

Louisiana Believes

SAMPLE TEST ITEMS

Algebra I

CONTENTS

INTRODUCTION

Purpose

MULTIPLE-CHOICE ITEMS

A1: A-REI.B.4a Completing the Square to Rewrite the Equation

A1: A-CED.A.2 Equation Modeling Road Length

A1: A-APR.A.1 Multiplying Binomials

A1: F-IF.B.6 Average Rate of Change from a Table

A1: F-IF.C.8a Interpret x -intercept of Quadratic Equation

A1: F-BF.B.3 Recognize $f(x - k)$ Results in $g(x)$

A1: N-Q.A.2 Units to Model Growth Rate

A1: S-ID.A.3 Interpreting Data Mean from Table

A1: S-ID.C.8 Interpreting a Correlation Coefficient

A1: F-IF.A.3 Describe Number Sequences

A1: A-SSE.A.1 Interpret the Domain of the Expression

A1: A-REI.A.1 Maintain Equivalency of Equation

A1: F-IF.A.2 Interpret Function Notation

A1: F-BF.A.1 Jalea's Camera

A1: F-LE.B.5 Interpret Slope of Long Jump Function

A1: S-ID.C.9 Correlation, but No Causation of Sunscreen

A1: N-Q.A.1 Units for a Quotient of Fuel Efficiency by Speed

A1: S-ID.B.5 Park Support by Neighborhood

CONSTRUCTED-RESPONSE ITEMS

A1: A-REI.B.4 Solving Quadratics

Sample Student Responses

A1: F-IF.A.2 Interpreting Features of a Quadratic Equation

Sample Student Responses

A1: F-IF.B.4 Modeling a Function for Water Spray

INTRODUCTION

Louisiana Believes embraces the principle that all children can achieve at high levels and promotes the idea that Louisiana’s educators should be empowered to make decisions to support the success of their students. In keeping with these values, the Louisiana Department of Education (LDOE) created this document with released and sample test items to help prepare teachers and students for the End-of-Course (EOC) assessments. These items reflect the LDOE’s commitment to deliver consistent and rigorous assessments and provide educators and families with clear information about expectations for student performance.

Purpose of This Document

Teachers are encouraged to use the released and sample test items to gauge student learning, guide instruction, and develop classroom assessments and tasks. The document includes multiple-choice and constructed-response items that exemplify how the [Louisiana Student Standards](#) for Mathematics will be assessed on the Algebra I EOC test. A discussion of each item highlights the knowledge and skills the item is intended to measure. It is important to remember that these sample items represent only a portion of the knowledge and skills measured by the Algebra I EOC test. The items assembled in this document have been previously available in separate documents released in 2013-2014 and 2014-2015. Additionally, these items have been reviewed by the LDOE to confirm alignment to the newly adopted content standards.

MULTIPLE-CHOICE ITEMS

This section presents a sampling of multiple-choice items selected to illustrate the types of skills and knowledge students need in order to demonstrate understanding of the Louisiana Student Standards and Standards for Mathematical Practices in the Algebra I course.

Information shown for each item includes the following:

- item data—conceptual category, domain, cluster, standard, Mathematical Practice(s) (MP), calculator designation (allowed or not allowed), correct answer
- commentary—on the skills and knowledge associated with the standard measured by the item, on the MP(s) linked with the item, on why the correct answer is correct (including how the answer is achieved), and on rationales for each incorrect answer option

A1: A-REI.B.4a Completing the Square to Rewrite the Equation

Solve quadratic equations in one variable.

- a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.

Calculator Allowed

Use the equation to answer the question.

$$2x^2 + 8x - 7 = 7$$

Natasha is completing the square to rewrite the equation. Which equation could be her result?

- A. $(x + 2)^2 = 7$
 B. $(x + 2)^2 = 9$
 C. $(x + 2)^2 = 11$
 D. $(x + 2)^2 = 15$

This item requires students to use the method of completing the square as a first step in solving the given quadratic equation. The method of completing the square results in an equation that is easier to interpret or solve. This item appears in the Online Tools Training (OTT).

Mathematical Practice(s)

MP 7 Students must recognize the structure of the quadratic and use this to create another equation that is more useful.

Correct Answer Explanation

- C. $(x + 2)^2 = 11$ One way to solve is by applying the following method.

step 1	$2x^2 + 8x - 7 = 7$ $\quad \quad +7 \quad +7$ $2x^2 + 8x = 14$	Add 7 to both sides of the equation.
step 2	$2(x^2 + 4x) = 14$	Factor 2 out of the left side of the equation.
step 3	$\frac{2(x^2 + 4x)}{2} = \frac{14}{2}$ $x^2 + 4x = 7$	Divide both sides of the equation by 2.
step 4	$x^2 + 4x = 7$ $\quad \quad +4 \quad +4$ $x^2 + 4x + 4 = 11$	Complete the square by adding 4 to both sides because $(4 \div 2)^2 = 4$.
step 5	$(x + 2)^2 = 11$	Write in factored form.

Incorrect Options Rationales for Incorrect Options

- A. $(x + 2)^2 = 7$ This is an incorrect answer because, in step 4, the student did not add 4 to the right side of the equation.
- B. $(x + 2)^2 = 9$ This is an incorrect answer because the student inverted steps 3 and 4. The student added 4 to both sides, and then divided by 2.
- D. $(x + 2)^2 = 15$ This is an incorrect answer because the student skipped steps 1 and 3. The student also multiplied the coefficient 2 by 4 when completing the square, and then added 8 to the right side of the equation.

A1: A-CED.A.2 Equation Modeling Road Length

Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

Calculator Neutral

A construction company spends w weeks extending an existing road. The existing road is 5 miles long. Each week the company completes 0.2 miles of the extension. Which equation models the **total** length (L) of the road over time?

- A. $L = 0.2w + 5$
- B. $L = 0.2w - 5$
- C. $w = 0.2L + 5$
- D. $w = 0.2L - 5$

This item requires students to select an equation in two variables to model the relationship between two quantities in a given situation. This item aligns to the content of the standard, but not the full depth and rigor with which it should be taught.

Mathematical Practice(s)

MP 4 Students must examine each linear equation to determine which slope and y -intercept correspond to the rate of change and initial value in the given real-world context.

Correct Answer**Explanation**

- | Correct Answer | Explanation |
|-------------------|---|
| A. $L = 0.2w + 5$ | The length of the extension completed by the construction company, 0.2 miles each week, may be represented by the expression $0.2w$. This quantity must be added to the existing length of road, 5 miles, to model the total length, L . |

Incorrect Options**Rationales for Incorrect Options**

- | Incorrect Options | Rationales for Incorrect Options |
|-------------------|---|
| B. $L = 0.2w - 5$ | The student incorrectly subtracts the length of the existing road instead of adding it to the length of the extension completed by the construction company over time. |
| C. $w = 0.2L + 5$ | This answer is a result of incorrectly transposing the variables that represent the number of weeks, w , the construction company spends extending the road and the total length of the road, L . |
| D. $w = 0.2L - 5$ | This answer represents incorrectly transposing the variables and also incorrectly subtracting the length of the existing road. |

A1: A-APR.A.1 Multiplying Binomials

Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

Calculator Not Allowed

Ellen organizes concerts for a band. She knows that if she charges \$50 per ticket, about 400 people will buy tickets. For every \$1 she lowers the ticket price, an additional 15 people will buy tickets. Ellen wrote this expression to show the total income from tickets, where x is the number of dollars the ticket price has been reduced.

$$(50 - x)(400 + 15x)$$

Which expression is equivalent to Ellen's?

- A. $14x + 450$
- B. $-15x + 20,000$
- C. $15x^2 - 400x + 20,000$
- D. $-15x^2 + 350x + 20,000$

This item requires students to multiply two binomials. Most items that assess this skill present the binomials with the x -terms first. Rearranging the terms, however, allows the expressions to align more naturally with the given context and more accurately assesses whether students understand the process of multiplying polynomials. This item appears in the Online Tools Training (OTT).

Mathematical Practice(s)

MP 7 Students must recognize that two binomials are being multiplied and apply the distributive property to find an equivalent expression.

Correct Answer**Explanation**

D. $-15x^2 + 350x + 20,000$

One method to solving this problem is to use the distributive property, as shown in the following steps. Using the distributive property over other methods connects to prior knowledge and extends its application.

step 1	$400(50 - x) + 15x(50 - x)$	distribute the first binomial to each term in the second binomial
step 2	$20,000 - 400x + 750x - 15x^2$	distribute 400 into each term in $(50 - x)$ then distribute $15x$ to each term in $(50 - x)$
step 3	$20,000 + 350x - 15x^2$	combine like terms
step 4	$-15x^2 + 350x + 20,000$	reorder terms

Incorrect Options**Rationales for Incorrect Options**

A. $14x + 450$

This answer is the result of adding the binomials instead of multiplying them.

B. $-15x + 20,000$

The student incorrectly multiplies only the like terms instead of using the distributive property.

C. $15x^2 - 400x + 20,000$

The student incorrectly applies the distributive property.

A1: F-IF.B.6 Average Rate of Change from a Table

Calculate and interpret the average rate of change of a linear, quadratic, piecewise linear (to include absolute value), and exponential function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

Calculator Allowed

Use the table to answer the question.

