A student could arrive at an incorrect answer by incorrectly determining the initial value or by multiplying the initial value by the term number. For example, a student could arrive at option B by determining the correct rate of change (14) but then using the first term in the pattern as the initial value.</p>

2. Each week, Erica measures the height of a plant she is growing. The table below shows her measurements.

Erica's Plant

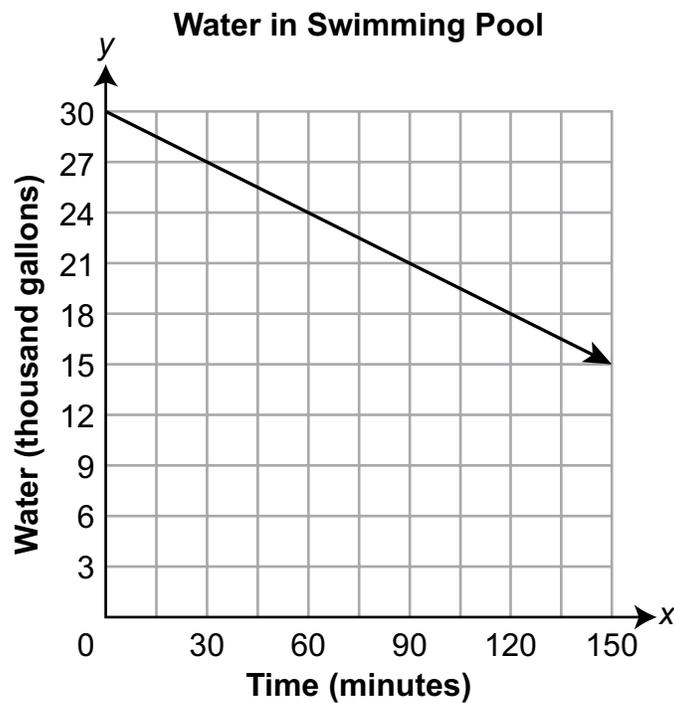
Week	Height (cm)
1	3
2	4
3	5
4	7
5	10
6	11

What does the domain of this relation represent?

- A. the heights, in centimeters, of the plant
- B. the rate at which the plant grew between measurements
- C. the numbers of the weeks during which Erica recorded the heights of the plant
- D. the height, in centimeters, of the plant 1 week before Erica made her first measurement

Item Information	
Alignment	A1.2.1.1.3
Answer Key	C
Depth of Knowledge	1
p-value A	15%
p-value B	19%
p-value C	61% (correct answer)
p-value D	5%
Option Annotations	<p>A student could determine the correct answer, option C, by recognizing that the domain of the relation is the independent variable and understanding that the height of the plant is dependent on the number of weeks, making the number of weeks the independent variable.</p> <p>A student could arrive at an incorrect answer by misinterpreting the domain as the dependent variable, the rate of change, or the initial value. For example, a student could arrive at option B by misinterpreting the domain as representing the rate of change by which the plant grew each week.</p>

3. A swimming pool holds 30,000 gallons of water. The graph shown below represents the amount of water, in gallons, in the swimming pool as the pool is being drained.

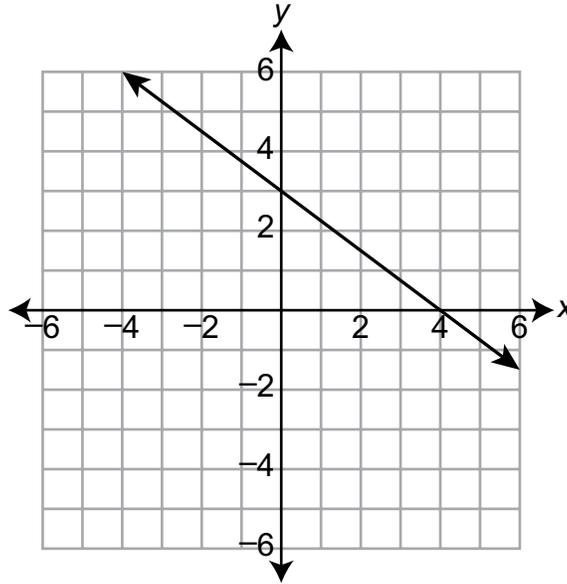


How much time, in minutes, does it take for the swimming pool to be completely drained?

- A. 100
- B. 300
- C. 900
- D. 1,000

Item Information	
Alignment	A1.2.1.2.1
Answer Key	B
Depth of Knowledge	2
p-value A	6%
p-value B	77% (correct answer)
p-value C	9%
p-value D	8%
Option Annotations	<p>A student could determine the correct answer, option B, by determining that the water is draining from the pool at a rate of 100 gallons per minute $\left(\frac{30,000 - 27,000}{30 - 0} = \frac{3,000}{30} = 100\right)$ and then dividing the total amount of water (30,000 gallons) by the rate: $30,000 \div 100 = 300$.</p> <p>A student could arrive at an incorrect answer by miscalculating the rate of change. For example, a student could arrive at option C by not applying the scale of the y-axis, determining that the water is draining from the pool at a rate of 1 gallon every 30 minutes, starting with 30 gallons rather than 30,000 gallons, and then determining the amount of time by dividing 30 by $\frac{1}{30}$, resulting in a quotient of 900 minutes.</p>

4. A function of x is graphed on the coordinate plane shown below.



Which equation describes the function of x ?

- A. $f(x) = \frac{-3}{4}x + 3$
- B. $f(x) = \frac{-3}{4}x + 4$
- C. $f(x) = \frac{-4}{3}x + 3$
- D. $f(x) = \frac{-4}{3}x + 4$

Item Information	
Alignment	A1.2.1.2.2
Answer Key	A
Depth of Knowledge	1
p-value A	69% (correct answer)
p-value B	15%
p-value C	10%
p-value D	6%
Option Annotations	<p>A student could determine the correct answer, option A, by determining the slope using the change in y-coordinates divided by the change in x-coordinates (rise over run), resulting in $m = \frac{0 - 3}{4 - 0} = \frac{-3}{4}$; identifying the y-intercept as (0, 3); and then substituting these values into the equation $y = mx + b$.</p> <p>A student could arrive at an incorrect answer by inverting the slope or by using the x-intercept rather than the y-intercept. For example, a student could arrive at option B by substituting the x-intercept (4) in for b into the equation $y = mx + b$.</p>

5. Dana reads a certain book at an average rate of 2 pages every 3 minutes. The fourth chapter of the book is 28 pages. Based on his average rate, how many minutes will it take Dana to read the fourth chapter of the book?
- A. $9\frac{1}{3}$
- B. $18\frac{2}{3}$
- C. 42
- D. 84

Item Information	
Alignment	A1.2.2.1.1
Answer Key	C
Depth of Knowledge	1
p-value A	12%
p-value B	14%
p-value C	65% (correct answer)
p-value D	9%
Option Annotations	<p>A student could determine the correct answer, option C, by determining the rate as 1.5 minutes per page ($3 \div 2 = 1.5$) and then multiplying that rate by the number of pages (28).</p> <p>A student could arrive at an incorrect answer by using the number of pages per minute as the rate or by setting up a proportion incorrectly. For example, a student could arrive at option B by using the number of pages per minute ($2 \div 3 = \frac{2}{3}$) as the rate and then multiplying that rate by the number of pages (28).</p>

6. Marty is exercising.

- After exercising, his heart rate is 168 beats per minute.
- His heart rate decreases at a constant rate of 4 beats per minute until it reaches his resting heart rate.
- Marty's resting heart rate is 72 beats per minute.

How many minutes after exercising will it be until Marty's heart rate returns to his resting heart rate?

- A. 18
- B. 24
- C. 30
- D. 60

Item Information	
Alignment	A1.2.2.1.2
Answer Key	B
Depth of Knowledge	2
p-value A	13%
p-value B	74% (correct answer)
p-value C	8%
p-value D	5%
Option Annotations	<p>A student could determine the correct answer, option B, by either subtracting the resting heart rate (72) from the heart rate after exercising (168) and then dividing the difference (96 beats per minute) by 4, resulting in 24 beats per minute OR by representing the situation with the equation $168 - 4m = 72$ and then solving for m by subtracting 168 from both sides of the equation and then dividing both sides of the equation by -4 ($168 - 4m = 72 \rightarrow -4m = -96 \rightarrow m = 24$).</p> <p>A student could arrive at an incorrect answer by misapplying the numbers or by not using all the given information. For example, a student could arrive at option A by dividing the resting heart rate (72) by the constant rate of change (4) without considering the heart rate after exercising (168).</p>

7. The graph of a linear function has a slope of $-\frac{1}{4}$ and contains the point (8, 12). What is the equation of the line?
- A. $y = -\frac{1}{4}x - 10$
- B. $y = -\frac{1}{4}x - 5$
- C. $y = -\frac{1}{4}x + 11$
- D. $y = -\frac{1}{4}x + 14$

Item Information	
Alignment	A1.2.2.1.3
Answer Key	D
Depth of Knowledge	1
p-value A	13%
p-value B	11%
p-value C	18%
p-value D	58% (correct answer)

Item Information

Option Annotations

A student could determine the **correct** answer, option D, either by substituting the given slope of $-\frac{1}{4}$ in for m , the x -coordinate (8) in for x_1 , and the y -coordinate (12) in for y_1 into the point-slope form $[y - y_1 = m(x - x_1)]$ to set up the equation $y - 12 = -\frac{1}{4}(x - 8)$ and then solving for y : $y - 12 = -\frac{1}{4}(x - 8) \rightarrow y = -\frac{1}{4}x - \frac{1}{4}(8) + 12 \rightarrow y = -\frac{1}{4}x + 2 + 12 \rightarrow y = -\frac{1}{4}x + 14$, OR by substituting the given slope of $-\frac{1}{4}$ in for m , the x -coordinate (8) in for x , and the y -coordinate (12) in for y into the slope-intercept form $[y = mx + b]$ to set up the equation $12 = -\frac{1}{4}(8) + b$ and then solving for b : $12 = -2 + b \rightarrow 14 = b \rightarrow y = -\frac{1}{4}x + 14$.

