IMAGINING the possibilities. MAKING THEM HAPPEN.

Indiana Department of Education

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Indiana Superintendent of Public Instruction

ISTEP+: Grade 10

Mathematics

Released Part 1 Applied Skills (open-ended) Items

and Scoring Notes

Introduction

The *ISTEP+* Spring 2016 test was administered to Indiana students in Grades 3-8 and 10. The test included two parts: Part 1 was given in March, and Part 2 took place in late April and early May. Part 1 contained Applied Skills test questions (also referred to as open-ended items) that were hand scored by trained evaluators, and Part 2 was machine scored. Scores for Part 1 and Part 2 are combined to generate a student's total score.

Test results, as well as images of the Applied Skills student responses, are available online, and schools are expected to discuss results with parents and students. As a springboard for these conversations and to serve as a resource for teachers, the Indiana Department of Education has created this document, which consists of the following:

- a brief description of the types of questions on the test
- a short summary of scoring rules utilized by the trained evaluators
- a copy of the rubrics—or scoring guides—used by evaluators to score student responses
- a copy of the released Applied Skills questions *("released" means the items are posted on the web and are no longer secure; therefore, the released test items can be discussed and used with students as future practice items)*
- anchor papers—or sample student responses—used by evaluators to distinguish between score points

Notes:

- The Part 1 open-ended questions are released when test results are made available.
- It is important to keep in mind that the majority of a student's score is calculated from items in Part 2. Since Part 2 items are secure and are not released, they are not included in this document.

Question Types

This document addresses questions from *ISTEP+ Part 1. Students* demonstrate their knowledge and understanding by responding to items that are open-ended, providing written responses in a short-answer or essay-type format.

Part 1 consists of the following test question types: Constructed-Response (CR), Extended-Response (ER), and a Writing Prompt (WP). Item types vary by subject area. Math, Science, and Social Studies include CR and ER items. English/Language Arts includes CR and WP test questions.

Scoring

The questions on *ISTEP+* Part 1 are scored by evaluators who must have a four-year college degree and pass a series of qualifying tests. Prior to scoring student responses, evaluators receive extensive training to ensure that student responses are scored accurately and consistently.

For Part 1 of *ISTEP+*, each question is scored according to a rubric, or scoring guide. Rubrics clearly define the requirements for each score point. A set of student responses representing all of the score points on a rubric are selected as samples—called anchor papers—and are used as clear examples of specific score points. Anchor papers are presented within this document.

ISTEP+ Part 1: Mathematics		
Question Type	**Score Reporting Categories**	**Scoring Method**
Constructed-Response (CR)	Number Sense, Expressions, and Computation Geometry and Measurement Data Analysis, Statistics, and Probability Linear Equations, Inequalities, and Functions Systems of Equations and Inequalities Quadratic and Exponential Equations and Functions Mathematical Process	2-pt. CR Content Rubric (Grades 3-8, 10) 2-pt. CR Process Rubric (Grades 3-8, 10)

Extended-Response (ER)	Number Sense, Expressions, and Computation Geometry and Measurement Data Analysis, Statistics, and Probability Linear Equations, Inequalities, and Functions Systems of Equations and Inequalities Quadratic and Exponential Equations and Functions Mathematical Process	3-pt. ER Content Rubric (Grades 3-8, 10) 3-pt. ER Process Rubric (Grades 3-8, 10)

If a student's response is unable to be scored, it is assigned one of the following condition codes:

- **A** Blank/No Response/Refusal
- **B** Illegible
- **C** Written predominantly in a language other than English
- **D** Insufficient response/Copied from text
- **E** Response not related to test questions or scoring rule (not applied to Mathematics questions)

More information is available regarding assessment topics on the Office of Student Assessment homepage at http://www.doe.in.gov/assessment.

Constructed-Response Rubric

	Content Rubric
2	A score of two indicates a **thorough understanding** of the mathematical concepts embodied in the task. The response • shows algorithms, computations, and other content related work executed correctly and completely.
1	A score of one indicates a **partial understanding** of the mathematical concepts embodied in the task. The response • contains errors in the execution of algorithms, computations, and/or other content related work.
0	A score of zero indicates **limited or no understanding** of the mathematical concepts embodied in the task.
	Process Rubric
2	A score of two indicates a **thorough understanding** of the problem-solving concepts embodied in the task. The response • shows an appropriate strategy to solve the problem, and the strategy is executed correctly and completely. • identifies all important elements of the problem and shows a complete understanding of the relationships among them. • provides clear and complete explanations and/or interpretations when required.
1	A score of one indicates a **partial understanding** of the problem-solving concepts embodied in the task. The response contains one or more of the following errors. The response • shows an appropriate strategy to solve the problem. However, the execution of the strategy contains errors and/or is incomplete. • identifies some of the important elements of the problem and shows a general understanding of the relationships among them. • provides incomplete, partial, or unclear explanations and/or interpretations when required.
0	A score of zero indicates **limited or no understanding** of the problem-solving concepts embodied in the task.

<u>Clarification and Implementation Guidance</u>

- Correct answers ONLY, on all parts of the problem with no work shown, will receive a maximum of 1 point in content and a maximum of 1 point in Process.
- A student can receive the top score point in Process if the strategy used would result in a correct answer even though the response contains computational errors.
- A student can receive the top score point in Process if an error made in the “content” portion is used with an appropriate strategy to solve the problem.

Extended-Response Rubric

Content Rubric	
3	A score of three indicates a **thorough understanding** of the mathematical concepts embodied in the task. The response • shows algorithms, computations, and other content related work executed correctly and completely.
2	A score of two indicates a **partial understanding** of the mathematical concepts embodied in the task. The response • shows an attempt to execute algorithms, computations, and other content related work correctly and completely; computation errors or other minor errors in the content related work may be present.
1	A score of one indicates a **limited understanding** of the mathematical concepts embodied in the task. The response • contains major errors, or only a partial process. • contains algorithms, computations, and other content related work which may only be partially correct.
0	A score of zero indicates **no understanding** of the mathematical concepts embodied in the task.
Process Rubric	
3	A score of three indicates a **thorough understanding** of the problem-solving concepts embodied in the task. The response • shows an appropriate strategy to solve the problem, and the strategy is executed correctly and completely. • identifies all important elements of the problem and shows a complete understanding of the relationships among them. • provides clear and complete explanations and/or interpretations when required.
2	A score of two indicates a **partial understanding** of the problem-solving concepts embodied in the task. The response contains one or more of the following errors. The response • shows an appropriate strategy to solve the problem. However, the execution of the strategy lacks an essential element. • identifies some of the important elements of the problem and shows a general understanding of the relationships among them. • provides incomplete or unclear explanations and/or interpretations when required.
1	A score of one indicates a **limited understanding** of the problem-solving concepts embodied in the task. The response contains one or more of the following errors. The response • shows an appropriate strategy to solve the problem. However, the execution of the strategy is applied incorrectly and/or is incomplete. • shows a limited understanding of the relationships among the elements of the problem. • provides incomplete, unclear, or omitted explanations and/or interpretations when required.
0	A score of zero indicates **no understanding** of the problem-solving concepts embodied in the task.

Clarification and Implementation Guidance

- Correct answers ONLY, on all parts of the problem with no work shown, will receive a maximum of 2 points in content and a maximum of 2 points in Process.
- A student can receive the top score point in Process if the strategy used would result in a correct answer even though the response contains computational errors.
- A student can receive the top score point in Process if an error made in the “content” portion is used with an appropriate strategy to solve the problem.

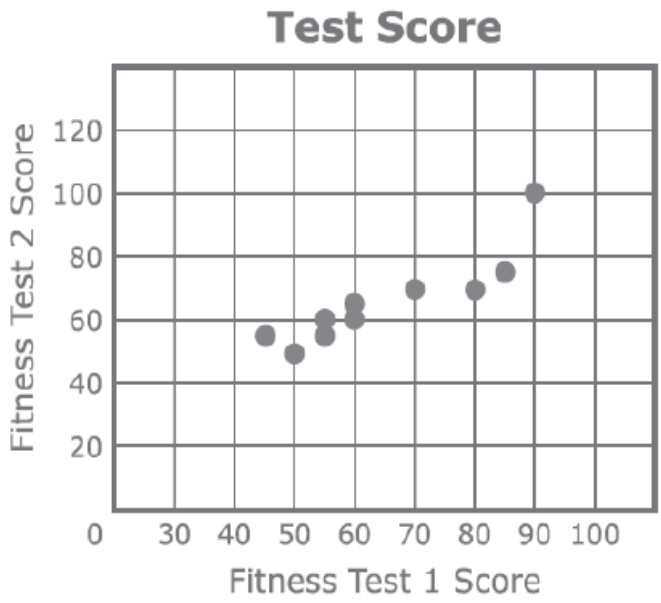
Item #1

Constructed-Response

Constructed-Response
Data Analysis, Statistics, and Probability
Mathematical Process

Question 1

1. A physical therapist randomly selected ten patients to complete two physical fitness tests. The patients' scores on each test are shown in the scatterplot.