Gulf Water Temperature, Gulfport
(data collected on the fifteenth of the month)

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Water Temperature (°F)	63.9	64.4	66.8	73.1	78.1	82.4	85.2	86.7	84.5

A scientist measures the water temperature in the Gulf at Gulfport on the fifteenth of each month. Her data is shown in the table. What is the average rate of change between March 15 and June 15?

- A. 2.6°F per month
- B. 3.9°F per month
- C. 5.2°F per month**
- D. 7.8°F per month

This item requires students to interpret data from a table and use it to calculate the average rate of change of a function. This standard is often misinterpreted as finding the slope of a linear function where the rate of change is constant. However, it is meant to also apply to functions in which the rate of change fluctuates over time. Determining the slope of a linear function is a skill that is covered by the grade 8 Functions domain.

Mathematical Practice(s)

MP 2 Students must use familiar slope calculations to compute the average rate of change of the function given in the table. Then, they must contextualize their result to identify the average change in water temperature over time.

Correct Answer**Explanation**

C. 5.2°F per month

This is the result of dividing the change in temperature ($82.4 - 66.8$) by the number of months (3) that elapsed between the given dates.

Incorrect Options**Rationales for Incorrect Options**

A. 2.6°F per month

This response represents finding the average rate of change for the entire data set instead of the specified range of dates.

B. 3.9°F per month

This answer is a result of dividing the change in temperature ($82.4 - 66.8$) by the number of boxes represented by the specified range of dates (4), rather than the change in time.

D. 7.8°F per month

The student incorrectly computes the change in time as 2 months instead of 3 months.

A1: F-IF.C.8a Interpret x-intercept of Quadratic Equation

Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

- a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

Calculator Not Allowed

A cliff diver's height above the water, in meters, is modeled by the function $h(d) = -d^2 + 2d + 24$, where d represents how far the diver is from the cliff. How far from the cliff will the diver be when she reaches the water?

- A. 0 meters
 B. 4 meters
C. 6 meters
 D. 24 meters

This item requires students to find the zeros of a quadratic function and interpret the zeros in terms of the context. Factoring is the most likely method students will use to solve the problem. Most factoring items involve a positive leading coefficient. This item begins with a $(-d^2)$ term, which will more accurately assess whether students understand how to factor a trinomial without relying on memorized algorithms. The item also adds a real-world context to the quadratic function, which allows students to demonstrate their skills beyond simple factoring. This item appears in the Online Tools Training (OTT).

Mathematical Practice(s)

- MP 1 Students must recognize that reaching the water is the same as the function intersecting the x-axis. Then, they must determine the appropriate course of action to calculate the zeros of the function.
- MP 2 Students must reason quantitatively to find the zeros of the given quadratic function. Then, they must contextualize the meaning of the zeros.
- MP 7 Students must examine the structure of the function in order to determine the proper way to factor into a product of two binomials.

Correct Answer**Explanation**

C. 6 meters

The student factors the given quadratic equation to determine the zeros of the function. Then, the student selects the zero with a positive value, as it is the only value that makes sense in the context described. The steps below show how the student arrived at the answer.

step 1	$0 = -d^2 + 2d + 24$	set the equation equal to zero
step 2	$0 = (-d + 6)(d + 4)$	factor the equation
step 3	$0 = (-d + 6)$ $0 = (d + 4)$	set each binomial equal to zero (zero product property)
step 4	$d = 6$ $d = -4$	solve each equation for d
step 5	$d = 6$	select the result that makes sense in the context of the problem

Incorrect Options**Rationales for Incorrect Options**

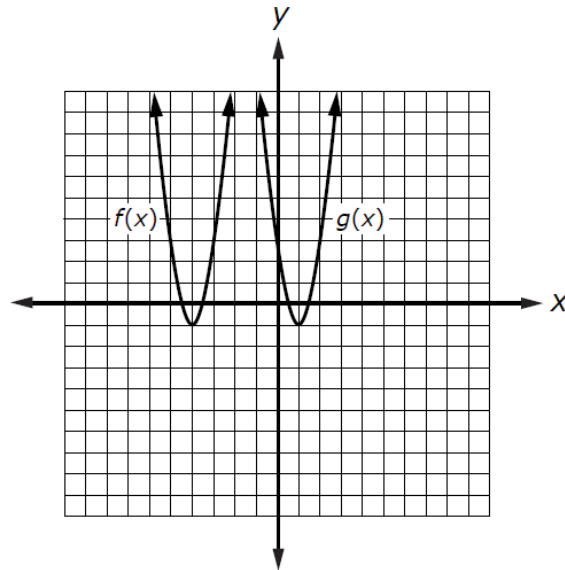
- A. 0 meters The student recognizes that the diver's height above the water is 0 meters when the diver reaches the water. However, the student confuses the vertical distance and the horizontal distance in the context of the problem.
- B. 4 meters The student has a sign error when solving the equation for d or has a sign error when factoring (step 4).
- D. 24 meters The student confuses the y-intercept of the graph with the x-intercepts that represent the zeros of the given function.

A1: F-BF.B.3 Recognize $f(x - k)$ Results in $g(x)$

Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative). Without technology, find the value of k given the graphs of linear and quadratic functions. With technology, experiment with cases and illustrate an explanation of the effects on the graphs that include cases where $f(x)$ is a linear, quadratic, piecewise linear (to include absolute value), or exponential function.

Calculator Not Allowed

Use the graph to answer the question.



Which equation relates $f(x)$ with $g(x)$?

- A. $g(x) = f(x) + 5$
- B. $g(x) = f(x) - 5$
- C. $g(x) = f(x + 5)$
- D. $g(x) = f(x - 5)$

This item requires students to identify the function $g(x)$ that correctly represents a transformation of the function $f(x)$. Students recognize that $g(x)$ is $f(x + k)$ and find the value of k , -5 , from the graph.

Mathematical Practice(s)

MP 7 Students must use the structure of the function $f(x)$ as a single entity and determine how the structure changes with different placements of k . Specifically, students need to determine whether to add 5 to or subtract 5 from the value of x or the function, $f(x)$, to correctly represent the function $g(x)$.

Correct Answer	Explanation
D. $g(x) = f(x - 5)$	Subtracting 5 from the value of x results in a horizontal translation of $f(x)$ to the right by 5 units.
Incorrect Options	Rationales for Incorrect Options
A. $g(x) = f(x) + 5$	The student incorrectly adds 5 to the function, $f(x)$. This represents a vertical translation of $f(x)$ up by 5 units.
B. $g(x) = f(x) - 5$	The student incorrectly subtracts 5 from the function, $f(x)$. This represents a vertical translation of $f(x)$ down by 5 units.
C. $g(x) = f(x + 5)$	The student incorrectly adds 5 to the value of x . This represents a horizontal translation of $f(x)$ to the left by 5 units.

A1: N-Q.A.2 Units to Model Growth Rate

Define appropriate quantities for the purpose of descriptive modeling.

Calculator Neutral

Kianna is writing an equation to model the growth rate of a vine treated with fertilizer. Which quantity is the **most** appropriate for modeling the growth rate?

- A. centimeters per day
- B. centimeters per hour
- C. feet per hour
- D. feet per day

This item requires students to consider which units would be most appropriate for modeling the growth rate of a vine. Even students who are not familiar with the actual growth rate will understand that a vine grows relatively slow. This leaves only one clearly correct response.

Mathematical Practice(s)

MP 2 Using the context, students must reason about the most appropriate units of measure and time to form a rate.

Correct Answer**Explanation**

A. centimeters per day These units will generate a very usable equation that more closely models the growth.

Incorrect Options**Rationales for Incorrect Options**

B. centimeters per hour If growth rate of a vine were measured in these units, it would be represented in fractions of a centimeter for each hour. Using these units would result in an equation that models the growth of the vine, but would not be usable in a realistic situation.

C. feet per hour If the growth rate of a vine were measured in these units, it would be measured in very small fractions of a foot for each hour. The quantity is not easily measurable and thus would result in a model that would not be practical to use.

D. feet per day If the growth rate of a vine were measured in these units, it would be measured in fractions of a foot for each day. The quantities measured would generate a model that would be impractical to use in a realistic situation.

A1: S-ID.A.3 Interpreting Data Mean from Table

Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

Calculator Allowed

Use the table to answer the question.

T-shirt Price Statistics for Two Stores

Store	Median	Mean	Interquartile Range
Cool Clothes	\$13.99	\$18.53	\$8.24
Ben's Shirts	\$14.99	\$14.63	\$4.60

Which conclusion about T-shirt prices at Cool Clothes and Ben's Shirts is **best** supported by the data?

- A. Some high-priced T-shirts at Cool Clothes make the mean higher than the median.
- B. The fact that the mean and median are very similar at Ben's Shirts shows that all of the shirts cost under \$15.
- C. Comparing the mean prices shows that most shirts are cheaper at Ben's Shirts than at Cool Clothes.
- D. Comparing the interquartile range shows that T-shirts at Cool Clothes are about twice as expensive as T-shirts at Ben's Shirts.

This item requires students to interpret data from a table and analyze how the statistical measures compare the prices of T-shirts for two stores. Students must select the description that accurately expresses the meaning of the data. The item requires more analysis of the statistical measures than the skills covered by the grade 7 Statistics and Probability domain.

