

# Ohio's State Tests

**ITEM RELEASE**

**SPRING 2023**

**GRADE 8  
MATHEMATICS**

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**Grade 8 Math**  
**Spring 2023 Item Release**  
**Content Summary and Answer Key**

Question No.*	Item Type	Content Cluster	Content Standard	Depth of Knowledge	Answer Key	Points
1	Equation Item	Work with radicals and integer exponents.	Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$ , where $p$ is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational. (8.EE.2)	Level 1	---	1 point
10	Multiple Choice Item	Define, evaluate, and compare functions.	Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. Function notation is not required in Grade 8. (8.F.1)	Level 1	B	1 point
11	Equation Item	Work with radicals and integer exponents.	Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities and to express how many times as much one is than the other. For example, estimate the population of the United States as $3 \times 10^8$ ; and the population of the world as $7 \times 10^9$ ; and determine that the world population is more than 20 times larger. (8.EE.3)	Level 2	---	1 point
12	Multiple Choice Item	Understand and apply the Pythagorean Theorem.	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. (8.G.7)	Level 2	D	1 point

\* The question numbers denote each question's place in the online test.  
 Items are numbered sequentially on the practice site.

**Grade 8 Math**  
**Spring 2023 Item Release**  
**Content Summary and Answer Key**

Question No.*	Item Type	Content Cluster	Content Standard	Depth of Knowledge	Answer Key	Points
13	Matching Item	Use functions to model relationships between quantities.	Describe qualitatively the functional relationship between two quantities by analyzing a graph, e.g., where the function is increasing or decreasing, linear or nonlinear. Sketch a graph that exhibits the qualitative features of a function that has been described verbally. (8.F.5)	Level 3	---	1 point
14	Multiple Choice Item	Understand congruence and similarity using physical models, transparencies, or geometry software.	Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them. (Include examples both with and without coordinates.) (8.G.4)	Level 2	A	1 point
19	Multiple Choice Item	Analyze and solve linear equations and pairs of simultaneous linear equations.	Solve linear equations in one variable. a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$ , $a = a$ , or $a = b$ results (where $a$ and $b$ are different numbers). (8.EE.7)	Level 2	A	1 point

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**Grade 8 Math**  
**Spring 2023 Item Release**  
**Content Summary and Answer Key**

Question No.*	Item Type	Content Cluster	Content Standard	Depth of Knowledge	Answer Key	Points
20	Multiple Choice Item	Understand congruence and similarity using physical models, transparencies, or geometry software.	Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them. (Include examples both with and without coordinates.) (8.G.2)	Level 2	D	1 point
25	Matching Item	Work with radicals and integer exponents.	Understand, explain, and apply the properties of integer exponents to generate equivalent numerical expressions. For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$ . (8.EE.1)	Level 1	---	1 point
28	Multi-Select Item	Understand congruence and similarity using physical models, transparencies, or geometry software.	Verify experimentally the properties of rotations, reflections, and translations (include examples both with and without coordinates). a. Lines are taken to lines, and line segments are taken to line segments of the same length. (8.G.1)	Level 1	A, D, E	1 point
30	Multiple Choice Item	Investigate patterns of association in bivariate data.	Understand that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. (GAISE Model, steps 3 and 4) (8.SP.2)	Level 2	A	1 point

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**Grade 8 Math**  
**Spring 2023 Item Release**  
**Content Summary and Answer Key**

Question No.*	Item Type	Content Cluster	Content Standard	Depth of Knowledge	Answer Key	Points
32	Equation Item	Understand the connections between proportional relationships, lines, and linear equations.	Use similar triangles to explain why the slope $m$ is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at $b$ . (8.EE.6)	Level 2	---	1 point
33	Equation Item	Understand congruence and similarity using physical models, transparencies, or geometry software.	Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates. (8.G.3)	Level 2	---	1 point
34	Multiple Choice Item	Define, evaluate, and compare functions.	Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points $(1, 1)$ , $(2, 4)$ , and $(3, 9)$ which are not on a straight line. (8.F.3)	Level 2	D	1 point

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**Grade 8 Math**  
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**Content Summary and Answer Key**