Part A

Do the data best represent a linear or a nonlinear association? Use words, numbers, and/or symbols to explain your answer.

_____

_____

_____

_____

Answer _____ association

Part B

Is there a positive or a negative association represented between the two variables in the scatterplot? Use words, numbers, and/or symbols to explain your answer.

_____

_____

_____

_____

Answer _____ association

Exemplary Response:

There appears to be a positive, linear correlation.

- Part A

So, a linear association.

Sample Process:

The data on the scatterplot reflects a linear association between the two variables. The data association is linear because the data points generally cluster around a straight line.

OR

- Other valid process

- Part B

So, a positive association.

Sample Process:

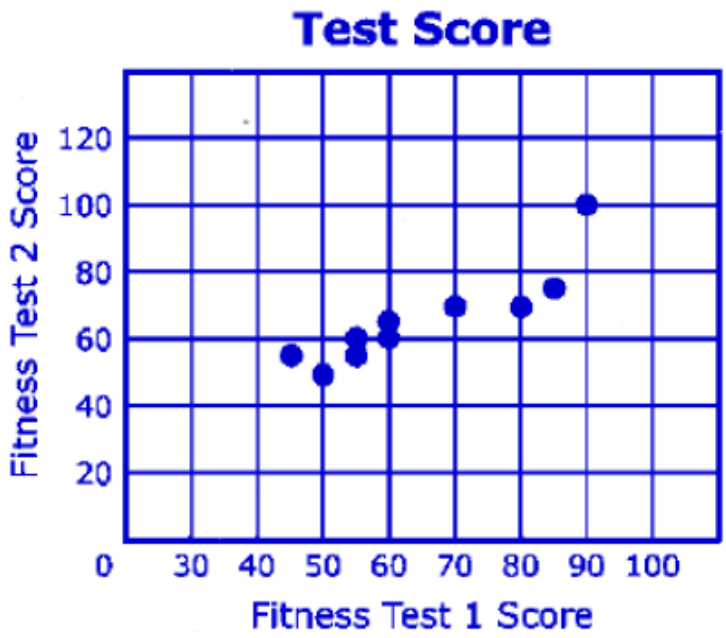
The data on the scatterplot describes a positive because as one set of variables, the Test 1 scores, increases the other set of variables, the Test 2 scores tends to increase as well.

OR

- Other valid process

Question 1, Sample A – Data Analysis, Statistics, and Probability Score Point 2; Process Score Point 2

A physical therapist randomly selected ten patients to complete two physical fitness tests. The patients' scores on each test are shown in the scatterplot.



Part A

Do the data best represent a linear or a nonlinear association? Use words, numbers, and/or symbols to explain your answer.

The data best represents a linear association. The points are not exactly in a line, but they would closely follow a line of best fit.

Answer linear association

Part B

Is there a positive or a negative association represented between the two variables in the scatterplot? Use words, numbers, and/or symbols to explain your answer.

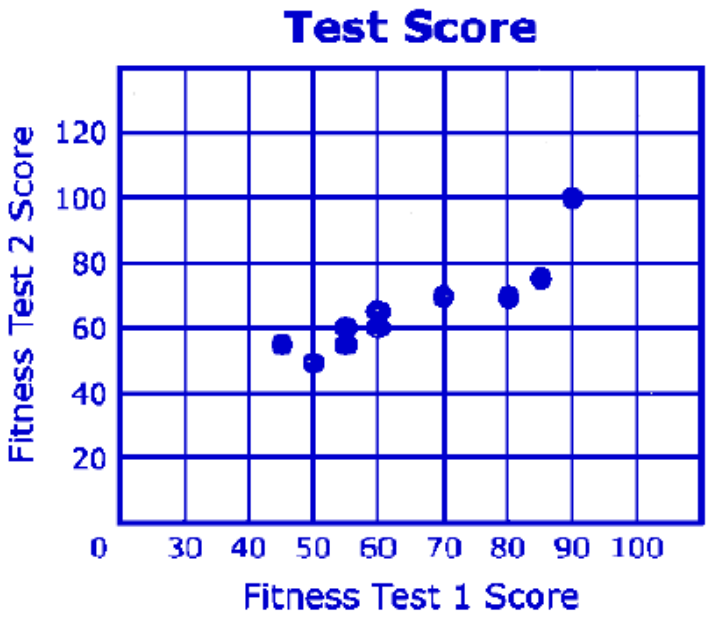
There is a positive association. when the value in Fitness Test 1 Score goes up, the value in Fitness Test 2 Score also goes up.

Answer positive association

Scoring Notes: The response demonstrates a thorough understanding of data analysis, statistics, and probability and mathematical processes by correctly identifying and providing an accurate description of a linear association in Part A and by correctly identifying and providing an accurate description of a positive association in Part B. This response receives two points for content and two points for process.

Question 1, Sample B – Data Analysis, Statistics, and Probability Score Point 2; Process Score Point 1

A physical therapist randomly selected ten patients to complete two physical fitness tests. The patients' scores on each test are shown in the scatterplot.



Part A

Do the data best represent a linear or a nonlinear association? Use words, numbers, and/or symbols to explain your answer.

The data represents a linear association. When the patients took the second test, their numbers were about the same compared to their first test.

Answer linear association

Part B

Is there a positive or a negative association represented between the two variables in the scatterplot? Use words, numbers, and/or symbols to explain your answer.

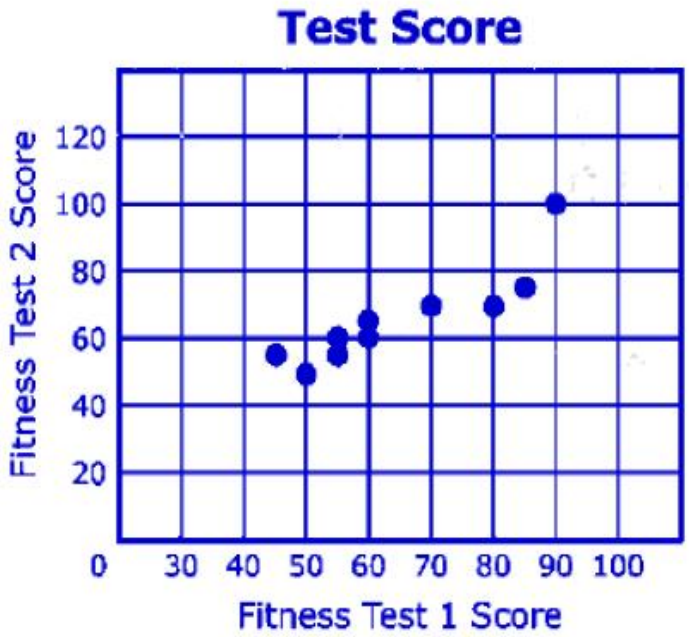
The plotted points make a positive line. The more people she picked, the better they got.

Answer positive **association**

Scoring Notes: The response demonstrates a thorough understanding of data analysis, statistics, and probability by correctly identifying a linear association in Part A and a positive association in Part B. The response demonstrates a partial understanding of mathematical processes with an accurate description of a linear association in Part A, "When the patients took their second test, their numbers were about the same compared to their first test." [This implies that the y-values are about the same as the x-values, or the data points approximately follow the line of y = x]. However, the response provides an incorrect description of a positive association in Part B, "The plotted points make a positive line." [A positive line does not describe a positive association.] This response receives two points for content and one point for process.

Question 1, Sample C – Data Analysis, Statistics, and Probability Score Point 2; Process Score Point 0

A physical therapist randomly selected ten patients to complete two physical fitness tests. The patients' scores on each test are shown in the scatterplot.



Part A

Do the data best represent a linear or a nonlinear association? Use words, numbers, and/or symbols to explain your answer.

This data best represents a linear function because if you were to pick the lowest and highest point, then draw a line, it would be straight.

Answer Linear. association

Part B

Is there a positive or a negative association represented between the two variables in the scatterplot? Use words, numbers, and/or symbols to explain your answer.