Mathematical Practice(s)

MP 2 Students must reason about what the numerical statistical measures signify relative to the context of the given real-world situation.

Correct Answer

Explanation

A. Some high-priced T-shirts at Cool Clothes make the mean higher than the median.

High-priced shirts at Cool Clothes cause the mean to be significantly greater than the median.

Incorrect Options

Rationales for Incorrect Options

B. The fact that the mean and median are very similar at Ben's Shirts shows that all of the shirts cost under \$15.

The student does not use the interquartile range, which shows that there is a range of prices at Ben's Shirts that goes above \$15.

C. Comparing the mean prices shows that most shirts are cheaper at Ben's Shirts than at Cool Clothes.

This answer is the result of incorrectly interpreting the mean, which does not provide evidence about the number of shirts that are priced for less at Ben's Shirts than at Cool Clothes.

D. Comparing the interquartile range shows that T-shirts at Cool Clothes are about twice as expensive as T-shirts at Ben's Shirts.

The student incorrectly interprets the interquartile range, which quantifies spread and is not a measure of center. The interquartile range does not provide details about specific values that would allow the student to state that shirts are "about twice as expensive."

A1: S-ID.C.8 Interpreting a Correlation Coefficient

Compute (using technology) and interpret the correlation coefficient of a linear fit.

Calculator Neutral

Deany collects data for a market research company on the number of dollars men and women spend on video games per year as a function of their age. She then models the data using linear functions.

- The correlation coefficient for the function for men is 0.30.
- The correlation coefficient for the function for women is 0.15.

Which statement correctly describes the meaning of the correlation coefficients?

- A. Men spend approximately twice as much as women on video games.
- B. **The function for men represents the amount they spend on video games better than the function for women.**
- C. Men spend the most on video games at age 30, and women spend the most on video games at age 15.
- D. Men increase the amount they spend on video games by 30% each year, and women increase the amount they spend by 15%.

This item requires students to select the description that accurately expresses a correct comparison of the given correlation coefficients. It is difficult to assess computing correlation coefficients using technology on a standardized test, but asking students to interpret correlation coefficients accurately measures whether students understand the statistical definition. This item appears in the Online Tools Training (OTT).

Mathematical Practice(s)

MP 2 Students must reason about what the correlation coefficients mean in the context of the given real-world situation. Then, they must translate these statistical measures into everyday language.

Correct Answer**Explanation**

B. The function for men represents the amount they spend on video games at age 15.

A higher correlation coefficient represents a greater linear dependence between age and the amount of money spent on video games each year.

Incorrect Options**Rationales for Incorrect Options**

A. Men spend approximately twice as much as women on video games.

The student incorrectly confuses the correlation coefficient with the relative amount of money men spend on video games versus women.

C. Men spend the most on video games at age 30, and women spend the most on video games at age 15.

The student incorrectly interprets the correlation coefficients as representing the age at which men and women spend the most amount of money on video games.

D. Men increase the amount they spend on video games by 30% each year, and women increase the amount they spend by 15%.

The student incorrectly interprets the correlation coefficient as the percentage increase in the amount of money men and women spend on video games each year.

A1: F-IF.A.3 Describe Number Sequences

Recognize that sequences are functions whose domain is a subset of the integers. Relate arithmetic sequences to linear functions and geometric sequences to exponential functions.

Calculator Neutral

Use the number sequences to answer the question.

	Term 1	Term 2	Term 3	Term 4	Term 5	Term 6
Sequence I	2	4	8	16	32	64
Sequence II	10	20	30	40	50	60
Sequence III	1	5	1	5	1	5

The table shows the first 6 terms for three different number sequences.

Which statement describes all number sequences?

- A. Sequences are functions, with the previous term as the domain and the following terms as the range.
- B. Sequences are not functions because the same number can appear more than once in a sequence.
- C. Sequences are functions, with the term number as the domain and the terms of the sequence as the range.
- D. Sequences are not functions because functions relate two sets of numbers, the inputs and the outputs, and sequences have only one set of numbers.

This item provides the first six terms of three sequences for students to determine whether sequences are functions and select the proper justification to support their conclusion. Students do not necessarily need to use the sequences provided if they have retained knowledge of sequences as functions from their classroom investigations. If students are fluent in mathematical language, the precise vocabulary used in this item should not be troubling and students should be able to reason through the language with ease.

Mathematical Practice(s)

MP 6	Students must understand the various mathematical vocabulary terms used throughout the answer choices.
MP 7	Students may use the structure of each sequence to determine a rule that applies to all sequences.
MP 8	Students should look for the repeated reasoning in the relationship between each term number and the corresponding term within each sequence to formulate and justify a conclusion.

Correct Answer	Explanation
C. Sequences are functions, with the term number as the domain and the terms of the sequence as the range.	Students may use previous knowledge or the sequences shown to determine that sequences are functions with one input having only one output. From there, students then determine that the input (domain) is the term number and the output (range) is the term itself. This item requires solid understanding and use of common mathematical language.
Incorrect Options	Rationales for Incorrect Options
A. Sequences are functions, with the previous term as the domain and the following terms as the range.	Students may use previous knowledge or the sequences shown to determine that sequences are functions with each input having only one output, but do not understand where the input (domain) and output (range) are in relation to the sequence.
B. Sequences are not functions because the same number can appear more than once in a sequence.	This answer possibly results from misunderstanding the concept of a function as an input having only one output, whereas the “justification” offered (the same output occurring for different inputs) is acceptable for a function.
D. Sequences are not functions because functions relate two sets of numbers, the inputs and the outputs, and sequences have only one set of numbers.	This answer is the possible result of misunderstanding the definition of a function.

A1: A-SSE.A.1 Interpret the Domain of the Expression

Interpret expressions that represent a quantity in terms of its context.

- Interpret parts of an expression, such as terms, factors, and coefficients.
- Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P .*

Calculator Neutral

Omar deposited d dollars into a savings account y years ago. Now he is going to use a portion of the money in his savings account to buy a bicycle. This expression can be used to find the percentage of the money in the savings account that Omar will use for the bicycle.

$$\frac{342}{d(1.03)^y} \times 100$$

What is the meaning of the denominator in the expression?

- the amount Omar will pay for the bicycle
- the amount in Omar's savings account now
- the yearly interest rate for the savings account
- the amount originally deposited in the savings account

This item requires students to interpret the quantity shown in the denominator in terms of the given context without explicitly stating what each value in the expression represents. The variables d and y are defined in the context, but the numeric value 1.03 is not. Students should use working knowledge for annual growth rate to recognize the structure of $(1.03)^y$. That quantity multiplied by the amount deposited would give to total amount in Omar's savings account now. Most students chose options C or D, interpreting only part of the denominator.

Mathematical Practice(s)

MP 2 Students must make sense of the quantities shown in the expression and their relationships to the context.

MP 7 Students should use the structure of the quantity shown in the denominator to determine that $(1.03)^y$ represents a rate of growth and d is the principal deposited. Multiplying the two together results in the current amount in the savings account. Students are not explicitly told what 1.03 represents in the given situation.

Correct Answer**Explanation**

B. the amount in Omar's savings account now

Students may look at the parts of the denominator separately in order to interpret the denominator as a whole in terms of the context. Students may recognize that $(1.03)^y$ represents a rate of growth and d is the principal deposited and understand that multiplying $d(1.03)^y$ is multiplying the original deposit times an annual growth rate. This would produce the amount of money in Omar's savings account now.

Incorrect Options**Rationales for Incorrect Options**

A. the amount Omar will pay for the bicycle

This choice represents the numerator of the fraction in the expression. Students may have confused the term denominator with numerator.

C. the yearly interest rate for the savings account

This choice represents only the numeric value of .03 in the denominator. Since the context defined the variables d and y , students may have misunderstood the question and thought they were only supposed to interpret the numeric value shown in the denominator, which was not explained in the context.

D. the amount originally deposited in the savings account

This choice represents only the definition of the variable d . Students may not have understood how d changed when multiplied by $(1.03)^y$.

A1: A-REI.A.1 Maintain Equivalency of Equation

Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

Calculator Not Allowed

Use the steps in the table to answer the question.

initial equation	$3(x + 2)^2 + 6x - x = 25x + 7x$
step 1	$3(x + 2)^2 + 5x = 32x$
step 2	$3(x + 2)^2 = 27x$
step 3	$(x + 2)^2 = 9x$
step 4	$x^2 + 4x + 4 = 9x$
step 5	$x^2 - 5x + 4 = 0$

The table shows the first 5 steps used to solve an equation.

Which statement is an incorrect explanation of one step in the process?

- A. From step 4, apply the subtraction property of equality to $x^2 + 4x + 4$ and $9x$ to get $x^2 - 5x + 4 = 0$.
- B. From step 3, apply the distributive property to $(x + 2)^2$ to get $x^2 + 4x + 4$ in step 4.
- C. From step 2, apply the distributive property to $3(x + 2)^2$ and $27x$ to get $(x + 2)^2 = 9x$ in step 3.
- D. From step 1, apply the subtraction property of equality to $5x$ and $32x$ to get $3(x + 2)^2 = 27x$ in step 2.