Question No.*	Item Type	Content Cluster	Content Standard	Depth of Knowledge	Answer Key	Points
36	Multiple Choice Item	Define, evaluate, and compare functions.	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change. (8.F.2)	Level 2	D	1 point
37	Equation Item	Work with radicals and integer exponents.	Perform operations with numbers expressed in scientific notation, including problems where both decimal notation and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities, e.g., use millimeters per year for seafloor spreading. Interpret scientific notation that has been generated by technology. (8.EE.4)	Level 3	---	1 point
40	Equation Item	Understand congruence and similarity using physical models, transparencies, or geometry software.	Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so. (8.G.5)	Level 2	---	1 point

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**Grade 8 Math**  
**Spring 2023 Item Release**  
**Content Summary and Answer Key**

Question No.*	Item Type	Content Cluster	Content Standard	Depth of Knowledge	Answer Key	Points
43	Equation Item	Use functions to model relationships between quantities.	Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two $(x, y)$ values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. (8.F.4)	Level 2	---	1 point
45	Matching Item	Know that there are numbers that are not rational, and approximate them by rational numbers.	Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions, e.g., $\pi^2$ . For example, by truncating the decimal expansion of $\sqrt{2}$ , show that $\sqrt{2}$ is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations. (8.NS.2)	Level 1	---	1 point
47	Multiple Choice Item	Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.	Solve real-world and mathematical problems involving volumes of cones, cylinders, and spheres. (8.G.9)	Level 2	B	1 point

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**Grade 8 Math**  
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**Content Summary and Answer Key**

Question No.*	Item Type	Content Cluster	Content Standard	Depth of Knowledge	Answer Key	Points
48	Inline Choice Item	Understand the connections between proportional relationships, lines, and linear equations.	Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. <i>For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed. (8.EE.5)</i>	Level 3	---	1 point
51	Multiple Choice Item	Investigate patterns of association in bivariate data.	Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering; outliers; positive, negative, or no association; and linear association and nonlinear association. (GAISE Model, steps 3 and 4) (8.SP.1)	Level 1	C	1 point

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## Depth of Knowledge (DOK)

DOK refers to the complexity of thinking required to complete a task in a given item. Items with a DOK 1 designation focus on the recall of information, such as definitions and terms, and simple procedures. Items with a DOK 2 designation require students to make decisions, solve routine problems, perform calculations, or recognize patterns. Items with a DOK 3 designation feature higher-order cognitive tasks. These DOK 3 tasks include but are not limited to: critiquing a statement and forming a conclusion; explaining, justifying, or proving a statement; or approaching abstract, complex, open-ended, and non-routine problems. Each grade's blueprint contains information about the number of points of opportunity students will encounter at each DOK level.

**Table 1: Math Descriptors – Applying Depth of Knowledge Levels for Mathematics (Webb, 2002) & NAEP 2002 Mathematics Levels of Complexity**

(M. Petit, Center for Assessment 2003, K. Hess, Center for Assessment, updated 2006)

<b>Level 1 Recall</b>	<b>Level 2 Skills/Concepts</b>	<b>Level 3 Strategic Thinking</b>	<b>Level 4* Extended Thinking</b>
<ul style="list-style-type: none"> <li>a. Recall, observe, or recognize a fact, definition, term, or property</li> <li>b. Apply/compute a well-known algorithm (e.g., sum, quotient)</li> <li>c. Apply a formula</li> <li>d. Determine the area or perimeter of rectangles or triangles given a drawing and labels</li> <li>e. Identify a plane or three-dimensional figure</li> <li>f. Measure</li> <li>g. Perform a specified or routine procedure (e.g., apply rules for rounding)</li> <li>h. Evaluate an expression</li> <li>i. Solve a one-step word problem</li> <li>j. Retrieve information from a table or graph</li> </ul>	<ul style="list-style-type: none"> <li>a. Classify plane and three-dimensional figures</li> <li>b. Interpret information from a simple graph</li> <li>c. Use models to represent mathematical concepts</li> <li>d. Solve a routine problem requiring multiple steps/decision points, or the application of multiple concepts</li> <li>e. Compare and/or contrast figures or statements</li> <li>f. Construct 2-dimensional patterns for 3-dimensional models, such as cylinders and cones</li> <li>g. Provide justifications for steps in a solution process</li> <li>h. Extend a pattern</li> </ul>	<ul style="list-style-type: none"> <li>a. Interpret information from a complex graph</li> <li>b. Explain thinking when more than one response is possible</li> <li>c. Make and/or justify conjectures</li> <li>d. Use evidence to develop logical arguments for a concept</li> <li>e. Use concepts to solve non-routine problems</li> <li>f. Perform a procedure with multiple steps and multiple decision points</li> <li>g. Generalize a pattern</li> <li>h. Describe, compare, and contrast solution methods</li> <li>i. Formulate a mathematical model for a complex situation</li> <li>j. Provide mathematical justifications</li> </ul>	<ul style="list-style-type: none"> <li>a. Relate mathematical concepts to other content areas</li> <li>b. Relate mathematical concepts to real-world applications in new situations</li> <li>c. Apply a mathematical model to illuminate a problem, situation</li> <li>d. Conduct a project that specifies a problem, identifies solution paths, solves the problem, and reports results</li> <li>e. Design a mathematical model to inform and solve a practical or abstract situation</li> <li>f. Develop generalizations of the results obtained and the strategies used and apply them to new problem situations</li> </ul>