A student could arrive at an **incorrect** answer by reversing the coordinates of the ordered pair when substituting into the point-slope form or by misapplying arithmetic properties when solving for y . For example, a student could arrive at option C by reversing the coordinates from the ordered pair, substituting 12 in for x_1 and 8 in for y_1 to set up the equation $y - 8 = -\frac{1}{4}(x - 12)$, and then solving for y .

8. A satellite is traveling in an orbit around Earth. Its altitude begins to decrease at a constant rate until the satellite reenters Earth's atmosphere. The equation shown below can be used to determine the satellite's altitude (y), in kilometers, x months after its altitude began to decrease.

$$y = 17,600 - 23x$$

Which statement about the satellite is true?

- A. The satellite was at an altitude of 17,600 kilometers before its altitude began to decrease.
- B. The satellite will reenter Earth's atmosphere 23 months after its altitude began to decrease.
- C. The satellite was traveling at a rate of 17,600 kilometers per hour before its altitude began to decrease.
- D. The satellite has been slowing down at a rate of 23 kilometers per hour since its altitude began to decrease.

Item Information	
Alignment	A1.2.2.1.4
Answer Key	A
Depth of Knowledge	2
p -value A	59% (correct answer)
p -value B	12%
p -value C	14%
p -value D	15%
Option Annotations	<p>A student could determine the correct answer, option A, by recognizing that the y-intercept (17,600) represents the starting altitude, in kilometers, of the satellite.</p> <p>A student could arrive at an incorrect answer by misinterpreting what the values in the equation represent. For example, a student could arrive at option D by misinterpreting the slope as a speed decrease measured in kilometers per hour rather than an altitude decrease measured in kilometers per month.</p>

9. The list below describes the results, in minutes and seconds (m:s), of the 800-meter run during a track meet.
- The fastest time was 2:00.
 - The first quartile time was 2:15.
 - The third quartile time was 3:05.
 - The slowest time was 3:30.

Which statement about the results of the 800-meter run is **most likely** true?

- A. About half the times were between 2:00 and 2:40.
- B. About half the times were between 2:00 and 2:45.
- C. About one-fourth of the times were between 2:15 and 3:30.
- D. About one-fourth of the times were between 3:05 and 3:30.

Item Information	
Alignment	A1.2.3.1.1
Answer Key	D
Depth of Knowledge	1
p-value A	12%
p-value B	20%
p-value C	20%
p-value D	48% (correct answer)
Option Annotations	<p>A student could determine the correct answer, option D, by recognizing that the quartile values divide a data set into four subsets, with each subset including about one-fourth of the data points.</p> <p>A student could arrive at an incorrect answer by miscalculating a data point or by incorrectly interpreting the meaning of a quartile. For example, a student could arrive at option B by knowing that about half the times should be between the fastest time and the median time but considering the median time to be the midpoint between the fastest and slowest times rather than being the average of the middle two times (which are not provided).</p>

10. There are 8 members in a running group. Last week, the group ran a mean distance of 33 miles and a median distance of 32 miles. The distances, in miles, that five of the members ran last week are shown below.

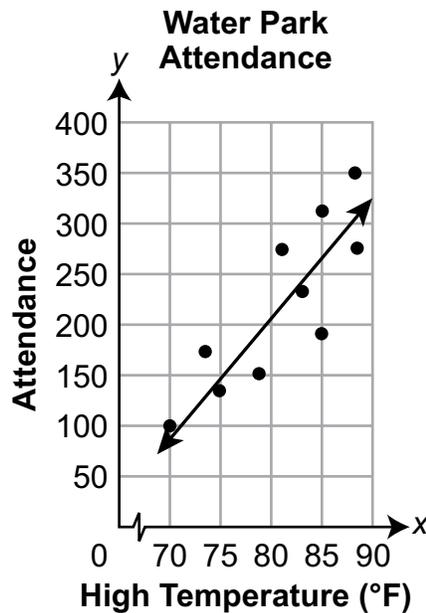
25 44 23 32 26

Which list could show the distances, in miles, that the other three members ran last week?

- A. 32 37 45
- B. 32 45 48
- C. 34 34 38
- D. 30 36 48

Item Information	
Alignment	A1.2.3.2.2
Answer Key	A
Depth of Knowledge	2
p-value A	59% (correct answer)
p-value B	13%
p-value C	14%
p-value D	14%
Option Annotations	<p>A student could determine the correct answer, option A, by recognizing that the median distance (32 miles) must be the average of the two middle numbers in the list and the mean distance (33 miles) can be found by adding the 8 distances together and dividing the sum by 8. When the given numbers are ordered from least to greatest (23, 25, 26, 32, 44), the first number in each answer choice and the 32 in the given list represent the middle two numbers, so the potential medians can be found by determining the average of these pairs. Subtracting the sum of the given numbers ($25 + 44 + 23 + 32 + 26 = 150$) from the total miles given by a mean of 33 over 8 values ($33 \cdot 8 = 264$) reveals that the list of numbers in the correct answer choice should have a sum of 114 ($264 - 150 = 114$). Of the given answer choices, only option A has the correct potential median [$(32 + 32) \div 2 = 32$] and the correct sum ($32 + 37 + 45 = 114$).</p> <p>A student could arrive at an incorrect answer by misinterpreting the meanings of median and mean. For example, a student could arrive at option C by switching the mean and median values, finding a sum that would result in a mean of 32 miles ($34 + 34 + 38 + 150 = 256$ and $256 \div 8 = 32$) and finding a median of 33 miles [$(32 + 34) \div 2 = 33$].</p>

11. The scatter plot shown below represents the relationship between the high temperature, in degrees Fahrenheit ($^{\circ}\text{F}$), and the attendance at a water park for that day.



Based on the line of best fit, which value is **most likely** the attendance at the water park on a day when the high temperature is 95°F ?

- A. 320
- B. 380
- C. 440
- D. 500

Item Information	
Alignment	A1.2.3.2.3
Answer Key	B
Depth of Knowledge	2
p-value A	11%
p-value B	73% (correct answer)
p-value C	13%
p-value D	3%
Option Annotations	<p>A student could determine the correct answer, option B, by observing that the rate of change is a little more than 50 people for every 5-degree increase (as seen from 75°F to 80°F), noting that the y-value for 90°F is about halfway between 300 and 350, and then applying the rate of change, resulting in a value between 350 and 400. Of the given answer choices, only 380 is between 350 and 400.</p> <p>A student could arrive at an incorrect answer by extending the graph to a temperature other than 95°F. For example, a student could arrive at option C by extending the graph by two more grid lines, which would represent 100°F, and then applying the rate of change, resulting in a value between 400 and 450.</p>

12. For a store's grand opening, the first 800 customers to enter the store receive a coupon for 10% off, 20% off, or 30% off their entire purchase. The coupons are distributed randomly. The table below shows the number of each type of coupon that will be distributed.

Grand Opening

Coupon Value	Number of Coupons
10% off	525
20% off	225
30% off	50

Which expression shows how to find the probability that the first three customers to enter the store each receive a coupon for 30% off?