This item requires students to determine which mathematical properties are used in the steps to solve the initial equation. Students must then determine which statement includes an incorrect property as an explanation for going from one step to another in the solving process shown in the table. The most common error is students not realizing that squaring a binomial is using the distributive property.

Mathematical Practice(s)

MP 6 Students need to understand appropriate mathematical terms and the individual steps required to solve an equation to decipher which explanation is incorrect.

MP 7 Students should examine the structure of the equation at each step in the process shown in order to determine which property has been applied from one step to the next.

Correct Answer	Explanation
C. From step 2, apply the distributive property to $3(x + 2)^2$ and $27x$ to get $(x + 2)^2 = 9x$ in step 3.	Students understand that the distributive property is not the correct property to describe the process from step 2 to step 3. Correct explanations for this part of the solving process is to either apply the division property of equality or multiply both sides of the equation by the inverse of 3.
Incorrect Options	Rationales for Incorrect Options
A. From step 4, apply the subtraction property of equality to $x^2 + 4x + 4$ and $9x$ to get $x^2 - 5x + 4 = 0$.	Students choosing this option may not have realized that to go from step 4 to step 5 the term $9x$ would be subtracted from both sides of the equation, thus $4x - 9x = -5x$ and $9x - 9x = 0$. The subtraction property of equality is the correct explanation for this part of the process.
B. From step 3, apply the distributive property to $(x + 2)^2$ to get $x^2 + 4x + 4$ in step 4.	Students choosing this option may not have realized that to go from step 3 to step 4 the binomial $(x + 2)$ is multiplied times itself or that the distributive property is the correct explanation, instead thinking of shortcut algorithms like the FOIL method. The FOIL method is not a property of mathematics.
D. From step 1, apply the subtraction property of equality to $5x$ and $32x$ to get $3(x + 2)^2 = 27x$ in step 2.	Students choosing this option may not have realized that to go from step 1 to step 2 the term $5x$ would be subtracted from both sides of the equation, thus $32x - 5x = 27x$ and $5x - 5x = 0$. The subtraction property of equality is the correct explanation for this part of the process.

A1: F-IF.A.2 Interpret Function Notation

Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

Calculator Neutral

Vincent goes to the gym for 30 minutes every day. He starts a new exercise routine on a Monday and uses a function to model the amount of calories he has used, $f(d)$, as a function of the number of days, d , he has exercised with the new routine.

Which statement represents a correct interpretation of $f(d)$?

- A. $f(5) = 150$ means Vincent has exercised for a total of 150 minutes after the fifth day of exercising with his new routine.
- B. $f(10) = 3,500$ means Vincent will use 3,500 calories on day 10 of exercising with his new routine.
- C. $f(15) = 5,250$ means after 15 days of exercising with his new routine, Vincent has used 5,250 calories.
- D. $f(30) = 10,500$ means the number of calories Vincent has used times 30 is equal to 10,500.

This item requires students to interpret quantities shown in function notation in terms of the given context.

Mathematical Practice(s)

MP 2 Students need to understand what the quantities shown in function notation represent and how to read function notation in order to process the quantitative and abstract information shown into contextualized reasoning.

MP 4 Students must choose the correct function notation which models the given explanation.

Correct Answer**Explanation**

C. $f(15) = 5,250$ means after 15 days of exercising with his new routine, Vincent has used 5,250 calories.

Students understand this represents an input of 15, d , and an output of 5,250, $f(d)$. So after 15 days of exercising with the new routine, Vincent has used 5,250 calories.

Incorrect Options**Rationales for Incorrect Options**

A. $f(5) = 150$ means Vincent has exercised for a total of 150 minutes after the fifth day of exercising with his new routine.

Students understand that an input represents the fifth day of exercising with the new routine but may not understand that the output is the number of calories used, not the amount of time spent exercising.

B. $f(10) = 3,500$ means Vincent will use 3,500 calories on day 10 of exercising with his new routine.

Students understand 10 is the number of days and 3,500 is the number of calories used. The error in this option is the interpretation that all 3,500 calories are used on day 10. The quantity 3,500 is an accumulation of calories over the 10 days of exercising with the new routine.

D. $f(30) = 10,500$ means the number of calories Vincent has used times 30 is equal to 10,500.

Students choosing this option do not demonstrate an understanding of function notation. These students see the parentheses as the operation of multiplication and f as a variable used to represent the number of calories. The quantities 30 and 10,500 are not interpreted qualitatively.

A1: F-BF.A.1 Jalea's Camera

Write a linear, quadratic, or exponential function that describes a relationship between two quantities.

- a. Determine an explicit expression, a recursive process, or steps for calculation from a context.

Calculator Neutral

Jalea has a camera that automatically takes pictures of hummingbirds visiting her hummingbird feeder. The camera takes 4 pictures on the first day and 10 pictures every day after that. Which function models the total number of hummingbird pictures, $f(d)$, the camera has taken after d days?

- A. $f(d) = 4d + 10$
 B. $f(d) = 4(d + 1) + 10$
 C. $f(d) = 10d + 4$
 D. $f(d) = 10(d - 1) + 4$

This item requires students to identify the correct function that can be used to represent the given context by determining an explicit expression from the context. In general, students regularly show difficulty expressing an input that requires manipulation, such as subtracting the first day. This item appears in the Online Tools Training (OTT).

Mathematical Practice(s)

MP 2 Students need to understand what the quantities shown in function notation represent how to read function notation in order to process the information of the given context into the abstract and quantitative reasoning shown in function notation.

MP 4 Students must choose the correct function notation which models the given context.

Correct Answer**Explanation**

- D. $f(d) = 10(d - 1) + 4$ Students understand that 10 pictures each day starts after the first day so 10 must be multiplied by the number of days d , without the first day which is represented by the expression $d - 1$. The quantity from the first day, 4 pictures, then needs to be added to the expression $10(d - 1)$ so that the total number of pictures is modeled by the function.

Incorrect Options**Rationales for Incorrect Options**

- A. $f(d) = 4d + 10$ This option represents a situation wherein Jalea's camera takes 4 pictures each day and 10 additional pictures on one occasion.
- B. $f(d) = 4(d + 1) + 10$ Students choosing this option misunderstood how the quantities in the context relate. This option has 4 as a rate, 10 as a constant, and adds the first day to the number of days, d , instead of representing it as a separate quantity.
- C. $f(d) = 10d + 4$ This option represents the most common error students make with contexts like these. Students regularly forget or don't understand to subtract the first day from the number of days in order to have 4 represent the first day. Not doing so results in over-calculating the number of pictures by 10.

A1: F-LE.B.5: Interpret Slope of Long Jump Function

Interpret the parameters in a linear, quadratic, or exponential function in terms of a context.

Calculator Neutral

Laniqua trains for the long jump each week. She writes this function to model the relationship between the number of weeks, w , she trains and the distance, $f(w)$, in inches, she can jump.

$$f(w) = 2w + 180$$

What does the slope of this function represent?

- A. the number of inches Laniqua can jump when she begins training
- B. the number of weeks it takes Laniqua to improve her jumping
- C. the number of weeks it takes Laniqua to increase her jump distance by 1 inch
- D. the number of inches Laniqua's jump distance increases per week of training**

This item requires students to interpret the slope parameter for the given function in terms of the given context. Students should know that slope represents a rate which would limit the viable options to choices C and D. From there, students would then need to decide which rate made sense in terms of the context and the defined variables.

Mathematical Practice(s)

MP 2 Students interpret the abstract concept of slope in terms of the given quantitative information.

Correct Answer**Explanation**

D. the number of inches Laniqua's jump distance increases per week of training

Students understand that slope is a rate. The rate of 2 inches increased per week of training makes sense in terms of the context.

Incorrect Options**Rationales for Incorrect Options**

A. the number of inches Laniqua can jump when she begins training

This option interprets the initial value or y-intercept of the function (180).

B. the number of weeks it takes Laniqua to improve her jumping

This option interprets an input or x-intercept of the function.

C. the number of weeks it takes Laniqua to increase her jump distance by 1 inch

This option represents an inverse, number of weeks per inch, of the appropriate rate.

A1: S-ID.C.9 Correlation, but No Causation of Sunscreen

Distinguish between correlation and causation.

Calculator Neutral

Eduardo notices he gets no mosquito bites when he wears a certain kind of sunscreen. He forms two possible conclusions.

1. The sunscreen causes mosquitoes to stay away from him.
2. There is a correlation between wearing sunscreen and getting no mosquito bites, but one does not cause the other.

Which observation would provide the best evidence to support conclusion 2?

- A. Eduardo’s friend gets mosquito bites when he goes out without sunscreen.
- B. Eduardo’s friend wears the same sunscreen and also gets no mosquito bites.
- C. Eduardo gets no mosquito bites when he goes out at the same time of day without sunscreen.
- D. Eduardo tries a new kind of sunscreen and goes out at a different time of day and gets mosquito bites.

This item requires students to choose the appropriate evidence to support a conclusion of a correlation, but not causation.

Mathematical Practice(s)

MP 3 Students must choose evidence that would produce a justifiable argument.