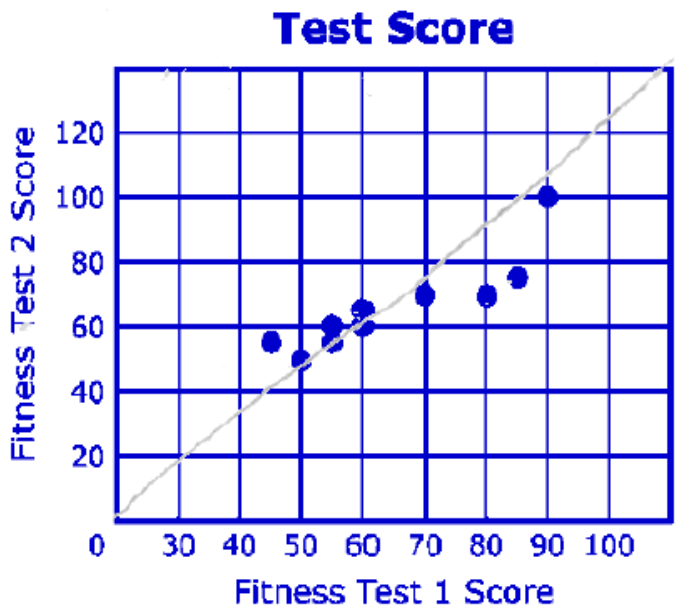
Positive, starting at a 50 on the test 1 scores, the scores continue to increase.

Answer positive association

Scoring Notes: The response demonstrates a thorough understanding of data analysis, statistics, and probability by correctly identifying a linear association in Part A and a positive association in Part B. However, the response demonstrates a limited understanding of mathematical processes with an incorrect explanation of a linear association in Part A, [A line can be drawn between any two points.] and an incorrect explanation of a positive association in Part B [The response must mention that the scores increase from left to right in order to receive credit.] This response receives two points for content and zero points for process.

Question 1, Sample D – Data Analysis, Statistics, and Probability Score Point 1; Process Score Point 1

A physical therapist randomly selected ten patients to complete two physical fitness tests. The patients' scores on each test are shown in the scatterplot.



Part A

Do the data best represent a linear or a nonlinear association? Use words, numbers, and/or symbols to explain your answer.

Linear because if you draw a line like the one shown above, most of the dots are on or touching the line

Answer linear association

Part B

Is there a positive or a negative association represented between the two variables in the scatterplot? Use words, numbers, and/or symbols to explain your answer.

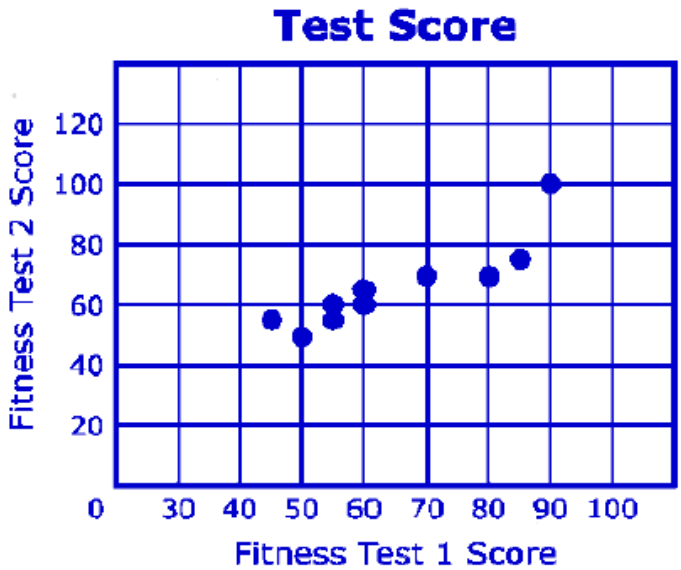
Negative association because most of the dots are going down.

Answer Negative association

Scoring Notes: The response demonstrates a partial understanding of data analysis, statistics, and probability by correctly identifying a linear association in Part A but incorrectly identifying a negative association in Part B. The response demonstrates a partial understanding of mathematical processes by providing an accurate description of a linear association in Part A, " ***if you draw a line like the one shown above, most of the dots are on or touching the line"*** *[including "most" is important as it acknowledges some points are farther from the line]. However, the response provides an incorrect explanation of the association in Part B. This response receives one point for content and one point for process.*

Question 1, Sample E – Data Analysis, Statistics, and Probability Score Point 1; Process Score Point 0

A physical therapist randomly selected ten patients to complete two physical fitness tests. The patients' scores on each test are shown in the scatterplot.



Part A

Do the data best represent a linear or a nonlinear association? Use words, numbers, and/or symbols to explain your answer.

The data best represent a linear association.

Answer Linear association

Part B

Is there a positive or a negative association represented between the two variables in the scatterplot? Use words, numbers, and/or symbols to explain your answer.

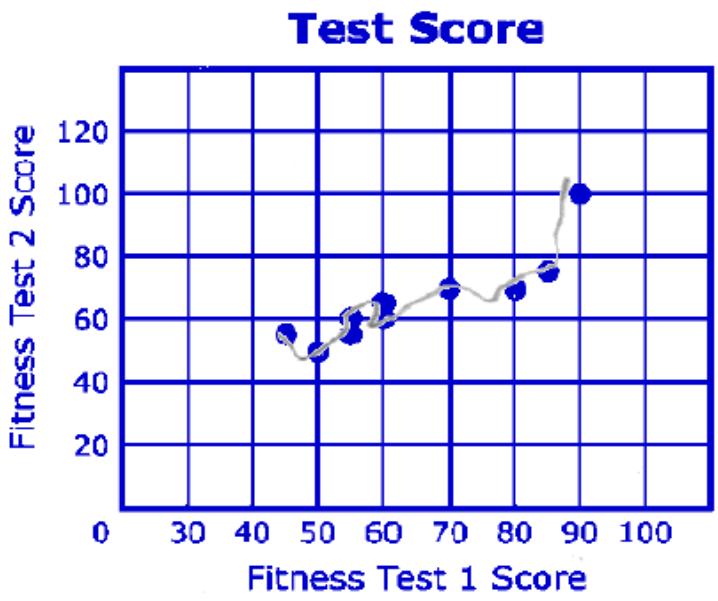
There is a positive association represented between the two variables in the scatterplot.

Answer Positive association

Scoring Notes: The response demonstrates a partial understanding of data analysis, statistics, and probability by correctly identifying a linear association in Part A and a positive association in Part B. However, in each case the explanations are restatements or descriptions of information given in the prompt. The response demonstrates limited understanding of mathematical processes by providing incorrect explanations of the associations in Part A and Part B. This response receives one point for content (a maximum of one point for content can be awarded because no explanations are given) and zero points for process.

Question 1, Sample F – Data Analysis, Statistics, and Probability Score Point 0; Process Score Point 0

A physical therapist randomly selected ten patients to complete two physical fitness tests. The patients' scores on each test are shown in the scatterplot.



Part A

Do the data best represent a linear or a nonlinear association? Use words, numbers, and/or symbols to explain your answer.

No, this is not a linear association because it is not a straight line and the lines are not equal.

Answer non linear association

Part B

Is there a positive or a negative association represented between the two variables in the scatterplot? Use words, numbers, and/or symbols to explain your answer.

There is both positive and negative association because the dots go up and down.

Answer negative + positive association

Scoring Notes: The response demonstrates limited understanding of data analysis, statistics, and probability by incorrectly identifying a nonlinear association in Part A and both negative and positive associations in Part B. The response demonstrates limited understanding of mathematical processes by providing incorrect explanations of the associations shown in Parts A and B. This response receives zero points for content and zero points for process.

Item #2

Constructed-Response

Constructed-Response
Quadratic and Exponential Equations and Functions
Mathematical Process

Question 2

2. A rectangle with an area of 104 square inches has a width that is 5 inches less than its length.

Part A

Write an equation representing the area of the rectangle. Use x to represent the length of the rectangle. Solve your equation for all values of x.

Show All Work

Part B

Use your solution to the equation to identify the width and length of the rectangle. Explain how you determined which value(s) of x to use.

Show All Work

Exemplary Response:

Part A

Area = (length)*(width)

Let x = length, then width = x -5.
Area = $x(x – 5)$
$104 = x(x – 5)$

AND

Part B

The length is 13 inches and the width is 8 inches.