- A. $\frac{50}{800} + \frac{50}{800} + \frac{50}{800}$
- B. $\frac{50}{800} + \frac{49}{799} + \frac{48}{798}$
- C. $\frac{50}{800} \cdot \frac{50}{800} \cdot \frac{50}{800}$
- D. $\frac{50}{800} \cdot \frac{49}{799} \cdot \frac{48}{798}$

Item Information	
Alignment	A1.2.3.3.1
Answer Key	D
Depth of Knowledge	2
p -value A	18%
p -value B	26%
p -value C	16%
p -value D	40% (correct answer)
Option Annotations	<p>A student could determine the correct answer, option D, by recognizing that the total number of 30%-off coupons and the total number of coupons will both decrease by one each time a 30%-off coupon is given to a customer and that the probabilities for these events must be multiplied to determine the probability for the compound event.</p> <p>A student could arrive at an incorrect answer by not subtracting 1 each time a 30%-off coupon is given to a customer and/or by adding the three probabilities. For example, a student could arrive at option B by recognizing that the total number of 30%-off coupons and the total number of coupons will both decrease by one each time but then adding the probabilities for these events rather than multiplying them.</p>

CONSTRUCTED-RESPONSE ITEM

13. Perform the indicated operations.

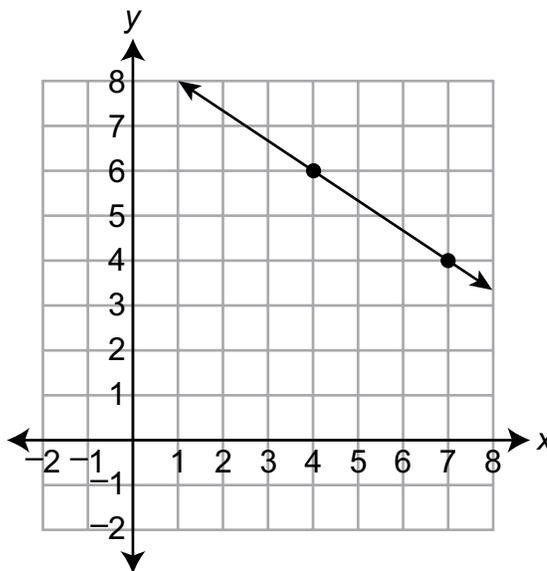
The table below shows some values of a linear function.

x	y
4	10
9	?
12	16
20	22

A. What is the missing value in the table?

missing value: _____

A linear function is graphed below.



B. What is the y -value of the function when the x -value is -5 ?

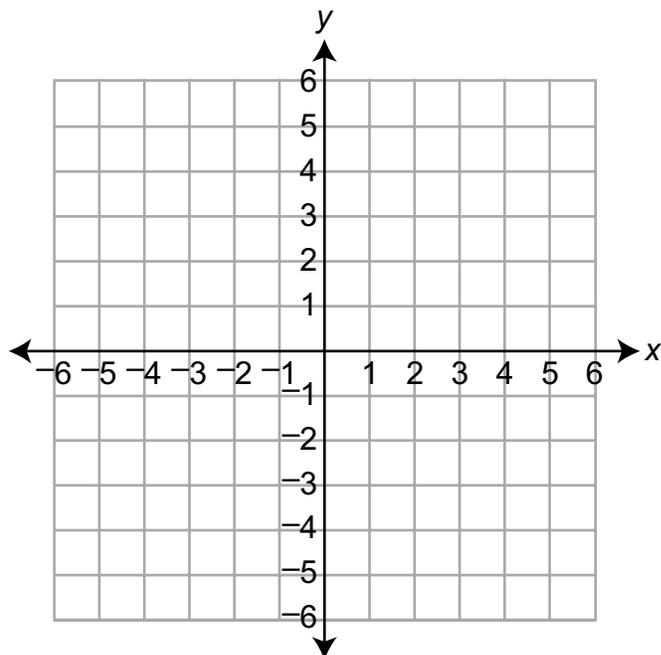
y -value: _____

Go to the next page to finish question 13.



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

C. On the coordinate plane shown below, graph the linear function $y = \frac{-2}{3}x - 3$.



A linear function of x is shown in the table below, but the y -values have been replaced with expressions using a constant k .

x	y
1	k
2	$k - 3$
3	$2k$

D. What is the value of the constant k ?

$k =$ _____

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



Item-Specific Scoring Guideline

#13 Item Information

Alignment	A1.2.1	Depth of Knowledge	2	Mean Score	1.22
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Assessment Anchor this item will be reported under:

A1.2.1—Functions

Specific Anchor Descriptor addressed by this item:

A1.2.1.1—Analyze and/or use patterns or relations.

A1.2.1.2—Interpret and/or use linear functions and their equations, graphs, or tables.

Scoring Guide

Score	Description
4	The student demonstrates a thorough understanding of functions by correctly solving problems with clear and complete procedures and explanations when required.
3	The student demonstrates a general understanding of functions by solving problems and providing procedures and explanations with only minor errors or omissions.
2	The student demonstrates a partial understanding of functions by providing a portion of the correct problem solving, procedures, and explanations.
1	The student demonstrates a minimal understanding of functions.
0	The response has no correct answer and insufficient evidence to demonstrate any understanding of the mathematical concepts and procedures as required by the task. Response may show only information copied from the question.

Top-Scoring Student Response and Training Notes

Score	Description
4	Student earns 4 points.
3	Student earns 3 points.
2	Student earns 2 points.
1	Student earns 1 point.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.

Top-Scoring Response**Part A (1 point):**

1 point for correct answer

What?	Why?
13.75 OR equivalent	

Part B (1 point):

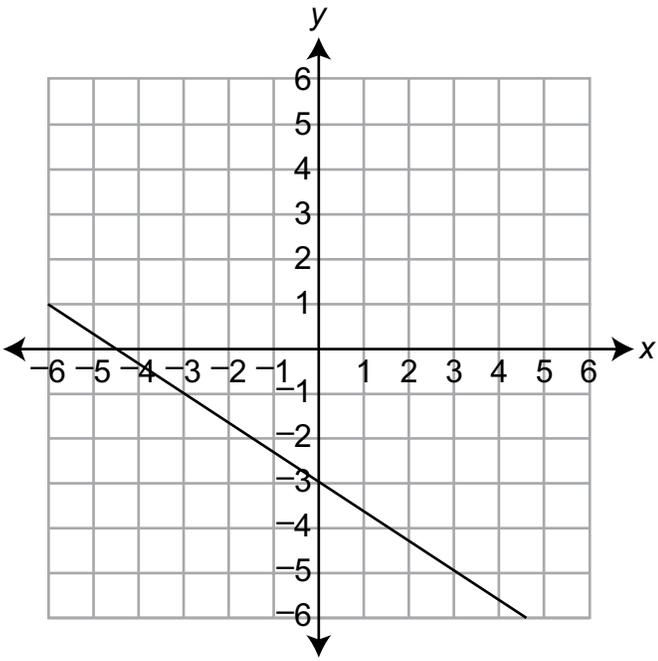
1 point for correct answer

What?	Why?
12	

Part C (1 point):

1 point for correct answer

Note: accept as correct regardless of arrowheads being present, and accept if line goes through at least two correct points— $(-6, 1)$, $(-3, -1)$, $(0, -3)$, $(3, -5)$

What?	Why?
	

Part D (1 point):

1 point for correct answer

What?	Why?
-6	

STUDENT RESPONSE

Response Score: 4 points

13. Perform the indicated operations.

The table below shows some values of a

x
4
9
12
20

A. What is the missing value in the table

missing value: 13.75

Part A: The student provided the correct answer (13.75).

While support is not required for Part A, the student likely found an equation for the linear function by first calculating the slope by using the formula $m = \frac{y_2 - y_1}{x_2 - x_1}$ and substituting two pairs of values for x and y from the table (e.g., $m = \frac{22 - 10}{20 - 4} = \frac{12}{16} = \frac{3}{4} = 0.75$). The student could have then used the slope-intercept form ($y = mx + b$) and substituted the slope in for m , resulting in the equation $y = 0.75x + b$. The student could have then determined the value of b by substituting one pair of values for x and y from the table into the equation [e.g., $22 = 0.75(20) + b \rightarrow 22 = 15 + b \rightarrow 7 = b$], resulting in the equation $y = 0.75x + 7$. The student could have then substituted 9 in for x and solved for y to find the missing value: $y = 0.75(9) + 7 = 6.75 + 7 = 13.75$. [1 point]

A linear function is graphed below.



B. What is the y-value of the function w

y-value: 12

Part B: The student provided the correct answer (12). While

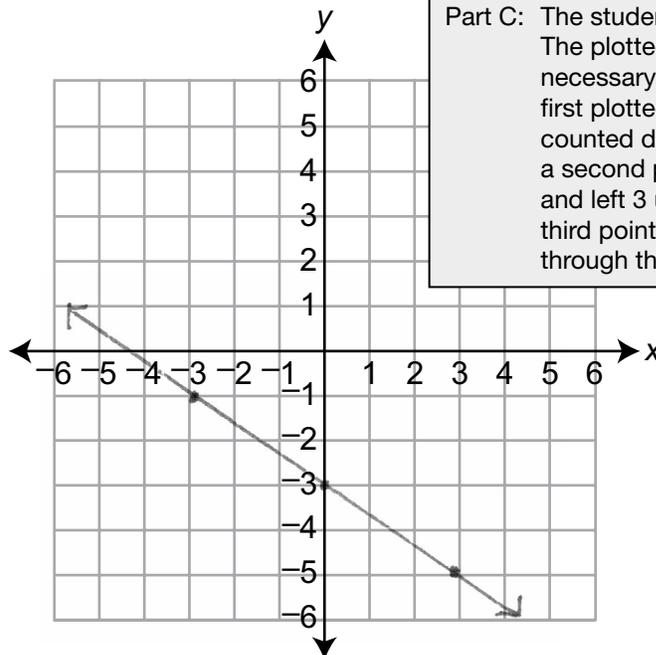
support is not required for Part B, the student likely found an equation for the linear function by first calculating the slope using the formula $m = \frac{y_2 - y_1}{x_2 - x_1}$ and substituting the coordinates of the two points plotted on the graph: $m = \frac{4 - 6}{7 - 4} = \frac{-2}{3}$. The student could have then used the point-slope form [$y - y_1 = m(x - x_1)$] and substituted the slope in for m and the coordinates of either point for x_1 and y_1 [e.g., $y - 4 = \frac{-2}{3}(x - 7) \rightarrow y = \frac{-2}{3}x - \frac{-14}{3} + 4 \rightarrow y = \frac{-2}{3}x + \frac{26}{3}$]. The student could have then substituted -5 in for x and solved for y to find the missing value: $y = \frac{-2}{3}(-5) + \frac{26}{3} = \frac{10}{3} + \frac{26}{3} = \frac{36}{3} = 12$. [1 point]

Go to the next page to finish question 13.