Correct Answer**Explanation**

C. Eduardo gets no mosquito bites when he goes out at the same time of day without sunscreen.

Students understand that this statement indicates that an alternative cause for lack of mosquito bites may exist since Eduardo also had no bites when not using the sunscreen. No other factors change.

Incorrect Options**Rationales for Incorrect Options**

A. Eduardo’s friend gets mosquito bites when he goes out without sunscreen.

This option is not appropriate evidence to support conclusion #2 because both the test subject (Eduardo) and the test substance (sunscreen) are missing.

B. Eduardo’s friend wears the same sunscreen and also gets no mosquito bites.

This option reinforces the correlation between wearing sunscreen and mosquito bites but does not support the conclusion that there is no causation.

D. Eduardo tries a new kind of sunscreen and goes out at a different time of day and gets mosquito bites.

This option is not appropriate evidence to support conclusion #2 because both the test subject (sunscreen) and another test factor (time of day of test) have changed.

A1: N-Q.A.1 Units for a Quotient of Fuel Efficiency by Speed

Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

Calculator Neutral

An engineer computes the ratio of these two measurements.

- fuel efficiency, measured in miles per gallon
- speed, measured in miles per hour

She divides fuel efficiency by speed. What unit will the quotient have?

- A. gallons per hour
- B. hours per mile
- C. gallons per mile
- D. hours per gallon

This item requires students to choose the appropriate units that would be used to represent a quotient involving unit rates.

Mathematical Practice(s)

MP 6 Students must choose the appropriate units that make sense in terms of the context.

Correct Answer**Explanation**

D. hours per gallon Students understand that a quotient of the two rates described will result in division of miles by miles and that the order of the division will result in hours being divided by gallons.

Incorrect Options**Rationales for Incorrect Options**

A. gallons per hour Students understand that a quotient of the two rates described will result in division of miles by miles but not that the order of the division will result in hours being divided by gallons.

B. hours per mile Students understand that the order of the division will result in hours being divided by gallons but not that the quotient results in division of miles by miles.

C. gallons per mile Students do not understand that a quotient of the two rates described will result in division of miles by miles or that the order of the division will result in hours being divided by gallons.

A1: S-ID.B.5 Park Support by Neighborhood

Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.

Calculator Allowed

Use the table to answer the question.

New Park Survey

	For the Park	Against the Park	Undecided
East Side	346	125	201
West Lake	349	250	252

A community has to decide whether to raise taxes to create a new park. Voters in two neighborhoods are surveyed about the issue. The results are shown in the table.

Which conclusion is best supported by the data?

- A. More than 50% of the people surveyed support the park.
- B. About the same percentage of East Side and West Lake voters support the park.
- C. About the same percentage of East Side and West Lake voters are undecided about the park.
- D. The percentage of West Lake residents who are against the park is about twice the percentage of East Side residents who are against the park.

This item requires students to calculate percentages based on information given in the table in order to identify the best conclusion supported by the data. When field-tested, most students chose the incorrect option that only used the raw data in the table, assuming that the numbers in the table represented percentages.

Mathematical Practice(s)

MP 3 Students must choose the conclusion that can best be supported by the given data.

MP 4 Students analyze mathematical relationships presented in the two-way table to identify the appropriate conclusion.

Correct Answer		Explanation
C. About the same percentage of East Side and West Lake voters are undecided about the park.		Students calculated the percentage of undecided East Side voters and the percentage of undecided West Lake voters to determine that the percentages were almost the same.
One possible method for solving is shown below.		
Calculations: East Side Undecided		
step 1	$346 + 125 + 201 = 672$	add to find the total number of East Side voters
step 2	$\frac{201}{672} \approx 0.299$	divide the number of undecided voters by the total number of voters for East Side
step 3	$0.299 \times 100 = 29.9\%$	multiply the answer from Step 2 by 100 to get the percentage of undecided
Calculations: West Lake Undecided		
step 1	$349 + 250 + 252 = 851$	add to find the total number of West Lake voters
step 2	$\frac{252}{851} \approx 0.296$	divide the number of undecided voters by the total number of voters for West Lake
step 3	$0.296 \times 100 = 29.6\%$	multiply the answer from Step 2 by 100 to get the percentage of undecided
Compare the percentage of East Side voters (29.9%) to the percentage of West Lake voters (29.6%). The percentages are approximately the same ($\approx 30\%$).		
Incorrect Options		Rationales for Incorrect Options
A. More than 50% of the people surveyed support the park.		Students may not have accounted for the undecided voters when calculating the percentage.
Possible calculations for option A are shown below.		
step 1	$346 + 125 + 201 + 349 + 250 + 252 = 1,523$	add to find the total number of voters
step 2	$346 + 349 = 695$	add to find the total number of voters who are for the park
step 3	$\frac{695}{1523} \approx 0.456$	divide the number of "in favor" voters by the total number of voters
step 4	$0.456 \times 100 = 45.6\%$	multiply the answer from Step 2 by 100 to get the percentage "in favor"
45.6% is less than 50%.		

B. About the same percentage of East Side and West Lake voters support the park.

Students choosing this option most likely compared the number of votes, 346 to 349, instead of the percentages.

Possible calculations for option B are shown below.

Calculations: East Side For the Park		
step 1	$346 + 125 + 201 = 672$	add to find the total number of East Side voters
step 2	$\frac{346}{672} \approx 0.515$	divide the number of "in favor" voters by the total number of voters for East Side
step 3	$0.515 \times 100 = 51.5\%$	multiply the answer from Step 2 by 100 to get the percentage of voters in favor of the park
Calculations: West Lake For the Park		
step 1	$349 + 250 + 252 = 851$	add to find the total number of West Lake voters
step 2	$\frac{349}{851} \approx 0.410$	divide the number of "in favor" voters by the total number of voters for West Lake
step 3	$0.410 \times 100 = 41.0\%$	multiply the answer from Step 2 by 100 to get the percentage of voters in favor of the park

The difference between East Side and West Lake is approximately 10.5%. With a difference greater than 5%, the voting percentages cannot be considered "about the same."

D. The percentage of West Lake residents who are against the park is about twice the percentage of East Side residents who are against the park.

Students who chose this option most likely compared the number of voters (125 and 250) instead of the percentages.

Possible calculations for option D are shown below.

Calculations: East Side Against the Park		
step 1	$346 + 125 + 201 = 672$	add to find the total number of East Side voters
step 2	$\frac{125}{672} \approx 0.186$	divide the number of "against" voters by the total number of voters for East Side
step 3	$0.186 \times 100 = 18.6\%$	multiply the answer from Step 2 by 100 to get the percentage of voters against the park
Calculations: West Lake Against the Park		
step 1	$349 + 250 + 252 = 851$	add to find the total number of West Lake voters
step 2	$\frac{250}{851} \approx 0.294$	divide the number of "against" voters by the total number of voters for West Lake
step 3	$0.294 \times 100 = 29.4\%$	multiply the answer from Step 2 by 100 to get the percentage of voters against the park

Divide 29.4% by 18.6% to find how many times greater the West Lake percentage is than the East Side percentage. This results in approximately 1.6. So, the percentage of West Lake voters who are against the park is not about twice the percentage of East Side voters who are against the park; it is only about 1.6 times.

CONSTRUCTED-RESPONSE ITEMS

This section presents three constructed-response items, scoring information, and samples of student responses (for two of the three items) that received scores of 4, 3, 2, 1, 1 for minimal understanding, and 0.

A1: A-REI.B.4 Solving Quadratics

Solve quadratic equations in one variable.

- Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.
- Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula, and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as “no real solution.”

Calculator Allowed

Shannon and Jermaine are solving quadratic equations. This table shows their work.

Steps	Shannon	Jermaine
initial equation	$x^2 - 6x + 5 = 12$	$x^2 + 2x - 29 = 2x + 7$
step 1	$x^2 - 6x = 7$	$x^2 + 2x - 36 = 2x$
step 2	$x^2 - 6x + 9 = 16$	$x^2 - 36 = 0$
step 3	$(x - 3)^2 = 16$	$(x - 18)(x + 18) = 0$
step 4	$x - 3 = \pm 4$	$x - 18 = 0$ or $x + 18 = 0$
step 5	$x = \pm 7$	$x = 18$ or $x = -18$

Both Shannon and Jermaine have errors in their work. Write a clear explanation of each student's error. Provide the correct solutions for both equations.

Shannon

Correct solution(s):

Explanation of error:

Jermaine

Correct solution(s):

Explanation of error:

This item requires students to identify and explain the incorrect steps in two solving processes and to provide correct solutions. Most students did not recognize that Shannon was trying to solve her equation by completing the square. These students usually identified step 1 as the error and corrected by subtracting 12 from both sides and solved by factoring. Jermaine's process was more familiar to most students. Most of the mistakes appeared in the explanations where students made minor errors like “he didn't take the square root of -36.” Some students claimed that Jermaine's work was actually correct. Teachers should stress to students that if the directions in an assessment item explicitly state that an error exists and students are supposed to find and correct the error, then that is what they should do; they should not mount a counter-argument that there is no error. This item appears in the Online Tools Training (OTT).

Mathematical Practice(s)	
MP 1	Students must examine and make sense of all of the given information in the problem and develop a solution pathway in order to provide the requested information
MP 3	Students must critique the given solution methods and provide correct solutions.
MP 4	Students must identify correct and incorrect parts to the process for solving the given equations.
MP 6	Students must complete the steps to solving with precision in order to determine the correct solutions. Any calculations shown must be free of mathematical errors.