- Sample Process

Part A

$104 = x(x – 5)$
$x(x – 5) = 104$
$x^2 – 5x – 104 = 0$
$(x – 13)(x + 8) = 0$

$x = -8$ or 13

AND

A distance or length cannot be negative. So the result $x = -8$ can be excluded. Since the length equals 13, the width equals 8.

- Other valid process

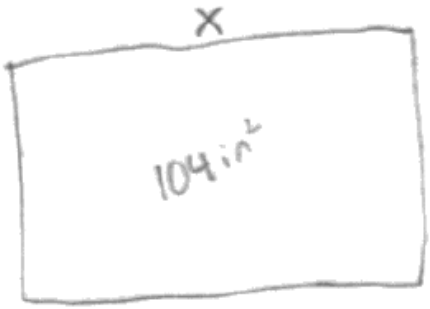
Question 2, Sample A – Quadratic and Exponential Equations and Functions
Score Point 2; Process Score Point 2

A rectangle with an area of 104 square inches has a width that is 5 inches less than its length.

Part A

Write an equation representing the area of the rectangle. Use x to represent the length of the rectangle. Solve your equation for all values of x.

Show All Work



$x(x-5)=104$

$x^2-5x-104=0$

$\frac{5 \pm \sqrt{25-4(1)(-104)}}{2}$

$\frac{5+21}{2}$ $\frac{5-21}{2}$

$x=13\text{in}$ $x=-8\text{in}$

Part B

Use your solution to the equation to identify the width and length of the rectangle. Explain how you determined which value(s) of x to use.

Show All Work

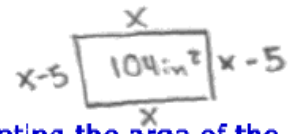
A length cannot be negative, which means that $x=-8$ cannot be an answer. This means that the length is 13in and the width is 8in.

Scoring Notes: The response demonstrates a thorough understanding of quadratic and exponential equations and functions by providing a correct equation setup in Part A and correct values for length and width of the rectangle. The response demonstrates a thorough understanding of mathematical processes by correctly using the quadratic formula in Part A and by correctly explaining that length cannot be a negative number, which excludes the negative solution. This response receives two points for content and two points for process.

Question 2, Sample B – Quadratic and Exponential Equations and Functions
Score Point 2; Process Score Point 1

A rectangle with an area of 104 square inches has a width that is 5 inches less than its length.

Part A



Write an equation representing the area of the rectangle. Use x to represent the length of the rectangle. Solve your equation for all values of x.

$l \times w = A \qquad x(x-5) = 104$

Show All Work

$$\boxed{x(x-5) = 104}$$

$x^2 - 5x = 104$

$x^2 - 5x - 104$

$\frac{-b \pm \sqrt{b^2-4ac}}{2a}$

$\frac{5 \pm \sqrt{(-5)^2 - 4(1)(-104)}}{2(1)}$

$\frac{5 \pm \sqrt{25 + 416 = 441}}{2}$

$\frac{5+21}{2} = x \qquad \frac{5-21}{2} = x$

$13 = x \qquad -8 = x$

Part B

$w = 13 - 5$

$w = 8\text{in}$

$l = 13\text{in}$

Use your solution to the equation to identify the width and length of the rectangle. Explain how you determined which value(s) of x to use.

Show All Work

The length is 13 inches, width is 8 inches. This can be confirmed because $8 \times 13 = 104$, 104 being the area. I found x by creating an equation based on $l \times w = A$. We knew w was 5 inches less than l, so I said $x(x-5) = 104$. I then factored, used the quadratic formula, and picked the positive answer.

Scoring Notes: The response demonstrates a thorough understanding of quadratic and exponential equations and functions by providing a correct equation setup in Part A and correct values for length and width of the rectangle. The response demonstrates a partial understanding of mathematical processes by correctly using the quadratic formula in Part A but failing to explain that length cannot be a negative number in Part B. This response receives two points for content and one point for process.

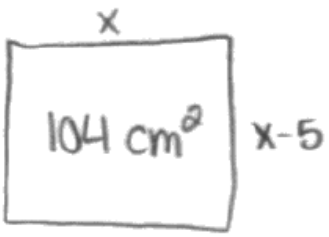
Question 2, Sample C – Quadratic and Exponential Equations and Functions
Score Point 1; Process Score Point 2

A rectangle with an area of 104 square inches has a width that is 5 inches less than its length.

Part A

Write an equation representing the area of the rectangle. Use x to represent the length of the rectangle. Solve your equation for all values of x.

Show All Work



$x(x-5) = 104\ cm^2$

$x^2 - 5x = 104$

$x^2 - 5x - 104 = 0$

$(x+8)(x-13) = 0$

$\cancel{x = -8}$ $x = 13$

$\begin{array}{c|c} 1 & 8 \\ 1 & -13 \end{array}$

Part B

Use your solution to the equation to identify the width and length of the rectangle. Explain how you determined which value(s) of x to use.

Show All Work

By using factoring in the equation $x(x-5) = 104cm^2$, we get two answers: -8 and 13. We know that -8 is not the answer because negatives can't be measurements of realistic shapes/figures.

Scoring Notes: The response demonstrates a partial understanding of quadratic and exponential equations and functions by providing a correct equation setup and finding the correct value for the length of the rectangle in Part A. However, the response does not provide the value for the width of the rectangle. The response demonstrates a thorough understanding of mathematical processes by factoring correctly in Part A and by explaining that length cannot be a negative number in Part B. This response receives one point for content and two points for process.

Question 2, Sample D – Quadratic and Exponential Equations and Functions
Score Point 1; Process Score Point 1

A rectangle with an area of 104 square inches has a width that is 5 inches less than its length.

Part A

Write an equation representing the area of the rectangle. Use x to represent the length of the rectangle. Solve your equation for all values of x.

Show All Work

$x(x-5)=104$

$x^2-5x=104$

$x^2-5x-104=0$

$(x-13)(x+8)=0$

$x-13=0 \quad x+8=0$

$x=13 \quad x=-8$

$\boxed{x=13\text{ in} \quad x=-8\text{ in}}$

Part B

Use your solution to the equation to identify the width and length of the rectangle. Explain how you determined which value(s) of x to use.

Show All Work

I set up an equation where the length and width were multiplied and equaled 104. I set the equation equal to zero and factored it. I set each factored part equal to zero to find x. Then I check both answers for extraneous solutions.

Scoring Notes: The response demonstrates a partial understanding of quadratic and exponential equations and functions by providing a correct equation setup and finding the correct value for the length of the rectangle in Part A. However, the response does not provide the value for the width of the rectangle. The response demonstrates a partial understanding of mathematical processes by factoring correctly in Part A, but the response fails to explain that length cannot be a negative number in Part B. This response receives one point for content and one point for process.

Question 2, Sample E – Quadratic and Exponential Equations and Functions
Score Point 0; Process Score Point 1

A rectangle with an area of 104 square inches has a width that is 5 inches less than its length.

Part A

Write an equation representing the area of the rectangle. Use x to represent the length of the rectangle. Solve your equation for all values of x.

Show All Work

$w - 5 = x$

$x \cdot w = 104$

$5 \cdot 10 = 50$
$6 \cdot 11 = 66$
$7 \cdot 12 = 84$
$8 \cdot 13 = 104$

Part B

Use your solution to the equation to identify the width and length of the rectangle. Explain how you determined which value(s) of x to use.

Show All Work

Using my equation I Found that the length of the rectangle is 13 in² and the width is 8 in². When you multiply 13 in² and 8 in² the product is 104 in², which is the given area of the rectangle.

Scoring Notes: The response demonstrates a limited understanding of quadratic and exponential equations and functions by providing an incorrect setup in Part A and by providing the correct values for length and width but with incorrect units. The response demonstrates a partial understanding of mathematical processes by showing several multiplication problems until finding the one that fits the scenario given in the prompt. This response receives zero points for content and one point for process.

Question 2, Sample F – Quadratic and Exponential Equations and Functions
Score Point 0; Process Score Point 0

A rectangle with an area of 104 square inches has a width that is 5 inches less than its length.

Part A

Write an equation representing the area of the rectangle. Use x to represent the length of the rectangle. Solve your equation for all values of x.

Show All Work

$104 = x \cdot w$

$104 - 2 = 52 \div 2 = 26 \div 2 = 13$

Part B

Use your solution to the equation to identify the width and length of the rectangle. Explain how you determined which value(s) of x to use.

Show All Work

I used 104÷2 to get 52. I then went on to divide 52 by 2 to get 26÷2=13. Since a rectangle doesn't have all congruent sides, 13 and 26 could be used for the 4 sides of this rectangle.