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

C. On the coordinate plane shown below, graph the linear function $y = \frac{-2}{3}x - 3$.



Part C: The student provided a correctly graphed line. The plotted points are correct, though not necessary for credit. The student may have first plotted a point for the y -intercept at $(0, -3)$, counted down 2 units and right 3 units to plot a second point at $(3, -5)$, counted up 2 units and left 3 units from the y -intercept to plot a third point at $(-3, -1)$, and then graphed a line through these three plotted points. [1 point]

A linear function of x is shown in the table below, but the y -values are replaced with expressions using a constant k .

x	y
1	k
2	$k - 3$
3	$2k$

D. What is the value of the constant k ?

$k = \underline{\quad -6 \quad}$

Part D: The student provided the correct answer (-6) . While support is not required for Part D, the student likely first determined the slope two different ways using the formula $m = \frac{y_2 - y_1}{x_2 - x_1}$ and substituting two different pairs of values for x and y from the table

$$\text{[e.g., } m = \frac{2k - k}{3 - 1} = \frac{k}{2} \text{ and } m = \frac{(k - 3) - k}{2 - 1} = \frac{-3}{1} = -3\text{].}$$

The student could have then set the slopes equal to each other and solved for k :

$$\frac{k}{2} = -3 \rightarrow k = -6. \text{ [1 point]}$$

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



STUDENT RESPONSE

Response Score: 3 points



PART A

Question 13
Page 1 of 4

Perform the indicated operations.

The table below shows some values of a linear function.

x	y
4	10
9	?
12	16
20	22

A. What is the missing value in the table?

missing value:

5 / 50

Review/End Test Pause Flag Options Next

Part A: The student provided the correct answer (13.75). While support is not required for Part A, the student likely found an equation for the linear function by first calculating the slope by using the formula $m = \frac{y_2 - y_1}{x_2 - x_1}$ and substituting two pairs of values for x and y from the table (e.g., $m = \frac{22 - 16}{20 - 12} = \frac{6}{8} = \frac{3}{4} = 0.75$). The student could have then used the slope-intercept form ($y = mx + b$) and substituted the slope in for m , resulting in the equation $y = 0.75x + b$. The student could have then determined the value of b by substituting one pair of values for x and y from the table into the equation [e.g., $10 = 0.75(4) + b \rightarrow 10 = 3 + b \rightarrow 7 = b$], resulting in the equation $y = 0.75x + 7$. The student could have then substituted 9 in for x and solved for y to find the missing value: $y = 0.75(9) + 7 = 6.75 + 7 = 13.75$.

[1 point]

PART B

Question 13

Page 2 of 4

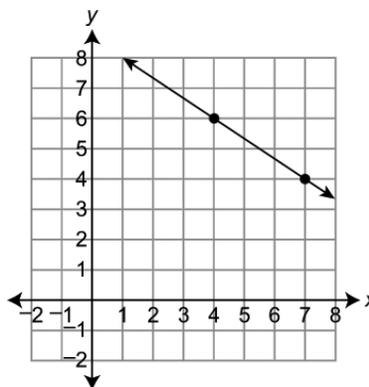


Item ID



Perform the indicated operations.

A linear function is graphed below.

B. What is the y-value of the function when the x-value is -5 ?

y-value:

5.4

3 / 50

Review/End Test

Pause

Flag

Options

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Next

Part B: The student provided an incorrect answer (5.4). No support (work or explanation) is required, so it is unclear where an error was made. The student may have attempted to find the y-value for $x = 5$ rather than $x = -5$. By using $x = 5$, the student would have looked at where the graphed line intersects the vertical grid line representing $x = 5$ and then approximated the y-value as 5.4 since the intersection is a little less than halfway between the horizontal grid lines representing $y = 5$ and $y = 6$. [0 points]

PART C

Question 13
Page 3 of 4

Perform the indicated operations.

C. On the coordinate plane shown below, graph the linear function $y = -\frac{2}{3}x - 3$.

Review/End Test Pause Flag Options Back Next

Part C: The student provided a correctly graphed line. While support is not required for Part C, the student likely drew the line by clicking on the y -intercept at $(0, -3)$ and then dragging the line until it had a slope of $-\frac{2}{3}$, passing through the ordered pair $(3, -5)$. Although the line does not pass through $(-6, 1)$ exactly, the line does pass through $(-3, -1)$ and $(3, -5)$, which is close enough for credit. [1 point]

PART D

Question 13
Page 4 of 4

Perform the indicated operations.

A linear function of x is shown in the table below, but the y -values have been replaced with expressions using a constant k .

x	y
1	k
2	$k - 3$
3	$2k$

D. What is the value of the constant k ?

$k = -6$

2 / 50

Review/End Test Pause Flag Options Back Next

Part D: The student provided the correct answer (-6). While support is not required for Part D, the student could have realized that since the x -values were equidistant (1, 2, 3), the y -values would also be equidistant, meaning that $k - 3$ would be equal to the average of k and $2k$, resulting in $\frac{k + 2k}{2} = k - 3 \rightarrow 3k = 2k - 6 \rightarrow k = -6$. [1 point]

STUDENT RESPONSE

Response Score: 2 points

13. Perform the indicated operations.

The table below shows some values of a linear function.

x	y
4	10
9	?
12	16
20	22

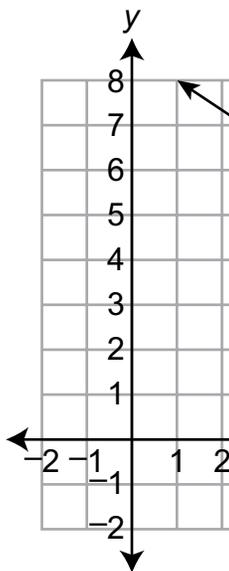
A. What is the missing value in the table?

missing value: 13

Part A: The student provided an incorrect answer (13). No support (work or explanation) is required, so it is unclear where an error was made. The student may have thought that the pairs of values in the table were equidistant and found the missing value by determining the average of the first and third y -values in the table:

$$\frac{10 + 16}{2} = \frac{26}{2} = 13. \text{ [0 points]}$$

A linear function is graphed below.



B. What is the y -value of the function

y -value: 12

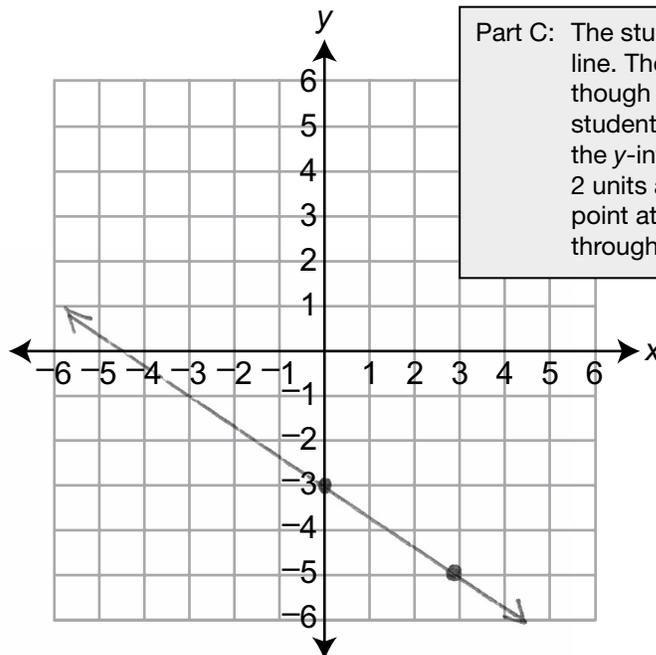
Part B: The student provided the correct answer (12). While support is not required for Part B, the student likely found an equation for the linear function by first calculating the slope by using the formula $m = \frac{y_2 - y_1}{x_2 - x_1}$ and substituting the coordinates of the two points plotted on the graph: $m = \frac{4 - 6}{7 - 4} = \frac{-2}{3}$. The student could have then used the slope-intercept form $[y = mx + b]$ and substituted the slope in for m and the coordinates of either point for x and y [e.g., $6 = \frac{-2}{3}(4) + b \rightarrow 6 = \frac{-8}{3} + b \rightarrow \frac{26}{3} = b \rightarrow y = \frac{-2}{3}x + \frac{26}{3}$]. The student could have then substituted -5 in for x and solved for y to find the missing value: $y = \frac{-2}{3}(-5) + \frac{26}{3} = \frac{10}{3} + \frac{26}{3} = \frac{36}{3} = 12$. [1 point]

Go to the next page to finish question 13.