Scoring Information

This section includes information used to score this constructed-response item: an exemplary response, an explanation of how points are assigned, and a scoring rubric. Appropriate scoring parameters for all EOC constructed-response items are determined by Rangelinding Committees comprised of teachers and curriculum experts from across the state of Louisiana.

Scoring Rubric	
4	The student earns 4 points.
3	The student earns 3.5 or 3.0 points.
2	The student earns 2.5 or 2.0 points.
1	The student earns 1.5, 1, or 0.5 points OR demonstrates minimal understanding of the standard being measured.
0	The student's response is incorrect, irrelevant to the skill or concept being measured, or blank.

Sample Answer

Shannon

$$x = 7; x = -1$$

Shannon's error is after step 4. She should have separated the equations out such that $x - 3 = 4$ or $x - 3 = -4$. Then solve both for x . Therefore, $x = 7$ or $x = -1$.

Jermaine

$$x = 6; x = -6$$

Jermaine's error is after step 2. He should have taken the square root of 36 instead of dividing it by 2. Step 3 could be $(x - 6)(x + 6) = 0$ which gives $x - 6 = 0$ or $x + 6 = 0$. Therefore, $x = 6$ or $x = -6$.

Points Assigned

Shannon

- 0.5 point for providing 7 as a correct solution to Shannon's equation
- 0.5 point for providing -1 as a correct solution to Shannon's equation
- 1 point for correct and complete explanation of Shannon's calculation error

Jermaine

- 0.5 point for providing 6 as a correct solution to Jermaine's equation
- 0.5 point for providing -6 as a correct solution to Jermaine's equation
- 1 point for correct and complete explanation of Jermaine's calculation error

Sample Student Responses¹

Score Point 4

The following authentic student responses show the work of two students who each earned a score of 4. A score of 4 is received when a student completes all required components of the task and communicates his or her ideas effectively. The response should demonstrate in-depth understanding of the content objectives, and all required components of the task should be complete.

Score Point 4, Student Response 1

Shannon

$x = 7$ or -1

Shannon's error occurred in between step 4 and 5. Though the first part of the procedure was correct, she should have solved " $x-3=4$ " and " $x-3=-4$."

Jermaine

$x = 6$ or -6

Jermaine's error occurred during steps 3 and 4 when he factored. When he put the factored form of " x^2-36 " as " $(x-18)(x+18)$," he should have factored like " $(x-6)(x+6)$," since the square root of 36 is 6.

This student response is correct and clear. The student writes the correct values for x and provides clear explanations identifying the errors in Shannon and Jermaine's work and explaining what should have been done instead.

Score Point 4, Student Response 2

Shannon

$x = 7, -1$

Shannon only added positive 3 and positive 4, she forgot to add positive 3 and negative 4.

Jermaine

$x = +6, -6$

Jermaine divided 36 by 2 instead of taking its square root. Instead of $(x-18)(x+18)=0$ it should have been $(x-6)(x+6)=0$.

This response receives full credit. The student writes the correct values for x and provides clear explanations identifying the errors in Shannon and Jermaine's work and explaining what should have been done instead.

¹ All student responses are authentic student work and not edited in any way, so responses may include typographical errors such as misspelled words or missing spaces.

Score Point 3

The following authentic student responses show the work of two students who each earned a score of 3. A score of 3 is received when a student earns 3 or 3.5 points, converting to a score of 3. There may be simple errors in calculations or some confusion with communicating his or her ideas effectively.

Score Point 3, Student Response 1

Shannon

$$x=7 \quad x=-1$$

Shannon added 3 to 4, in step 5, but did not add 3 to -4.

Jermaine

$$x=6 \quad x=-6$$

Jermaine, in step 2-3 did not change -36 to the other side of the equation.

This student provides the correct solutions to both equations. The explanation provided for Shannon's error is short, but sufficient. The explanation for Jermaine's error does not describe the error that Jermaine made. This student attempts to provide an alternate solution method (factoring) instead. The student earns 3 points for providing correct solutions for both equations and one complete and correct explanation (Shannon's equation).

Score Point 3, Student Response 2

Shannon

$$7, -1$$

In step 1 five was subtracted from twelve which made the equation equal seven when twelve should have been subtracted from five so that the equation equals zero.

Jermaine

$$6, -6$$

In step three $x^2 - 36$ was factored out to be $(x - 18)(x - 18)$ when it should have factored to be $(x - 6)(x + 6)$.

This student provides the correct solutions to both equations. The explanation provided for Jermaine's error is complete and correct. The explanation for Shannon's error does not describe the error that Shannon made. This student attempts to provide an alternate solution method instead. The student earns 3 points for providing correct solutions for both equations and one complete and correct explanation (Jermaine's equation).

Score Point 2

The following authentic student responses show the work of two students who each earned a score of 2. A score of 2 is received when a student earns 2 or 2.5 points, converting to a score of 2. There may be simple errors in calculations, one or two missing responses, or unclear or incorrect communications of his or her ideas.

Score Point 2, Student Response 1

Shannon

$x = 7$ or -1

Shannon made an error on step 2. She did not subtract the seven over to $x^2 - 6x$, so it would be $x^2 - 6x - 7$. With this slight error, her solution of $x = 7$ or -7 is wrong as well. When working out the equation, she should have got $(x - 7)$ and $(x + 1)$. Furthermore, her Step 5 answers would have been $x = 7$ or -1 .

Jermaine

$x = 6$ or -6

Jermaine made an error in step 2. Whenever you subtract numbers with variables, the variable stays. So the problem would be $x^2 - x - 36$. You would get $(x + 6)$ and $(x - 6)$. After that, you find your solution, which should be 6 and -6 .

This student provides the correct solutions to both equations. The explanation for Shannon's error does not describe the error that Shannon made. This student attempts to provide an alternate solution method (factoring) instead. The explanation for Jermaine's error is incorrect because it includes " $x^2 - x - 36$ " which is not mathematically correct. The student earns 2 points for providing solutions for both equations.

Score Point 2, Student Response 2

Shannon

$x = 19$

Shannon left out 16 after step 3.

Jermaine

$x = 6$ or $x = -6$

Jermaine put $(x - 18)(x + 18) = 0$ which is wrong. He should have put $(x - 6)(x + 6) = 0$ which would have gave him the wright awnser.

This student provides incorrect solutions and an incorrect explanation for Shannon's work, not realizing that the square root of both sides of the equation was taken after step 3. The solutions and explanation provided for Jermaine's work is correct and complete. The student earns 2 points for providing correct solutions and a correct and complete explanation for Jermaine's equation.

Score Point 1

The following authentic student responses show the work of three students who each earned a score of 1 for their responses. A score of 1 is received when a student earns .5 or 1.5 points which convert to a score of 1.

Score Point 1, Student Response 1

Shannon

$$x = 7 \text{ or } -1$$

Shannon's first error was when she added 9 to both sides of the equation. There wasn't a 9 in the equation, so she pulled the 9 out of nowhere. Shannon's second error was when the $-6x$ was taken out of the problem.

Jermaine

$$x = 6$$

Jermaine only had one error. Once he had $x^2 - 36 = 0$ he factored the left side of the equation when he should have tried to get x by its self.

This student provides correct solutions for Shannon's equation. The explanation provided for Shannon's error indicates that the student did not recognize that Shannon was trying to solve the equation by completing the square and, therefore, did not understand steps that were correct ("she pulled the 9 out of nowhere" and "when the $-6x$ was taken out"). One out of two correct solutions is provided for Jermaine's equation. The explanation for Jermaine's error does not describe the error that Jermaine made. This student attempts to provide an alternate solution method instead (possibly factoring). This response receives 1.5 points (1 for two correct solutions to Shannon's equation, .5 for one correct solution to Jermaine's equation) according to the rubric which converts to a score of 1.

Score Point 1, Student Response 2

Shannon

$$x=13 \text{ or } 17$$

In step one she subtracted 5 instead of keeping it and multiplying x^2 by 5, which threw off the whole problem.

Jermaine

$$x=6 \text{ or } -6$$

In step three he should have added 36 to the other side, which would have been used to find the square root of 36.

This student provides incorrect solutions for Shannon's equation, but two correct solutions for Jermaine's equation. The explanation for Shannon's error attempts to correct a step that is already correct; information provided is mathematically incorrect. The explanation for Jermaine's error does not describe the error that Jermaine made. This student attempts to provide an alternate solution method instead. The student earns 1 point for providing correct solutions for Jermaine's equation.

Score Point 1, Student Response 3

Shannon

-1

He should not have put a +9 in step 2

Jermaine

$x=6$

Jermaine added 7 to 29 first instead of subtracting $2x$ on both sides to get the variable on one side.

This student provides one correct solution for Shannon's equation (.5 point) and one correct solution for Jermaine's equation (.5 point). The explanation provided for Shannon's error indicates that the student did not recognize that Shannon was trying to solve the equation by completing the square and, therefore, did not understand steps that were correct ("should not have put a +9 in step 2"). For Jermaine's error, this student does not describe the error that Jermaine made and attempts to correct a step that is already correct. This response receives two half-points to make 1 point, a score of 1.