Scoring Notes: The response demonstrates limited understanding of quadratic and exponential equations and functions by providing an incorrect setup in Part A and incorrect values for length and width. The response demonstrates no understanding of mathematical processes related to quadratic equations as none of the steps shown can be used in any way to solve the given problem. This response receives zero points for content and zero points for process.

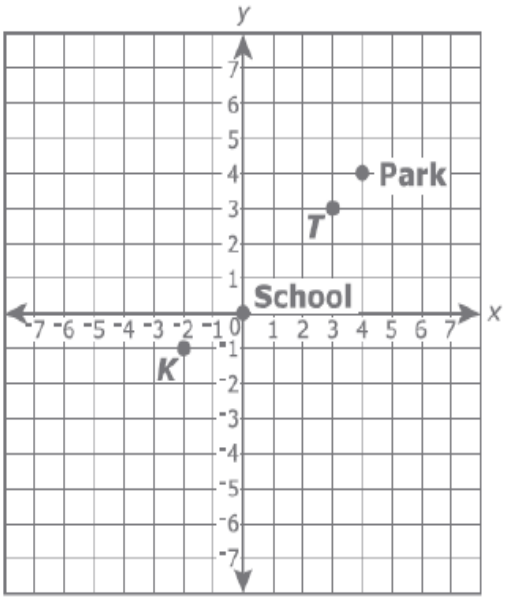
Item #3

Constructed-Response

Constructed-Response
Geometry and Measurement
Mathematical Process

Question 3

3. The coordinate grid shows the location of a school and a park. Point *K* represents the location of Kim's home, and point *T* represents the location of Tim's home.



Part A

What is the shortest distance between the school and the park on the grid? Round your answer to the nearest tenth of a unit. Use words, numbers, and/or symbols to explain how you found your answer.

_____

_____

_____

_____

Distance: _____ units

Part B

Tim claims that the distance from the school to the park is the same as the distance from Kim's home to Tim's home. Use words, numbers, and/or symbols to explain whether he is correct.

_____

_____

_____

_____

Exemplary Response:

Part A

5.7 units

Part B

No, Tim is not correct. The distance between Tim's home and Kim's home is greater than the distance from the school to the park.

- Sample Process

The Pythagorean Theorem can be used to determine the shortest distance between two points on a coordinate plane, the school and the park. Extend vertical or horizontal rays from the two points. The intersection of those rays will form the right angle in the right triangle.

$4^2 + 4^2 = c^2$
$16 + 16 = c^2$
$c^2 = 32$
$c = \sqrt{32}$, which is approximately 5.7 units (rounded to the nearest tenth)

OR

- Other valid process

$5^2 + 4^2 = c^2$
$25 + 16 = c^2$
$c^2 = 41$
$c = \sqrt{41}$, which is approximately 6.4 units (rounded to the nearest tenth)

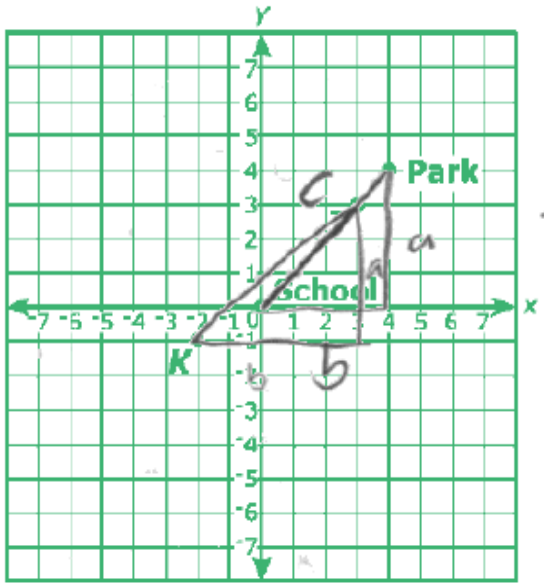
$6.4 > 5.7$, so the distances are not equal.

OR

- Other valid process

Question 3, Sample A – Geometry and Measurement Score Point 2; Process Score Point 2

The coordinate grid shows the location of a school and a park. Point *K* represents the location of Kim's home, and point *T* represents the location of Tim's home.



K = Kim

T = Tim

a = 4 b = 4

$a^2+b^2=c^2$

$4^2+4^2=c^2$

$16+16=c^2$

$32=c^2$

Part A $\sqrt{32} = c$

What is the shortest distance between the school and the park on the grid? Round your answer to the nearest tenth of a unit. Use words, numbers, and/or symbols to explain how you found your answer.

$a^2+b^2=c^2$ ← pythagorean formula for right triangle lengths

a=4 b=4

$4^2+4^2=c^2$ $16+16=c^2$ $32=c^2$

$\sqrt{32}=c$ $c=5.657$ 5.7

Distance: 5.7 units

Part B

Tim claims that the distance from the school to the park is the same as the distance from Kim's home to Tim's home. Use words, numbers, and/or symbols to explain whether he is correct.

$a^2+b^2=c^2$ $a=4$ $b=5$

$4^2+5^2=c^2$ $16+25=c^2$ $41=c^2$

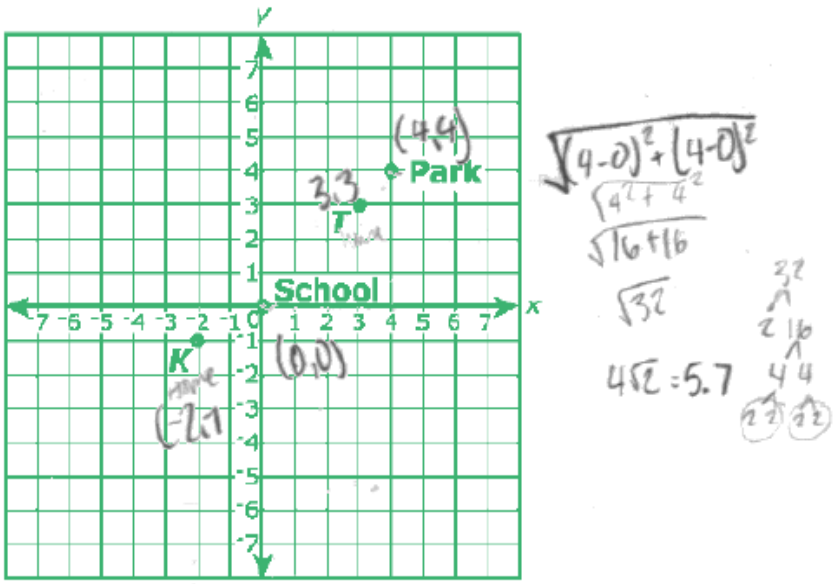
$\sqrt{41}=c$ $c=6.403$ 6.4 He is not correct

distance Tim to Kim $6.4 \neq 5.7$ distance park to school

Scoring Notes: The response demonstrates a thorough understanding of geometry and measurement by providing a correct setup in Parts A and B. The response demonstrates a thorough understanding of mathematical processes with correct calculations of the distances between the School and the Park in Part A and between Kim's Home and Tim's home in Part B. This response receives two points for content and two points for process.

Question 3, Sample B – Geometry and Measurement Score Point 2; Process Score Point 1

The coordinate grid shows the location of a school and a park. Point *K* represents the location of Kim's home, and point *T* represents the location of Tim's home.



Part A

What is the shortest distance between the school and the park on the grid? Round your answer to the nearest tenth of a unit. Use words, numbers, and/or symbols to explain how you found your answer.

The shortest distance between the school and the park on the grid is 5.7 units. I found my answer by pluggin in the coordinates of the school, (0,0), and the park, (4,4), into the distance formula, $\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$.

Distance: 5.7 units

Part B

Tim claims that the distance from the school to the park is the same as the distance from Kim's home to Tim's home. Use words, numbers, and/or symbols to explain whether he is correct.

The distance from the school to the park is not the same as the distance from Kim's to Tim's home, proving Tim wrong. Just like the distance from the school to the park, I plugged in the coordinates for Kim's and Tim's house into the distance formula.