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

C. On the coordinate plane shown below, graph the linear function $y = \frac{-2}{3}x - 3$.



Part C: The student provided a correctly graphed line. The plotted points are correct, though not necessary for credit. The student may have first plotted a point for the y-intercept at (0, -3), counted down 2 units and right 3 units to plot a second point at (3, -5), and then graphed a line through these two plotted points. [1 point]

A linear function of x is shown in the table below, but replaced with expressions using a constant k .

x	y
1	k
2	$k - 3$
3	$2k$

D. What is the value of the constant k ?

$$k = \underline{\quad -3 \quad}$$

Part D: The student provided an incorrect answer (-3). No support (work or explanation) is required, so it is unclear where an error was made. The student may have determined the slope (m) rather than the value of k , or the student may have thought that the relationship was proportional and that the value of k , which is the y -value for $x = 1$, would be the same as the slope. The student would have calculated the slope as

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{(k - 3) - k}{2 - 1} = \frac{-3}{1} = -3.$$

[0 points]

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



STUDENT RESPONSE

Response Score: 1 point



PART A

Question 13
Page 1 of 4

Perform the indicated operations.

The table below shows some values of a linear function.

x	y
4	10
9	?
12	16
20	22

A. What is the missing value in the table?

missing value:

2 / 50

Review/End Test Pause Flag Options Next

Part A: The student provided an incorrect answer (11). No support (work or explanation) is required, so it is unclear where an error was made. The student may have thought the y -values should be consecutive integers and added 1 to the first y -value in the table: $10 + 1 = 11$. [0 points]

PART B

Question 13

Page 2 of 4

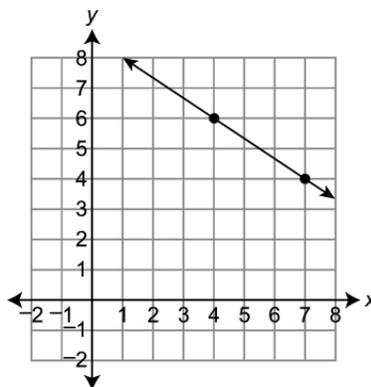


Item ID



Perform the indicated operations.

A linear function is graphed below.



B. What is the y-value of the function when the x-value is -5?

y-value:

12

2 / 50

Review/End Test

Pause

Flag

Options

Back

Next

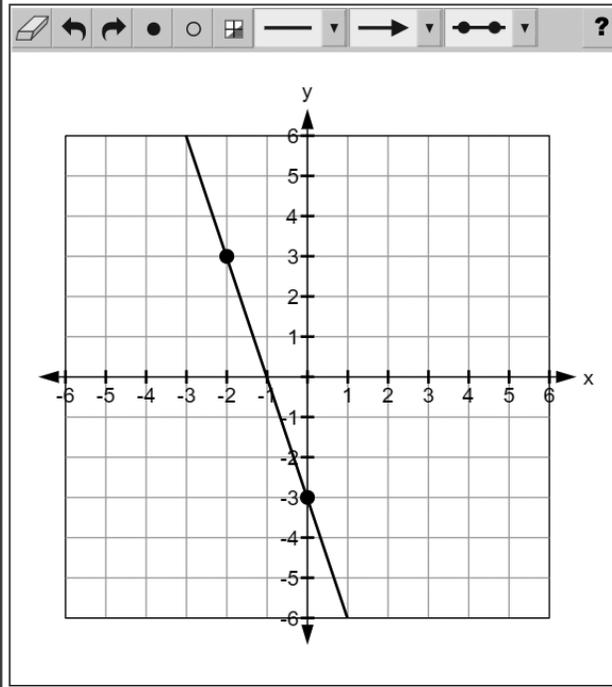
Part B: The student provided the correct answer (12). While support is not required for Part B, the student likely found an equation for the linear function by first calculating the slope using the formula $m = \frac{y_2 - y_1}{x_2 - x_1}$ and substituting the coordinates of the two points plotted on the graph: $m = \frac{4 - 6}{7 - 4} = \frac{-2}{3}$. The student could have then used the point-slope form $[y - y_1 = m(x - x_1)]$ and substituted the slope in for m and the coordinates of either point for x_1 and y_1 [e.g., $y - 4 = \frac{-2}{3}(x - 7) \rightarrow y = \frac{-2}{3}x - \frac{-14}{3} + 4 \rightarrow y = \frac{-2}{3}x + \frac{26}{3}$]. The student could have then substituted -5 in for x and solved for y to find the missing value: $y = \frac{-2}{3}(-5) + \frac{26}{3} = \frac{10}{3} + \frac{26}{3} = \frac{36}{3} = 12$. [1 point]

PART C

Question 13
Page 3 of 4

Item ID ?

Perform the indicated operations.

C. On the coordinate plane shown below, graph the linear function $y = -\frac{2}{3}x - 3$.

Review/End Test

Pause

Flag

Options

Back

Next

Part C: The student graphed an incorrect line. The student plotted two points, although they are not required or assessed. The student correctly plotted a point for the y -intercept at $(0, -3)$; however, the student incorrectly plotted a point at $(-2, 3)$. No support (work or explanation) is required, so it is unclear where an error was made. The student may have interpreted the slope of $-\frac{2}{3}$ as the ordered pair $(-2, 3)$ and plotted a point at that location. The student then graphed a line passing through these two plotted points. [0 points]

PART D

Question 13
Page 4 of 4

Perform the indicated operations.

A linear function of x is shown in the table below, but the y -values have been replaced with expressions using a constant k .

x	y
1	k
2	$k - 3$
3	$2k$

D. What is the value of the constant k ?

$k = 5$

1 / 50

Review/End Test Pause Flag Options Back Next

Part D: The student provided an incorrect answer (5). No support (work or explanation) is required, so it is unclear where an error was made. The student may have thought that the second y -value ($k - 3$) should be equal to the second x -value (2) and solved for k using the equation $k - 3 = 2$, resulting in $k = 5$. [0 points]

STUDENT RESPONSE

Response Score: 0 points

13. Perform the indicated operations.

The table below shows some values of a linear function.

x	y
4	10
9	?
12	16
20	22

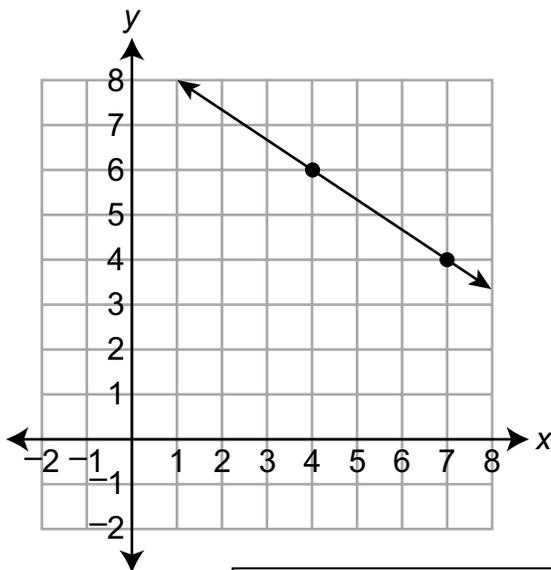
A. What is the missing value in the table?

missing value: 13

Part A: The student provided an incorrect answer (13). No support (work or explanation) is required, so it is unclear where an error was made. The student may have thought that the pairs of values in the table were equidistant and found the missing value by determining the average of the first and third y -values in the table:

$$\frac{10 + 16}{2} = \frac{26}{2} = 13. \text{ [0 points]}$$

A linear function is graphed below.