Score Point 1 for Minimal Understanding

Below is the work of one student who earned a score of 1 for minimal understanding. Once a response receives 0 points according to the rubric, it is examined by the scorer to determine if the student has demonstrated minimal understanding of the standard being assessed. If the scorer determines that the student has demonstrated minimal understanding of the standard, then a response that received 0 points can earn a score of 1.

Score Point 1 for minimal understanding

Shannon

$(x-7)*(x+1)$

Shannon was working the problem properly until she pulled a 9 out of thin air instead of subtracting the 7 back into the equation at Step 2.

Jermaine

$(x-6)^2$

Jermaine was working the problem correctly until he squared -36 incorrectly at Step 3. It appears that he divided by 2 instead of finding the square root of 36, which is 6.

This student provides incorrect solutions for both Shannon's and Jermaine's equations. The explanation provided for Shannon's error indicates that the student did not recognize that Shannon was trying to solve the equation by completing the square and, therefore, did not understand steps that were correct ("pulled a 9 out of thin air"). The explanation for Jermaine's error contains an incorrect mathematical statement ("he squared -36"). This response does not receive any points according to the rubric; however, this student demonstrates minimal understanding in their explanation or Jermaine's error. While the explanation includes a mistake and is incomplete (square root of 36 would also be -6), it has enough ("It appears that he divided by 2 instead of finding the square root of 36.") to warrant a score of 1 for minimal understanding.

Score Point 0

The following samples show the work of two students who each earned a score of 0. A score of 0 is received when a student response is incorrect, irrelevant, too brief to evaluate, or blank.

Score Point 0, Student Response 1

Shannon

step 4 is 1

cause $-3+4$ is 1

Jermaine

the correct one is -18

cause there is a -36 and u cant have both a nevative and a possitive 18.

This student provides incorrect solutions and explanations for both Shannon and Jermaine's work.

Score Point 0, Student Response 2

Shannon

2-5

Shannon should have not put the 9 in step two after she after she did step one she should have proceeded on with the equation powering oOut the x squared and just brought that one down and the equation would have been $1-6x=7$ and then she would have to subtract 7 by 1 and woud have ended up with a 6 and when she would have brought that 6x down she could ahev subtracted 6 by 6x and she would have gotten $x=1$ and thats how she would have gotten the correct answer.

Jermaine

[no response]

Thereis nothing wrong with Jermmaines equations he worked it out in order step by step and he formated the equation right and he came out with the correct answer.

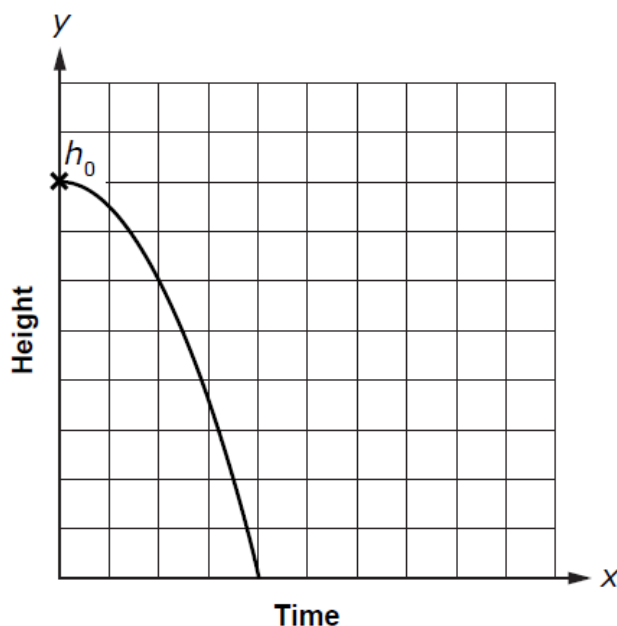
This student provides incorrect solutions for Shannon's equation and leaves the answer box empty for Jermaine's equation. The explanation provided for Shannon's error indicates that the student did not recognize that Shannon was trying to solve the equation by completing the square and, therefore, did not understand steps that were correct ("should not have put the 9 in step 2"). This student attempts to solve with an alternate method (factoring), but makes several mathematical errors. For Jermaine's error, the student attempts to argue against the directions and claim that there is "nothing wrong with Jermmaines equations...he came out with the correct answer."

A1: F-IF.A.2 Interpreting Features of a Quadratic Equation

Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

Calculator Allowed

The height, in meters, of a rock as it falls at a given time (x), in seconds, can be found using the expression $-5x^2 + h_0$, where h_0 is the starting height where the rock falls.



Part A

A rock falls from a starting height of 80 meters. Write a function, $f(x)$, that models the height of the rock as it falls. Make sure to use proper function notation.

Part B

Using the function from part A, what is the value of $f(3)$?

Part C

Ahmed states that the domain for this function in the given context is $x \leq 4$. Explain why Ahmed is incorrect, and provide a correct domain.

This item requires students to use proper function notation to model a situation presented as a graph. To further test the standard, students must also evaluate their function for a given value for x . The student must provide a correct domain for the situation and explain why the given domain is incorrect.

Mathematical Practice(s)

- | | |
|------|---|
| MP 1 | Students must examine and make sense of all of the given information in the problem and develop a solution pathway in order to provide the requested information. |
| MP 2 | Students must use the given information and symbolic representations to contextualize their results and provide meaning for the quantities. |
| MP 3 | Students must critique the given domain and clearly explain why it is wrong. |
| MP 4 | Students must write a mathematical function to model the given situation. |
| MP 6 | Students must accurately use function notation to communicate their response. |

Scoring Information

This section includes information used to score this constructed-response item: an exemplary response, an explanation of how points are assigned, and a scoring rubric. Appropriate scoring parameters for all EOC constructed-response items are determined by Rangefinding Committees comprised of teachers and curriculum experts from across the state of Louisiana.

Scoring Rubric

- | | |
|---|---|
| 4 | The student earns 4 points. |
| 3 | The student earns 3 points. |
| 2 | The student earns 2 points. |
| 1 | The student earns 1 point OR demonstrates minimal understanding of the standard being measured. |
| 0 | The student's response is incorrect, irrelevant to the skill or concept being measured, or blank. |

Sample Answer

Part A

$$f(x) = -5x^2 + 80$$

Part B

35 meters

Part C

Ahmed is incorrect because the time has to start at 0. You cannot have a negative time. The correct domain is $0 \leq x \leq 4$.

Points Assigned

Part A

1 point for correct function to model the situation

Part B

1 point for correct height for $f(3)$ from equation in part A

Part C

2 points:

- 1 point for correctly explaining why Ahmed is incorrect
- 1 point for providing a correct domain for the given situation

Sample Student Responses²

Score Point 4

The following authentic student responses show the work of two students who each earned a score of 4. A score of 4 is received when a student completes all required components of the task and communicates his or her ideas effectively. The response should demonstrate in-depth understanding of the content objectives, and all required components of the task should be complete.

Score Point 4, Student Response 1

Part A

$$f(x) = -5x^2 + 80$$

Part B

35 meters

Part C

Ahmed is incorrect because his answer is too vague. If anything less than zero is plugged into the equation it will not be a solution because the starting height was 80 meters. The correct domain would be $0 \leq x \leq 4$

This student response is correct and well-reasoned. The student writes the correct function using proper function notation and evaluates the function to determine the correct value for $f(3)$. The student clearly explains why Ahmed's domain is incorrect and provides the correct domain for the given function situation.

Score Point 4, Student Response 2

Part A

$$f(x) = -5x^2 + 80$$

Part B

35 meters

Part C

Ahmed is incorrect, because his domain (all x values) goes into the negatives; in this function, the x values won't go into the negatives. The correct domain is $0 \leq x \leq 4$.

This response receives full credit. The student provides the correct function using proper function notation and gives the correct value for $f(3)$. The student provides a clear explanation of why Ahmed is incorrect and provides the correct domain.

² All student responses are authentic student work and not edited in any way, so responses may include typographical errors such as misspelled words or missing spaces.

Score Point 3

The following authentic student responses show the work of two students who each earned a score of 3. A score of 3 is received when a student earns 3 points. There may be simple errors in calculations or some confusion with communicating his or her ideas effectively.

Score Point 3, Student Response 1

Part A

$$f(x) = -5x^2 + 80$$

Part B

35 meters

Part C

The domain is wrong because the smallest x value on the graph where the rock starts is 0, not just any number less than 4. The rock does not go into negative x .

This student response provides the correct function using proper function notation and also gives the correct value for $f(3)$. The student explains that the lowest value on the graph is 0, which means that the left bound of infinity for Ahmed's domain is incorrect. However, the student does not provide the correct domain.

Score Point 3, Student Response 2

Part A

$$f(x) = -5x^2 + 80$$

Part B

$$f(3) = -5(3)^2 + 80 \quad f(3) = 35$$

Part C

It is incorrect because there has to be two numbers and the x in the inside of the two numbers. The correct answer would be $0 \leq x \leq 4$.

In this response, the student provides the correct function using proper notation and the correct value for $f(3)$ in the response. The student incorrectly explains why Ahmed is incorrect. Not all domains require x to be between two numbers. The student provides the correct domain for the function.