Park → School
5.7 units

K → T
6.7 units

K T
(2,-1) (3,3)

$\sqrt{(3++2)^2+(3++1)^2}$

$\sqrt{5^2+4^2}$

$\sqrt{25+20}$

$\sqrt{45}$

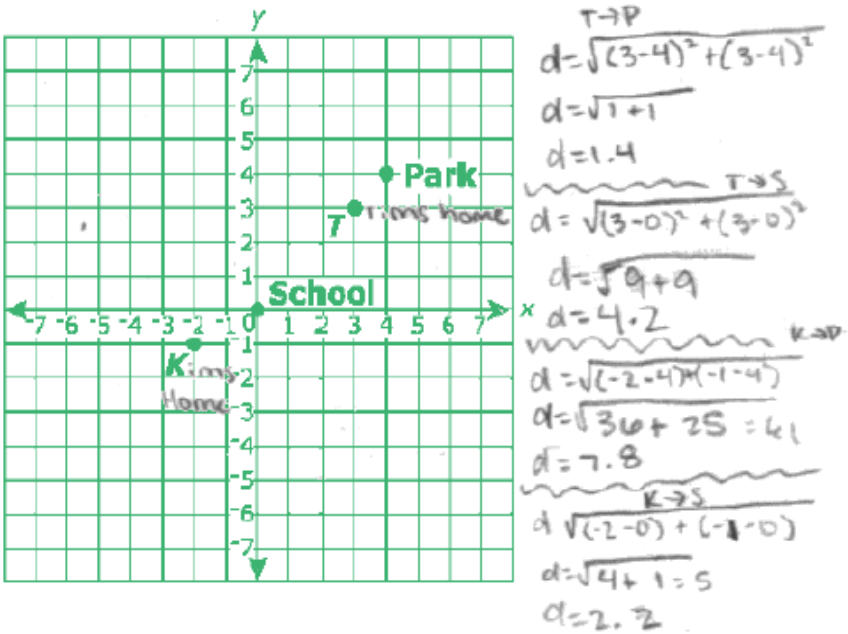
$3\sqrt{5}=6.7$

45
5 9
3 3

Scoring Notes: The response demonstrates a thorough understanding of geometry and measurement by providing a correct setup in Parts A and B. The response demonstrates a partial understanding of mathematical processes with a correct calculation of the distance between the School and the Park in Pat A, but with a minor error in the calculation between Kim's Home and Tim's home in Part B. This response receives two points for content and one point for process.

Question 3, Sample C – Geometry and Measurement Score Point 1; Process Score Point 2

The coordinate grid shows the location of a school and a park. Point *K* represents the location of Kim's home, and point *T* represents the location of Tim's home.



Part A

What is the shortest distance between the school and the park on the grid? Round your answer to the nearest tenth of a unit. Use words, numbers, and/or symbols to explain how you found your answer.

The closest distance is Tims house. His combined distance was 5.6. Kims combined was 10.

Distance: 5.6 units

Part B

Tim claims that the distance from the school to the park is the same as the distance from Kim's home to Tim's home. Use words, numbers, and/or symbols to explain whether he is correct.

No, this is incorrect. The distance from the school to the park is only 5.7. The distance from Kims house to Tims house is 6.4.

$d\ S\ to\ P = \sqrt{(0-4)^2 + (0-4)^2}$

$d = \sqrt{16 + 16 = 32}$

$d = 5.7$

$d\ K\ to\ T = \sqrt{(-2-3)^2 + (-1-3)^2}$

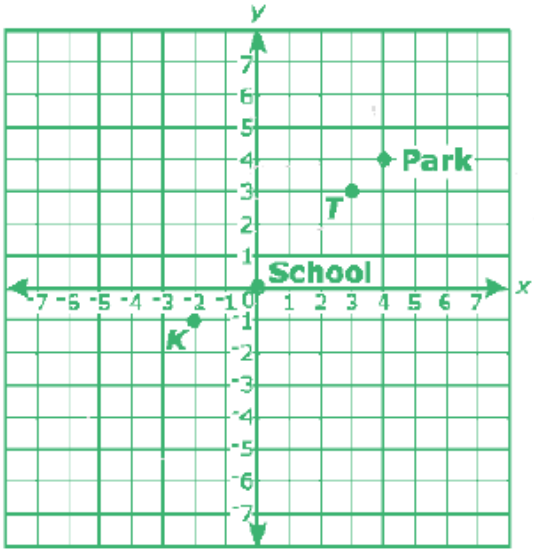
$d = \sqrt{25 + 16 = 41}$

$d = 6.4$

Scoring Notes: The response demonstrates a partial understanding of geometry and measurement by providing an incorrect setup and distance between the School and the Park in Part A, but a correct setup in Part B. The response demonstrates a thorough understanding of mathematical processes with correct calculation and conclusion in Part B and a correct calculation based on the incorrect setup in Part A. This response receives one point for content and two points for process.

Question 3, Sample D – Geometry and Measurement Score Point 1; Process Score Point 1

The coordinate grid shows the location of a school and a park. Point *K* represents the location of Kim's home, and point *T* represents the location of Tim's home.



$d = \sqrt{(4-0)^2 + (4-0)^2}$

$d = \sqrt{16}$

$d = 4$ units

Part A

What is the shortest distance between the school and the park on the grid? Round your answer to the nearest tenth of a unit. Use words, numbers, and/or symbols to explain how you found your answer.

The shortest distance between the school and the park would be 4 units. I found the distance by using the distance formula.

Distance: 4 units

Part B

Tim claims that the distance from the school to the park is the same as the distance from Kim's home to Tim's home. Use words, numbers, and/or symbols to explain whether he is correct.

No, Tim is not correct. The distance from the school to the park is 4 units. However, from Tim's house to Kim's house is about 6.4 units, meaning they are not the same.

School to Park. 4 units

tim (3,3)
Kim (-2,-1)

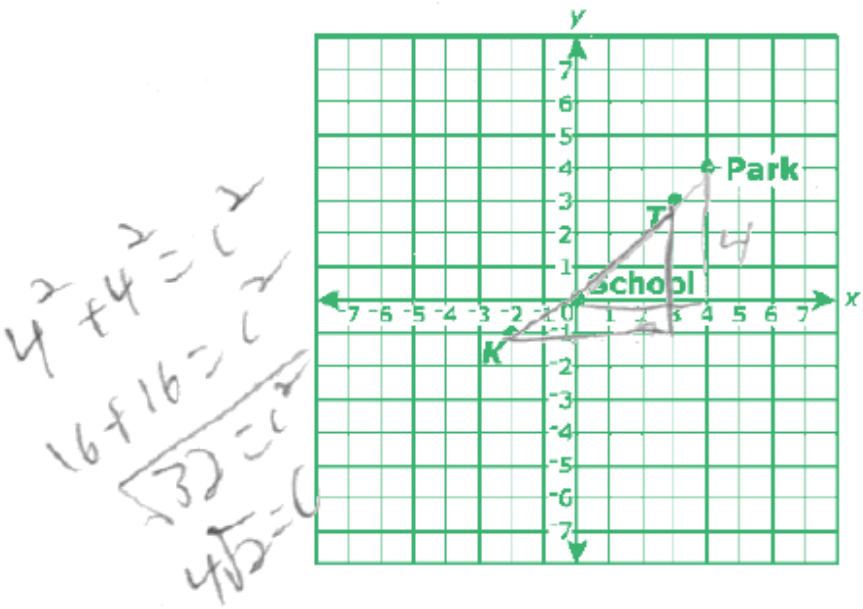
$d = \sqrt{(3+2)^2 + (3+1)^2}$
$d = \sqrt{25 + 16}$
$d = \sqrt{41}$

$d = 6.4$ units

Scoring Notes: The response demonstrates a partial understanding of geometry and measurement by providing an incorrect setup and incorrect solution in Part A, but a correct setup and solution in Part B. The response demonstrates a partial understanding of mathematical processes with an incorrect calculation in Part A, but a correct calculation in Part B. This response receives one point for content and one point for process.

Question 3, Sample E – Geometry and Measurement Score Point 0; Process Score Point 1

The coordinate grid shows the location of a school and a park. Point *K* represents the location of Kim's home, and point *T* represents the location of Tim's home.



$4^2 + 4^2 = c^2$

$16 + 16 = c^2$

$\sqrt{32} = c$

$4\sqrt{2} = c$

Part A

What is the shortest distance between the school and the park on the grid? Round your answer to the nearest tenth of a unit. Use words, numbers, and/or symbols to explain how you found your answer.

The answer was found by finding the lengths of both the legs of a right triangle where the Distance is the hypotenuse, Then using the pythagorean theorem.