B. What is the y -value of the function

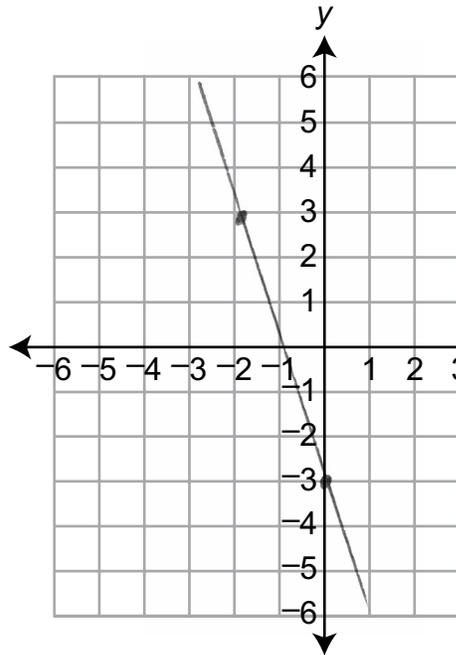
y -value: 5

Part B: The student provided an incorrect answer (5). No support (work or explanation) is required, so it is unclear where an error was made. The student may have attempted to find the y -value for $x = 5$ rather than $x = -5$. By using $x = 5$, the student would have looked at where the graphed line intersects the vertical grid line representing $x = 5$ and approximated the y -value as 5 since the intersection is close to the horizontal grid line representing $y = 5$. [0 points]

Go to the next page to finish question

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

C. On the coordinate plane shown below, graph the linear function $y = \frac{-2}{3}x - 3$.



Part C: The student graphed an incorrect line. The student plotted two points, although they are not required or assessed. The student correctly plotted a point for the y -intercept at $(0, -3)$; however, the student incorrectly plotted a point at $(-2, 3)$. No support (work or explanation) is required, so it is unclear where an error was made. The student may have interpreted the slope of $\frac{-2}{3}$ as the ordered pair $(-2, 3)$ and plotted a point at that location. The student then graphed a line passing through these two plotted points. [0 points]

A linear function of x is shown in the table below, but the y -values have been replaced with expressions using a constant k .

x	y
1	k
2	$k - 3$
3	$2k$

D. What is the value of the constant k ?

$$k = \underline{\quad 2 \quad}$$

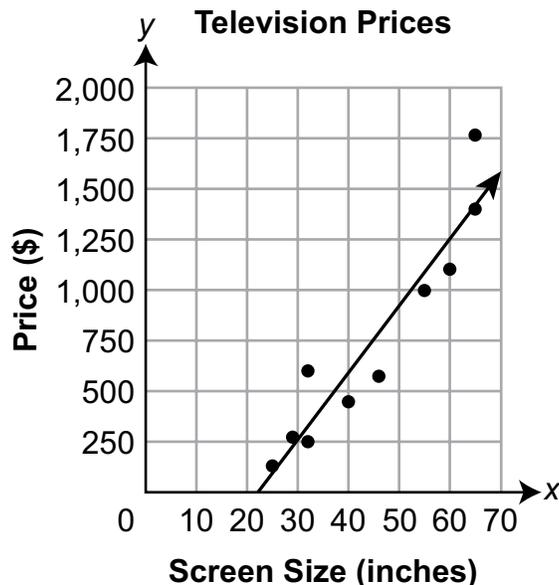
Part D: The student provided an incorrect answer (2). No support (work or explanation) is required, so it is unclear where an error was made. The student may have thought that the first y -value in the table (k) should be equal to the second x -value (2). [0 points]

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



CONSTRUCTED-RESPONSE ITEM

14. The scatter plot shown below shows the relation between the screen size of a new television and the price of the television.



A line of best fit is also shown on the scatter plot. The equation for the line of best fit is

$$y = \frac{100}{3}x - 750.$$

A customer has a budget of \$450 to purchase a new television.

- A.** Based on the customer's budget and the equation for the line of best fit, what is the largest screen size, in inches, the customer should plan to purchase?

- B.** Explain why the ordered pair $(21, -50)$ is **not** a solution for this context even though the equation $-50 = \frac{100}{3}(21) - 750$ is true.

Go to the next page to finish question 14.



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

One television company charges a price that increases the same amount for each additional inch added to the screen size of the television.

Television Prices

Screen Size (inches)	Price (\$)
33	375
39	525

- C.** Based on the information in the table, what is the price, in dollars, the company charges for a new television with a screen size of 48 inches?

The two points from the table in **part C**, (33, 375) and (39, 525), will be added to the scatter plot.

- D.** Explain why adding these two points to the scatter plot will have little to no effect on the line of best fit.

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



Item-Specific Scoring Guideline

#14 Item Information

Alignment	A1.2.2	Depth of Knowledge	3	Mean Score	1.52
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Assessment Anchor this item will be reported under:

A1.2.2—Coordinate Geometry

Specific Anchor Descriptor addressed by this item:

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

A1.2.2.2—Analyze and/or interpret data on a scatter plot.

Scoring Guide

Score	Description
4	The student demonstrates a thorough understanding of coordinate geometry by correctly solving problems with clear and complete procedures and explanations when required.
3	The student demonstrates a general understanding of coordinate geometry by solving problems and providing procedures and explanations with only minor errors or omissions.
2	The student demonstrates a partial understanding of coordinate geometry by providing a portion of the correct problem solving, procedures, and explanations.
1	The student demonstrates a minimal understanding of coordinate geometry.
0	The response has no correct answer and insufficient evidence to demonstrate any understanding of the mathematical concepts and procedures as required by the task. Response may show only information copied from the question.

Top-Scoring Student Response and Training Notes

Score	Description
4	Student earns 4 points.
3	Student earns 3.0–3.5 points.
2	Student earns 2.0–2.5 points.
1	Student earns 0.5–1.5 points. OR Student demonstrates minimal understanding of coordinate geometry.
0	Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.

Top-Scoring Response**Part A (1 point):**

1 point for correct answer

What?	Why?
36 (inches)	

Part B (1 point):

1 point for correct and complete explanation

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

What?	Why?
	<p>Sample Explanations:</p> <p>Even though (21, -50) is a point on the line of best fit, the price for a new television should always be a positive number.</p> <p>OR</p> <p>Even though (21, -50) is a point on the line of best fit, the price for a new television cannot be a negative number.</p> <p>OR equivalent</p>

Part C (1 point):

1 point for correct answer

What?	Why?
(\$)750	

Part D (1 point):

1 point for correct and complete explanation

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

What?	Why?
	<p>Sample Explanations:</p> <p>Since the first point is slightly above the line of best fit (by \$25) and the second point is slightly below the line of best fit (by \$25), the effect of adding one of the points to the scatter plot is canceled out by adding the other point.</p> <p>OR</p> <p>Both points lie reasonably close to the line of best fit.</p> <p>OR equivalent</p>

STUDENT RESPONSE

Response Score: 4 points



PARTS A and B

Question 14

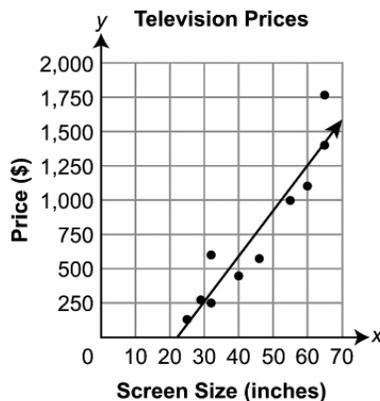
Page 1 of 3



Item ID



The scatter plot shown below shows the relation between the screen size of a new television and the price of the television.



A line of best fit is also shown on the scatter plot. The equation for the line of best fit is $y = \frac{100}{3}x - 750$.

A customer has a budget of \$450 to purchase a new television.

A. Based on the customer's budget and the equation for the line of best fit, what is the largest screen size, in inches, the customer should plan to purchase?

EQ

36 inches

9 / 50

B. Explain why the ordered pair $(21, -50)$ is **not** a solution for this context even though the equation $-50 = \frac{100}{3}(21) - 750$ is true.

EQ

-\$50.00 would be the price of that television, and they would not give you a free television and \$50.

104 / 1000

Review/End Test

Pause

Flag

Options

Next

Part A: The student provided the correct answer (36 inches). While support is not required for Part A, the student likely used the equation given for the line of best fit ($y = \frac{100}{3}x - 750$), substituted the customer's budget (\$450) in for y , and then solved for x : $450 = \frac{100}{3}x - 750 \rightarrow 1,200 = \frac{100}{3}x \rightarrow \frac{3}{100}(1,200) = x \rightarrow 36 = x$. [1 point]

Part B: The student provided a correct and complete explanation as to why the ordered pair $(21, -50)$ is not a solution in this context. The student explained that the price of the television would be negative (*-\$50.00 would be the price of that television, and they would not give you a free television and \$50.*). [1 point]

PART C

Question 14

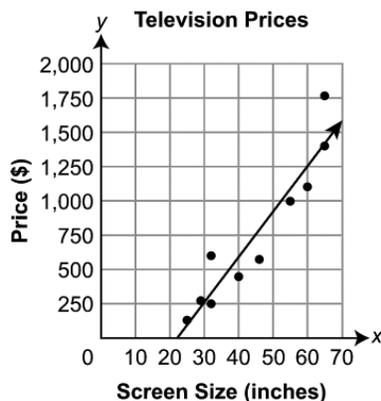
Page 2 of 3



Item ID



The scatter plot shown below shows the relation between the screen size of a new television and the price of the television.



A line of best fit is also shown on the scatter plot. The equation for the line of best fit is $y = \frac{100}{3}x - 750$.

One television company charges a price that increases the same amount for each additional inch added to the screen size of the television.

Television Prices

Screen Size (inches)	Price (\$)
33	375
39	525

C. Based on the information in the table, what is the price, in dollars, the company charges for a new television with a screen size of 48 inches?