Score Point 2

The following authentic student responses show the work of two students who each earned a score of 2. A score of 2 is received when a student earns 2 points. There may be simple errors in calculations, one or two missing responses, or unclear or incorrect communications of his or her ideas.

Score Point 2, Student Response 1

Part A

$$f(x) = -5x^2 + 80$$

Part B

35 meters

Part C

Ahmed is incorrect because if x equals 4 the solution would be undefined. The solution can not be undefined because if the solution is undefined the function is higher then the starting point. A correct domain would be $x \leq 3$.

The student provides the correct function using proper function notation and provides the correct value for $f(3)$. The student does not understand how the domain connects to the context and does not provide the correct domain.

Score Point 2, Student Response 2

Part A

$$f(x) = -5x^2 + 80$$

Part B

$$f(x) = -145$$

Part C

Ahmed is incorrect because the line does not cross the x -axis at only 4. The domain should be $0 \leq x \leq 4$

The student provides the correct function using proper function notation. The value for $f(3)$ is incorrect. The student incorrectly confuses the x -intercepts with the domain. Although the concepts are related in this context, they are different. The student provides the correct domain.

Score Point 1

The following authentic student responses show the work of three students who each earned a score of 1 for their responses. A score of 1 is received when a student earns 1 point.

Score Point 1, Student Response 1

Part A

$$-5x^2+80$$

Part B

45m

Part C

The domain is NOT $x \leq 4$ because the rock starts to fall at 0 and lands at 4. The correct domain is $0 \leq x \leq 4$.

This student response provides the correct expression that relates to the situation, but does not use proper function notation. The value given for $f(3)$ is incorrect. The student provides a clear reason for why Ahmed is incorrect; however, there is a sign error in the corrected domain.

Score Point 1, Student Response 2

Part A

$$-5x^2 + 80 = f(x)$$

Part B

35 seconds

Part C

Ahmed is incorrect because when the rock falls it could fall greater than 4. A correct domain is $x \geq 4$

This response uses proper function notation and provides the correct function. The value for $f(3)$ is correct; however, the units are incorrect. The student does not understand that the domain represents the possible x -values in the situation and does not provide the correct domain.

Score Point 1 for Minimal Understanding

Below is the work of students who earned a score of 1 for minimal understanding. Once a response receives 0 points according to the rubric, it is examined by the scorer to determine if the student has demonstrated minimal understanding of the standard being assessed. If the scorer determines that the student has demonstrated minimal understanding of the standard, then a response that received 0 points can earn a score of 1.

Score Point 1 for minimal understanding, Student Response 1

Part A

$$y = -5x^2 + 80$$

Part B

$$-5(3)^2 + 80 = 125m$$

Part C

Ahmed is incorrect because the value of $f(3)$ is 125m. which is greater than 4.

The student does not use proper function notation, but does provide the correct equation. The value for $f(3)$ is incorrect. The student confuses domain with range in the explanation, and there is no corrected domain. The student does not earn any points according to the rubric; however, a single point is awarded for demonstrating minimal understanding of functions. The student provides a correct equation, but does not know how to use proper function notation. In order to earn minimal understanding, the student MUST write an equation; expressions cannot earn minimal understanding. This is the case because an equation demonstrates understanding of input/output relationships (relating to functions), whereas an expression does not.

Score Point 1 for minimal understanding, Student Response 2

Part A

$$-5x^2 + 80$$

Part B

35 feet

Part C

Because 35 is more than 4 not less.

The student provides the correct expression for the situation, but does not use function notation. The value for $f(3)$ is correct, but the units are incorrect. The student thinks the output for the function must be in the domain. All outputs make up the range. The response does not include a correct domain. The student demonstrates how to find specific values for functions, but does not read the context close enough to determine the correct units to use. The student does not earn any points based on the Points Assigned section of the rubric; however, one point is awarded for minimal understanding for providing the correct value for $f(3)$ with the wrong units.

Score Point 0

The following samples show the work of two students who each earned a score of 0. A score of 0 is received when a student response is incorrect, irrelevant, too brief to evaluate, or blank.

Score Point 0, Student Response 1

Part A

$$-5x^2+80$$

Part B

$$-5*3^2+8 \text{ the value is } -37$$

Part C

Ahmed is incorrect because the domain is not less than or equal to 4. the correct answer would be $x \geq -5$

This student response provides the correct expression for the situation, but does not use function notation. The value for $f(3)$ is incorrect. The student does not provide any reasoning for why Ahmed is incorrect—he or she simply restates that the domain is not what was given. The student provides an incorrect domain.

Score Point 0, Student Response 2

Part A

$$f(x)=80m$$

Part B

$$f(3)=80m$$

Part C

Ashmed is incorrect ,because he didn't show the starting height of the rock falling which was 80 .

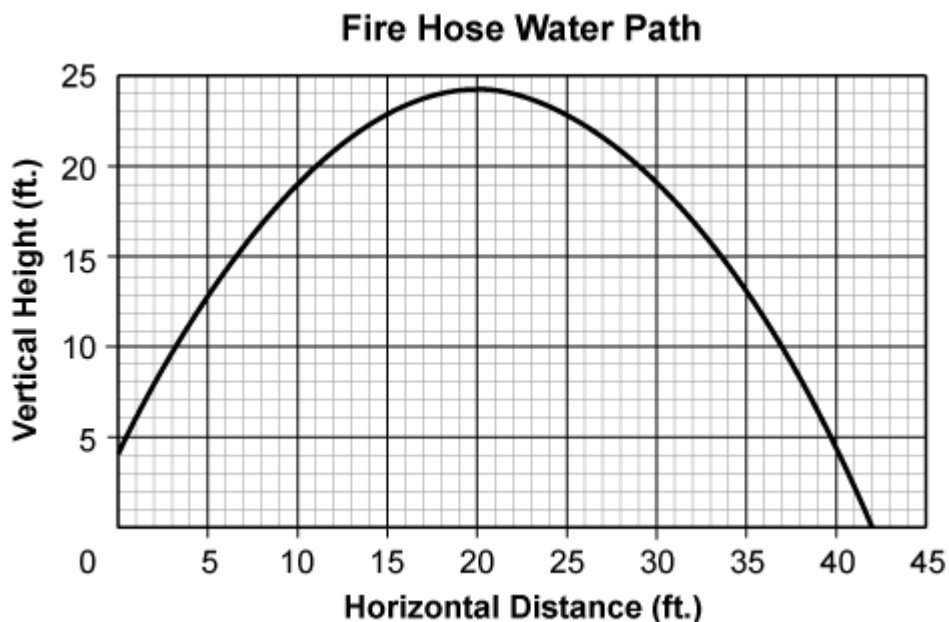
The student attempts to use proper notation, but does not use the expression given to represent the situation. The value for $f(3)$ is incorrect. The student confuses the domain with the y -intercept.

A1: F-IF.B.4 Modeling a Function for Water Spray

For linear, piecewise linear (to include absolute value), quadratic, and exponential functions that model a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior.

Calculator Allowed

Use the graph to answer the questions.



Part A

Explain what the maximum value of this represents in this situation. Make sure to identify the maximum and include information about the x -value and y -value in your explanation.

Part B

What does the x -intercept of the graph represent in terms of the water spray? Use specific information about the coordinates of the x -intercept in your answer.

Part C

Describe characteristics of the rate of change of the function over the interval $0 \leq x \leq 20$.

This item requires students to interpret the maximum point, x -intercept, and slope over a given interval for the graph shown. Students must go beyond identifying key features of a graph by interpreting what those features mean in terms of the given context. Teachers may need to discuss with students what it means to interpret information “in terms of” a situation or context.

Mathematical Practice(s)

MP 2 Students must use the given information and symbolic representations to contextualize their results and provide meaning for the quantities.

Scoring Information

This section includes information used to score this constructed-response item: an exemplary response, an explanation of how points are assigned, and a scoring rubric. Appropriate scoring parameters for all EOC constructed-response items are determined by Rangefinding Committees comprised of teachers and curriculum experts from across the state of Louisiana.

Scoring Rubric	
4	The student earns 4 points.
3	The student earns 3 points.
2	The student earns 2 points.
1	The student earns 1 point OR demonstrates minimal understanding of the standard being measured.
0	The student's response is incorrect, irrelevant to the skill or concept being measured, or blank.
Sample Answer	
Part A	The maximum is (20, 24). This means that the maximum height the water spray will reach is 24 feet above the ground which is 20 feet from the base of the hose.
Part B	The water spray will reach the ground 42 feet from the base of the fire hose.
Part C	The overall rate of change for the interval is positive over the interval. However, as the x-value increases over the interval, the rate of change value actually decreases or slows down as it reaches $x=20$, or the maximum height.
Points Assigned	
Part A	2 points: <ul style="list-style-type: none">• 1 point for identifying the coordinates of the maximum value• 1 point for a correct and complete explanation of the given maximum value in context, including both x- and y-values
Part B	1 point for a correct and complete explanation of the x-intercept in terms of the context
Part C	1 point for a correct and complete description of characteristics of the rate of change over the given interval
Note:	A point may be awarded for part B if the explanation is correct even though it is based on incorrect values given in part A.

There are no sample student responses for this constructed-response item.