Distance: $4\sqrt{2}$ units

Part B

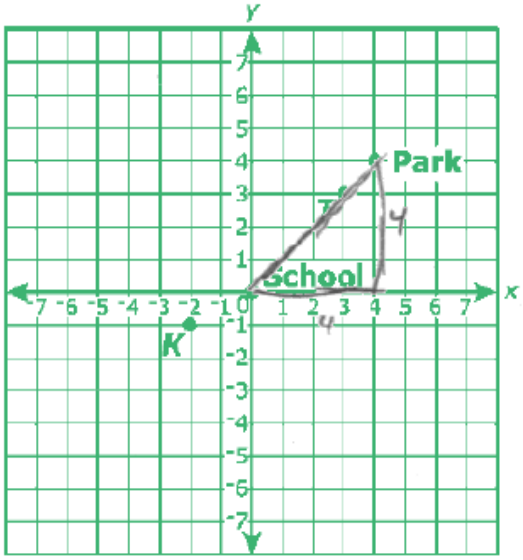
Tim claims that the distance from the school to the park is the same as the distance from Kim's home to Tim's home. Use words, numbers, and/or symbols to explain whether he is correct.

The distance is not the same because the right triangle made using "K" and "J" was not congruent to the one made with the school and park

Scoring Notes: The response demonstrates a limited understanding of geometry and measurement by providing a correct setup in Part A only and by providing a solution that is not in the format requested in the problem. The response demonstrates a partial understanding of mathematical processes by calculating the correct distance between the School and the Park in Part A, but failing to provide any setup or calculations in Part B. This response receives zero points for content and one point for process.

Question 3, Sample F – Geometry and Measurement Score Point 0; Process Score Point 0

The coordinate grid shows the location of a school and a park. Point *K* represents the location of Kim's home, and point *T* represents the location of Tim's home.



Part A

What is the shortest distance between the school and the park on the grid? Round your answer to the nearest tenth of a unit. Use words, numbers, and/or symbols to explain how you found your answer.

5.6 is correct because you us pythagorean theorem to find the hypotonuse

Distance: 5.6 units

Part B

Tim claims that the distance from the school to the park is the same as the distance from Kim's home to Tim's home. Use words, numbers, and/or symbols to explain whether he is correct.

no, because the distance from kims home to school would be the same as tims to the park

Scoring Notes: The response demonstrates a limited understanding of geometry and measurement by providing a description that the Pythagorean Theorem should be used and a solution that was rounded incorrectly in Part A and by providing no setup and a misconception in Part B. The response demonstrates a limited understanding of mathematical processes by showing no work in Parts A and B. This response receives zero points for content and zero points for process.

Item #4

Extended-Response

Extended-Response
Algebra and Functions
Mathematical Process

Question 4

4. The table shows the price, P, for renting a car for d days from a car-rental company.

Number of Days, *d*	**Price, *P***
1	$115
2	$150
3	$185
4	$220

Part A

Construct a linear function that models the relationship between the price, P, and the number of days, d, for which the car is rented. Show the steps that are required in order to construct the model.

Part B

What is the slope of the line in Part A? What does it represent in the context of the problem?

Show All Work

Part C

What is the value of this function when $d = 0$? What does this value represent in the context of the problem?

Show All Work

Exemplary Response:

Part A

- Sample Process:

Let m = slope of the line
Let b = y-intercept of the line

m = (150 – 115)/(2 – 1) = 35/1 = 35

slope-intercept form of equation is: y = mx + b

so, linear equation has form of y = 35x + b
substitute an ordered pair from the table (3, 185)

this means 185 = (35)*(3) + b
185 = 105 + b
b = 185 – 105
b = 80

so y = mx + b form becomes y = 35x + 80

given our variables d and P, we have: P = 35d + 80

Part B

Slope = 35 (from Part A)

The slope represents how much the price changes per day. Here, the price increases by $35 per day.

When d = 0, we are at the vertical intercept. Substituting d = 0 into P = 35d + 80 ----------> P = (35)*(0) + 80
P = 0 + 80 which means P = 80, when d = 0. This P value of 80 corresponds to the vertical intercept. So at day 0, the rental car costs $80. This $80 is the initial cost of renting the car (or the fixed cost) before the variable cost of $35 per day is included.

OR

- Other valid process

Question 4, Sample A – Algebra and Functions Score Point 3; Process Score Point 3

The table shows the price, P, for renting a car for d days from a car-rental company.

Number of Days, d	Price, P
1	\$115
2	\$150
3	\$185
4	\$220

Part A

Construct a linear function that models the relationship between the price, P, and the number of days, d, for which the car is rented. Show the steps that are required in order to construct the model.

$(1,115)\ (2,150)$ $\quad m = \frac{\Delta y}{\Delta x} = \frac{150-115}{2-1} = \frac{35}{1}$

$P = md + b$

$y = 35x + b$

$(115) = 35(1) + b$

$-35 \quad -35$

$b = 80$

$\boxed{\begin{array}{l} y = 35x + 80 \\ P = 35d + 80 \end{array}}$

Part B

What is the slope of the line in Part A? What does it represent in the context of the problem?

Show All Work

The slope of the line is $\frac{35}{1}$ or 35.

In the problem, the slope represents the increase in price for each day that you use the rental car.

$(1,115)\ (2,150)$ $m = \frac{\Delta y}{\Delta x}$ $m = \frac{150-115}{2-1} = \frac{35}{1}$

Part C

What is the value of this function when $d = 0$? What does this value represent in the context of the problem?

$P = 35x + b$ $(1,115)$

$(115) = 35(1) + b$

$-35 \quad -35$

$b = 80$

Show All Work when $d=0$ → $P = 35d + 80$

$P = 35(0) + 80$ $P = 80.$

The value of the function when $d = 0$ is 80. This represents the initial payment to rent a car, before you add the amount of money that needs to be paid for the days that the car is used.

Scoring Notes: The response demonstrates a thorough understanding of algebra and functions by providing a correct equation in Part A, the correct slope in Part B, and the correct value for the P-intercept (vertical intercept) in Part C. The response demonstrates a thorough understanding of mathematical processes by correctly calculating the slope in Part A, correctly interpreting the slope in Part B, and correctly interpreting the P-intercept in Part C. This response receives three points for content and three points for process.

Question 4, Sample B – Algebra and Functions Score Point 3; Process Score Point 2

The table shows the price, P, for renting a car for d days from a car-rental company.

Number of Days, d x	Price, P y
1	\$115
2	\$150
3	\$185
4	\$220

Part A

$y = mx + b$

Construct a linear function that models the relationship between the price, P, and the number of days, d, for which the car is rented. Show the steps that are required in order to construct the model.

$P = m(d) + b$

$P = 35d + b$

$115 = 35(1) + b$

$115 = 35 + b$

$80 = b$

$\frac{115 - 150}{1 - 2} = 35$

$\boxed{P = 35d + 80}$

Part B

What is the slope of the line in Part A? What does it represent in the context of the problem?

Show All Work

$$\frac{115 - 150}{2 - 1} = \frac{-35}{-1} = \boxed{35}$$

The slope is 35, and it represents the rate of change per day.

Part C

What is the value of this function when $d = 0$? What does this value represent in the context of the problem?

Show All Work

$P = 35(0) + 80 \quad P = 80$

when $d = 0$, $P = 80$. This value would represent the y intercept, or the cost of a car for 0 days.

Scoring Notes: The response demonstrates a thorough understanding of algebra and functions by providing a correct equation in Part A, the correct slope in Part B, and the correct value for the P-intercept (vertical intercept) in Part C. The response demonstrates a partial understanding of mathematical processes by correctly calculating the slope in Part A and correctly interpreting the P-intercept in Part C. However, the slope is misinterpreted in Part B, as rate of change per day is provided, but the units (of price) are not. This response receives three points for content and two points for process.

Question 4, Sample C – Algebra and Functions Score Point 2; Process Score Point 3

The table shows the price, P, for renting a car for d days from a car-rental company.

Number of Days, d	Price, P
1	$115
2	$150
3	$185
4	$220

Part A

Construct a linear function that models the relationship between the price, P, and the number of days, d, for which the car is rented. Show the steps that are required in order to construct the model.

1 = 115
2 = 150

$$\begin{array}{r} 150 \\ -115 \\ \hline 35 \end{array} \qquad \begin{array}{r} 115 \\ -35 \\ \hline 80 \end{array}$$

$P = 35d + 115$

Part B

What is the slope of the line in Part A? What does it represent in the context of the problem?

Show All Work

The slope is 35, it represents the cost of the car each time another day passes

Part C

What is the value of this function when $d = 0$? What does this value represent in the context of the problem?

Show All Work

When d=0, the value of the function is 115, which represents the initial cost of renting a car.