7 / 50

Review/End Test

Pause

Flag

Options

Back

Next

Part C. The student provided the correct answer (\$750.00). While support is not required for Part C, the student likely calculated the slope by using the formula $m = \frac{y_2 - y_1}{x_2 - x_1}$ and substituting the two pairs of values for x and y from the table to determine the slope: $m = \frac{525 - 375}{39 - 33} = \frac{150}{6} = 25$. The student could have then used the slope-intercept form ($y = mx + b$) and substituted the slope in for m , resulting in the equation $y = 25x + b$. The student could have then determined the value of b by substituting one pair of values for x and y from the table into the equation [e.g., $525 = 25(39) + b \rightarrow 525 = 975 + b \rightarrow -450 = b$], resulting in the equation $y = 25x - 450$. The student could have then substituted the screen size of the new television (48) in for x and solved for y :

$$y = 25(48) - 450 = 1,200 - 450 = 750. \text{ [1 point]}$$

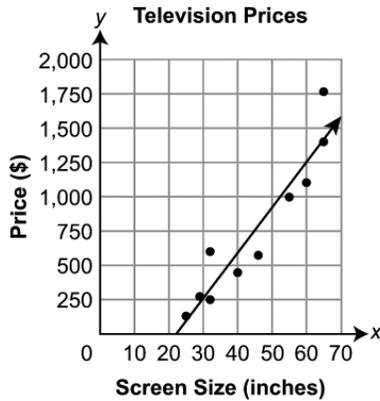
PART D

Question 14
Page 3 of 3



Item ID ?

The scatter plot shown below shows the relation between the screen size of a new television and the price of the television.



A line of best fit is also shown on the scatter plot. The equation for the line of best fit is $y = \frac{100}{3}x - 750$.

The two points from the table in **part C**, (33, 375) and (39, 525), will be added to the scatter plot.

D. Explain why adding these two points to the scatter plot will have little to no effect on the line of best fit.

90

The line of best fit will not change because the points are so close to the existing line.

90 / 1000

Review/End Test

Pause

Flag

Options

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Next

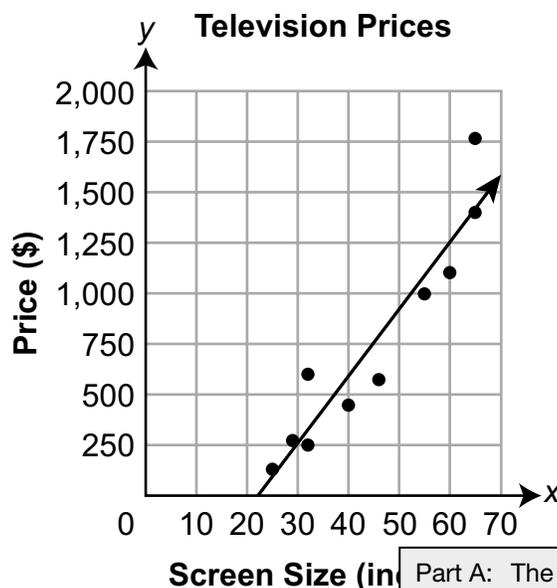
Part D: The student provided a correct and complete explanation as to why adding these two points to the scatter plot will have little to no effect on the line of best fit (*The line of best fit will not change because the points are so close to the existing line.*). [1 point]

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STUDENT RESPONSE

Response Score: 3 points

14. The scatter plot shown below shows the relation between the screen size of a new television and the price of the television.



A line of best fit is also shown on the scatter plot. The

$$y = \frac{100}{3}x - 750.$$

A customer has a budget of \$450 to purchase a new

- A.** Based on the customer's budget and the equation, what is the largest screen size, in inches, the customer can purchase?

36 inches

Part A: The student provided the correct answer (36 inches). While support is not required for Part A, the student likely used the equation given for the line of best fit ($y = \frac{100}{3}x - 750$), substituted the customer's budget (\$450) in for y , and then solved for x :

$$450 = \frac{100}{3}x - 750 \rightarrow 1,200 = \frac{100}{3}x \rightarrow \frac{3}{100}(1,200) = x \rightarrow 36 = x. [1 \text{ point}]$$

- B.** Explain why the ordered pair (21, -50) is **not** a solution for this context even though the equation $-50 = \frac{100}{3}(21) - 750$ is true.

The ordered pair (21, -50) is not a solution because you can't buy a 21-inch television for \$-50, You can't buy any screen size for a television if the price is negative.

Part B: The student provided a correct and complete explanation as to why the ordered pair (21, -50) is not a solution in this context. The student explained that the price of the television would be negative (. . . you can't buy a 21-inch television for \$-50, You can't buy any screen size for a television if the price is negative.). [1 point]

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

One television company charges a price that increases the same amount for each additional inch added to the screen size of the television.

Television Prices

Screen Size (inches)	Price (\$)
33	375
39	525

- C. Based on the information in the table, what is the price the company charges for a new television with a screen size of 48 inches?

\$825

45	675	+50
46	725	+50
47	775	+50
48	825	

Part C: The student provided an incorrect answer (\$825). The student provided work, although the work is not required or assessed. Based on the work provided, the student created a table with a correct first row (45 | 675). The student likely determined the values for this row by finding the differences between the two screen sizes and between the two prices in the table ($39 - 33 = 6$ and $525 - 375 = 150$) and then added these differences to the larger set of values in the table ($39 + 6 = 45$ and $525 + 150 = 675$). The student then used an incorrect rate of change of \$50 per inch rather than \$25 per inch to extend the table until reaching the row representing the screen size of the new television (48 | 825). [0 points]

The two points from the table in **part C**, (33, 375) and (39, 525), will be added to the scatter plot.

- D. Explain why adding these two points to the scatter plot will have little to no effect on the line of best fit.

These points are very alike to the ones that were already on the line. When estimating where the points fall on the graph they are very close to where the line of best fit currently is.

Part D: The student provided an incorrect explanation (*The points are not on the line of best fit because they are outliers.*). The two points are not outliers since they are reasonably close to the line of best fit. [0 points]

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



STUDENT RESPONSE

Response Score: 2 points



PARTS A and B

Question 14

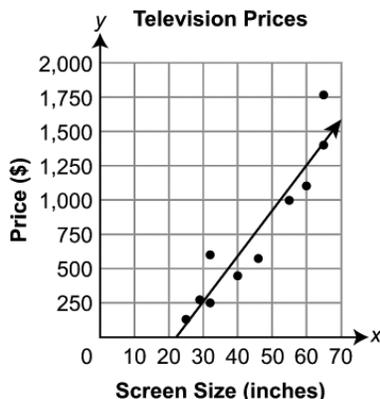
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Item ID



The scatter plot shown below shows the relation between the screen size of a new television and the price of the television.



A line of best fit is also shown on the scatter plot. The equation for the line of best fit is $y = \frac{100}{3}x - 750$.

A customer has a budget of \$450 to purchase a new television.

A. Based on the customer's budget and the equation for the line of best fit, what is the largest screen size, in inches, the customer should plan to purchase?

EQ

40 inches

9 / 50

B. Explain why the ordered pair $(21, -50)$ is **not** a solution for this context even though the equation $-50 = \frac{100}{3}(21) - 750$ is true.

EQ

You can not have a negative price for the television.

53 / 1000

Review/End Test

Pause

Flag

Options

Next

Part A: The student provided an incorrect answer (*40 inches*). No support (work or explanation) is required, so it is unclear where an error was made. The student may have looked at the points on the scatter plot (rather than using the equation for the line of best fit), identified a point with a y -coordinate close to 450, and then provided the x -coordinate for that point. [0 points]

Part B: The student provided a correct and complete explanation as to why the ordered pair $(21, -50)$ is not a solution in this context. The student explained that the price of the television would be negative (*You can not have a negative price for the television.*). [1 point]

PART C

Question 14

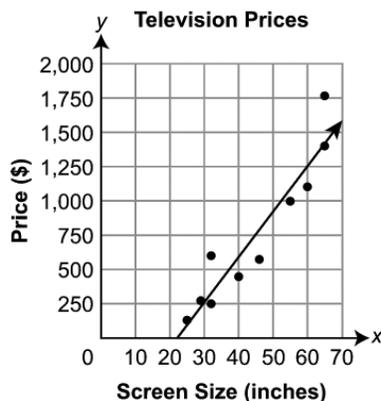
Page 2 of 3



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One television company charges a price that increases the same amount for each additional inch added to the screen size of the television.

Television Prices	
Screen Size (inches)	Price (\$)
33	375
39	525

C. Based on the information in the table, what is the price, in dollars, the company charges for a new television with a screen size of 48 inches?

4 / 50

Review/End Test

Pause

Flag

Options

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Next

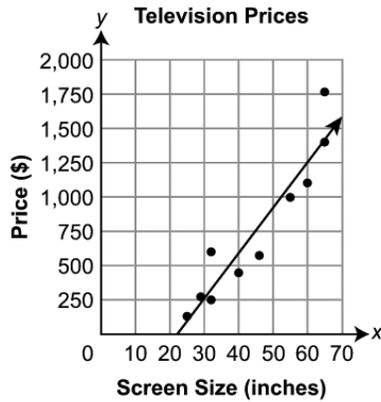
Part C. The student provided the correct answer (\$750). While support is not required for Part C, the student likely calculated the slope by using the formula $m = \frac{y_2 - y_1}{x_2 - x_1}$ and substituting the two pairs of values for x and y from the table to determine the slope: $m = \frac{525 - 375}{39 - 33} = \frac{150}{6} = 25$. The student could have then found the difference between the larger screen size in the table and the screen size of the new television ($48 - 39 = 9$) and then added the slope 9 times to the larger price in the table: $525 + 9(25) = 525 + 225 = 750$. [1 point]

PART D

Question 14
Page 3 of 3



The scatter plot shown below shows the relation between the screen size of a new television and the price of the television.



A line of best fit is also shown on the scatter plot. The equation for the line of best fit is $y = \frac{100}{3}x - 750$.

The two points from the table in **part C**, (33, 375) and (39, 525), will be added to the scatter plot.

D. Explain why adding these two points to the scatter plot will have little to no effect on the line of best fit.

EQ

The points are not on the line of best fit because they are outliers.

69 / 1000

Review/End Test

Pause

Flag

Options

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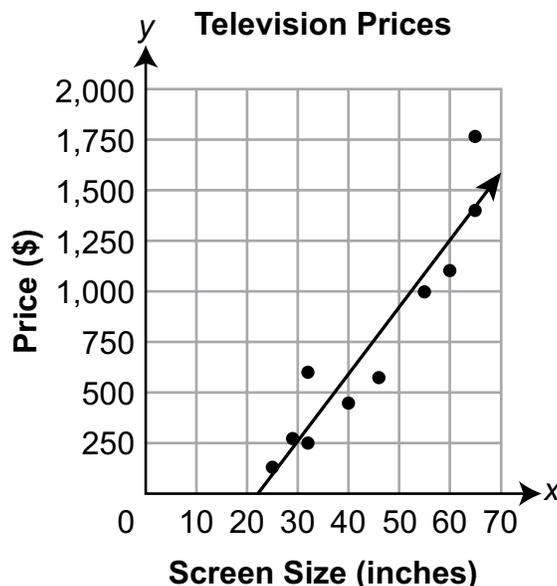
Part D: The student provided an incorrect explanation (*The points are not on the line of best fit because they are outliers.*). The two points are not outliers since they are reasonably close to the line of best fit. [0 points]

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STUDENT RESPONSE

Response Score: 1 point

14. The scatter plot shown below shows the relation between the screen size of a new television and the price of the television.



A line of best fit is also shown on the scatter plot. The equation for the line of best fit is

$$y = \frac{100}{3}x - 750.$$

A customer has a budget of \$450 to purchase a new television.

- A. Based on the customer's budget and the equation for the line of best fit, what is the largest screen size, in inches, the customer should plan to purchase?

31

Part A: The student provided an incorrect answer (31). No support (work or explanation) is required, so it is unclear where an error was made. The student may have looked at the points on the scatter plot (rather than using the equation for the line of best fit), identified a point with a y-coordinate of 250 (rather than 450), and then provided an approximate x-coordinate for that point. [0 points]

- B. Explain why the ordered pair (21, -50) is **not** a solution for this context even though the equation $-50 = \frac{100}{3}(21) - 750$ is true.

It's not the highest number that they can go

Part B: The student provided an incorrect explanation (*It's not the highest number that they can go*). The student did not explain that the price of the television either must be a positive number or cannot be a negative number. [0 points]

Go to the next page to finish question 14.



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

One television company charges a price that increases the same amount for each additional inch added to the screen size of the television.

Television Prices

Screen Size (inches)	Price (\$)
33	375
39	525

- C.** Based on the information in the table, what is the price, in dollars, the company charges for a new television with a screen size of 48 inches?

850

Part C: The student provided an incorrect answer (850). No support (work or explanation) is required, so it is unclear where an error was made. [0 points]

The two points from the table in **part C**, (33, 375) and (39, 525), will be added to the scatter plot.

- D.** Explain why adding these two points to the scatter plot will have little to no effect on the line of best fit.

They both stay in the same area as the other points, so making it that there will be little to no change

Part D: The student provided a correct and complete explanation as to why adding these two points to the scatter plot will have little to no effect on the line of best fit (*They both stay in the same area as the other points, so making it that there will be little to no change*). [1 point]

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



STUDENT RESPONSE

Response Score: 0 points



PARTS A and B

Question 14

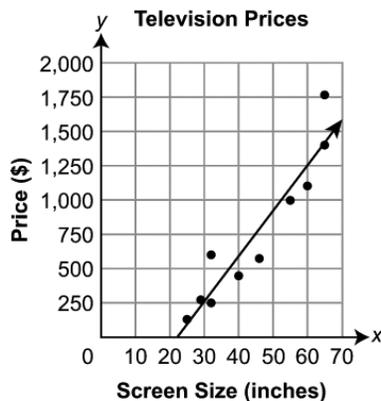
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Item ID



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A line of best fit is also shown on the scatter plot. The equation for the line of best fit is $y = \frac{100}{3}x - 750$.

A customer has a budget of \$450 to purchase a new television.

A. Based on the customer's budget and the equation for the line of best fit, what is the largest screen size, in inches, the customer should plan to purchase?

EQ

35

2 / 50

B. Explain why the ordered pair $(21, -50)$ is **not** a solution for this context even though the equation $-50 = \frac{100}{3}(21) - 750$ is true.

EQ

because he dosent want his screen size to be -50

48 / 1000

Review/End Test

Pause

Flag

Options

Next

Part A: The student provided an incorrect answer (35). No support (work or explanation) is required, so it is unclear where an error was made. The student may have looked at the line of best fit on the scatter plot (rather than using the equation for the line of best fit), identified a point on the line with a y -coordinate close to 450, and then estimated the x -coordinate for that point to be 35. [0 points]

Part B: The student provided an incorrect explanation (*because he dosent want his screen size to be -50*). The student incorrectly identified the -50 as referring to the screen size rather than to the price. [0 points]

PART C

Question 14

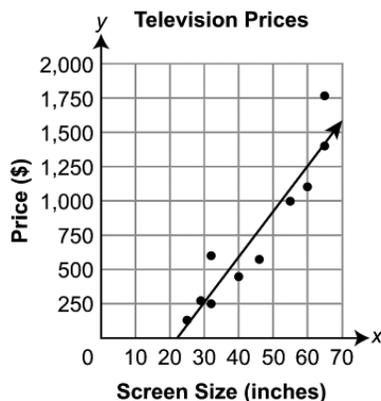
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Television Prices

Screen Size (inches)	Price (\$)
33	375
39	525

C. Based on the information in the table, what is the price, in dollars, the company charges for a new television with a screen size of 48 inches?

3 / 50

Review/End Test

Pause

Flag

Options

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Next

Part C. The student provided an incorrect answer (600). No support (work or explanation) is required, so it is unclear where an error was made. The student may have determined the correct rate of change (\$25 per inch) and the difference between the larger screen size in the table and the screen size of the new television ($48 - 39 = 9$), but then the student may have added the slope 9 times to the smaller price in the table rather than to the larger price: $375 + 9(25) = 375 + 225 = 600$. [0 points]

PART D

Question 14

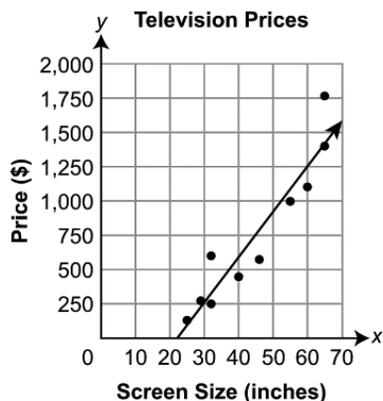
Page 3 of 3



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The two points from the table in **part C**, (33, 375) and (39, 525), will be added to the scatter plot.

D. Explain why adding these two points to the scatter plot will have little to no effect on the line of best fit.

EQ

Because the line is already placed

34 / 1000

Review/End Test

Pause

Flag

Options

Back

Next

Part D: The student provided an incorrect explanation (*Because the line is already placed*). The student did not show an understanding that the line of best fit represents the relationship between the points on the scatter plot and that the line of best fit can change based on whether points are added or removed from the scatter plot. [0 points]

ALGEBRA I MODULE 2—SUMMARY DATA

Multiple-Choice

Sample Number	Alignment	Answer Key	Depth of Knowledge	p-value A	p-value B	p-value C	p-value D
1	A1.2.1.1.1	A	2	50%	35%	7%	8%
2	A1.2.1.1.3	C	1	15%	19%	61%	5%
3	A1.2.1.2.1	B	2	6%	77%	9%	8%
4	A1.2.1.2.2	A	1	69%	15%	10%	6%
5	A1.2.2.1.1	C	1	12%	14%	65%	9%
6	A1.2.2.1.2	B	2	13%	74%	8%	5%
7	A1.2.2.1.3	D	1	13%	11%	18%	58%
8	A1.2.2.1.4	A	2	59%	12%	14%	15%
9	A1.2.3.1.1	D	1	12%	20%	20%	48%
10	A1.2.3.2.2	A	2	59%	13%	14%	14%
11	A1.2.3.2.3	B	2	11%	73%	13%	3%
12	A1.2.3.3.1	D	2	18%	26%	16%	40%

Constructed-Response

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
13	A1.2.1	4	2	1.22
14	A1.2.2	4	3	1.52

Keystone Exams Algebra I

Item and Scoring Sampler 2023

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