Scoring Notes: The response demonstrates a partial understanding of algebra and functions by providing the correct slope in Part B, and the correct value for the P-intercept (vertical intercept) in Part C. However, an incorrect equation is given in Part A. The response demonstrates a thorough understanding of mathematical processes by correctly calculating the slope in Part A, correctly interpreting the slope in Part B, and correctly interpreting the P-intercept in Part C. This response receives two points for content and three points for process.

Question 4, Sample D – Algebra and Functions Score Point 2; Process Score Point 2

The table shows the price, *P*, for renting a car for *d* days from a car-rental company.

Number of Days, *d*	Price, *P*
1	$115
2	$150
3	$185
4	$220

Part A

Construct a linear function that models the relationship between the price, *P*, and the number of days, *d*, for which the car is rented. Show the steps that are required in order to construct the model.

$d = p + 35$

Step 1: find the difference between each price by subtracting day 2 from day 1.

Step 2: find varibles and plug them in correctly

Step 3: plug in 35, the diffence between the prices.

Part B

What is the slope of the line in Part A? What does it represent in the context of the problem?

Show All Work

d = p + 35

* slope is $35 each day

* It means every day the prices are added onto by 35 dollars.

Part C

What is the value of this function when $d = 0$? What does this value represent in the context of the problem?

Show All Work

$$\begin{array}{r} 115 \\ -35 \\ \hline 80 \end{array}$$

* 0 = $80

Scoring Notes: The response demonstrates a partial understanding of algebra and functions by providing the correct slope in Part B, and the correct value for the P-intercept (vertical intercept) in Part C. However, an incorrect equation is given in Part A. The response demonstrates a partial understanding of mathematical processes by correctly calculating the slope in Part A and correctly interpreting the slope in Part B. However, no explanation is given in Part C. This response receives two points for content and two points for process.

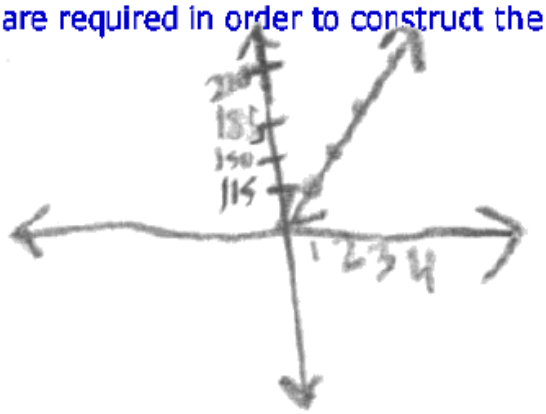
Question 4, Sample E – Algebra and Functions Score Point 1; Process Score Point 2

The table shows the price, *P*, for renting a car for *d* days from a car-rental company.

Number of Days, *d*	Price, *P*
1	$115
2	$150
3	$185
4	$220

Part A

Construct a linear function that models the relationship between the price, *P*, and the number of days, *d*, for which the car is rented. Show the steps that are required in order to construct the model.



Part B

What is the slope of the line in Part A? What does it represent in the context of the problem?

Show All Work

the Slope of the line is $\frac{35}{1}$.

It represents how much it costs per day you have the car for.

Part C

What is the value of this function when $d = 0$? What does this value represent in the context of the problem?

Show All Work

0 days = $85

115 − 35 = 85

This value represents how much it is to just rent a car which is $85.

Scoring Notes: The response demonstrates a limited understanding of algebra and functions by providing the correct slope in Part B but no equation in Part A and an incorrect value for the P-intercept in Part C. The response demonstrates a partial understanding of mathematical processes by interpreting the slope correctly in Part B and interpreting the P-intercept correctly in Part C. However, no process steps are shown in Part A. This response receives one point for content and two points for process.

Question 4, Sample F – Algebra and Functions Score Point 1; Process Score Point 1

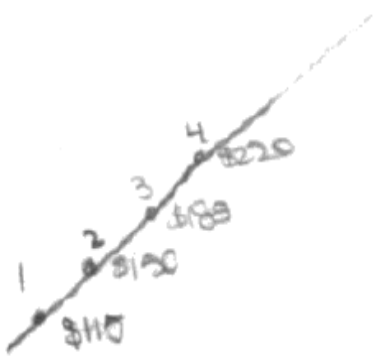
The table shows the price, *P*, for renting a car for *d* days from a car-rental company.

Number of Days, *d*	Price, *P*
1	$115
2	$150
3	$185
4	$220

Part A

Construct a linear function that models the relationship between the price, *P*, and the number of days, *d*, for which the car is rented. Show the steps that are required in order to construct the model.

$35 is added everyday



Part B

What is the slope of the line in Part A? What does it represent in the context of the problem?

Show All Work

$35 is added to the price everyday.

Slope = $\frac{1}{2}$

Part C

What is the value of this function when $d = 0$? What does this value represent in the context of the problem?

Show All Work

(day 1)

If d=0 115 - 35

Then p = 80

Scoring Notes: The response demonstrates a limited understanding of algebra and functions by providing a correct value for the P-intercept in Part C, but no equation in Part A and an incorrect slope in Part B. The response shows a limited understanding of mathematical processes by correctly interpreting the slope in Part B. However, the response provides insufficient work in Part A and no description of the P-intercept in Part C. This response receives one point for content and one point for process.

Question 4, Sample G – Algebra and Functions Score Point 0; Process Score Point 1

The table shows the price, P, for renting a car for d days from a car-rental company.

Number of Days, d	Price, P
1	\$115
2	\$150
3	\$185
4	\$220

x1 x1 x1 +35 +35 +35

Part A

Construct a linear function that models the relationship between the price, P, and the number of days, d, for which the car is rented. Show the steps that are required in order to construct the model.

$d = P + 35$

Part B

What is the slope of the line in Part A? What does it represent in the context of the problem?

Show All Work

Slope is X. It represents the price going up.

Part C

What is the value of this function when $d = 0$? What does this value represent in the context of the problem?

Show All Work It represents you don't have a car.

Scoring Notes: The response demonstrates no understanding of algebra and functions by providing an incorrect equation in Part A, an incorrect slope in Part B, and no value for the P-intercept in Part C. The response demonstrates a limited understanding of mathematical processes by providing a correct process to find the slope in Part A, but an incorrect explanation of slope in Part B and an incorrect description of the P-intercept in Part B. This response receives zero points for content and one point for process.

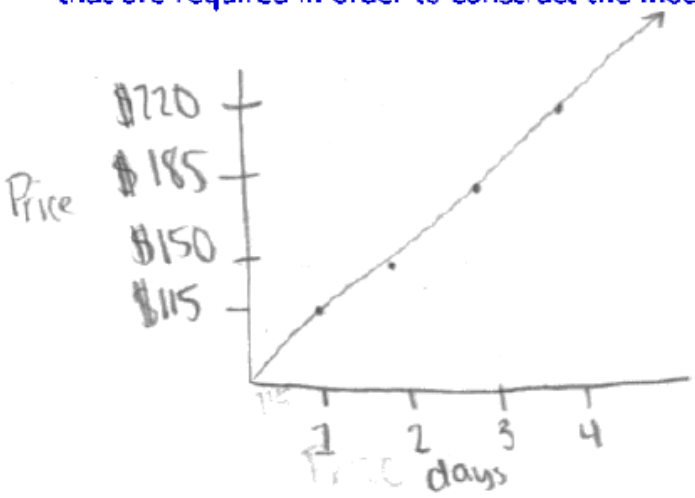
Question 4, Sample H – Algebra and Functions Score Point 0; Process Score Point 0

The table shows the price, *P*, for renting a car for *d* days from a car-rental company.

Number of Days, *d*	Price, *P*
1	$115
2	$150
3	$185
4	$220

Part A

Construct a linear function that models the relationship between the price, *P*, and the number of days, *d*, for which the car is rented. Show the steps that are required in order to construct the model.



Part B

What is the slope of the line in Part A? What does it represent in the context of the problem?

Show All Work

The slope is 1/1 or 1. This represents the cost being more for each extra day.

Part C

What is the value of this function when $d = 0$? What does this value represent in the context of the problem?

Show All Work

When d=0 the price will be zero as well. This will mean that the point will be on the origin.

Scoring Notes: The response demonstrates no understanding of algebra and functions by not providing an equation in Part A, by providing an incorrect slope in Part B, and by providing an incorrect value for the P-intercept in Part C. The response demonstrates no understanding of mathematical processes by not providing a process in Part A, and by providing an incorrect explanation of slope in Part B, and by providing an incorrect explanation of the P-intercept in Part C. This response receives zero points for content and zero points for process.