**Table 1** continued on next page.

<b>Level 1 Recall</b>	<b>Level 2 Skills/Concepts</b>	<b>Level 3 Strategic Thinking</b>	<b>Level 4* Extended Thinking</b>
<p>k. Recall, identify, or make conversions between and among representations or numbers (fractions, decimals, and percents), or within and between customary and metric measures</p> <p>l. Locate numbers on a number line, or points on a coordinate grid</p> <p>m. Solve linear equations</p> <p>n. Represent math relationships in words, pictures, or symbols</p> <p>o. Read, write, and compare decimals in scientific notation</p>	<p>i. Retrieve information from a table, graph, or figure and use it to solve a problem requiring multiple steps</p> <p>j. Translate between tables, graphs, words and symbolic notation</p> <p>k. Make direct translations between problem situations and symbolic notation</p> <p>l. Select a procedure according to criteria and perform it</p> <p>m. Specify and explain relationships between facts, terms, properties, or operations</p> <p>n. Compare, classify, organize, estimate, or order data</p>	<p>k. Solve a multiple-step problem and provide support with a mathematical explanation that justifies the answer</p> <p>l. Solve 2-step linear equations/inequalities in one variable over the rational numbers, interpret solution(s) in the original context, and verify reasonableness of results</p> <p>m. Translate between a problem situation and symbolic notation that is not a direct translation</p> <p>n. Formulate an original problem, given a situation</p> <p>o. Analyze the similarities and differences between procedures</p> <p>p. Draw conclusion from observations or data, citing evidence</p>	<p>g. Apply one approach among many to solve problems</p> <p>h. Apply understanding in a novel way, providing an argument/justification for the application</p> <p><b>NOTE:</b> Level 4 involves such things as complex restructuring of data or establishing and evaluating criteria to solve problems.</p>

**\*Note: Ohio's State Tests only assess and measure DOK Levels 1 – 3 in grades K – 12. Level 4 is included in this table for informational purposes only.**

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**Grade 8 Math  
Spring 2023 Item Release**

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**Question 1**

**Question and Scoring Guidelines**

## Question 1

An equation is given.

$$a^2 = 36$$

What is a solution to the equation?

$a =$

The calculator interface includes a numeric keypad (1-9, 0, .) and a set of operators (+, -, ×, ÷, <, ≤, =, ≥, >). It also features square root ( $\sqrt{\square}$ ), cube root ( $\sqrt[3]{\square}$ ), and pi ( $\pi$ ) buttons. Navigation keys (left, right, up, down, clear) are located at the top left.

**Points Possible:** 1

**Content Cluster:** Work with radicals and integer exponents.

**Content Standard:** Use square root and cube root symbols to represent solutions to equations of the form  $x^2 = p$  and  $x^3 = p$ , where  $p$  is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that  $\sqrt{2}$  is irrational. (8.EE.2)

**Depth of Knowledge:** Level 1

**Modeling and Reasoning:** No

## **Scoring Guidelines**

For full credit (1 point), the student's response satisfies the bullet below.

- The student correctly identifies that  $a$  is equal to 6 or  $-6$ , providing evidence of the ability to use square root symbols to represent or solve equations in the form  $x^2 = p$ .

### Exemplar Response

- $a = 6$   
or
- $a = -6$   
or
- any equivalent values

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**Question 1**

**Sample Responses**

## Sample Response: 1 point

An equation is given.

$$a^2 = 36$$

What is a solution to the equation?

$$a = \boxed{6}$$

The image shows a digital calculator interface. At the top, there is a text input field containing the equation  $a^2 = 36$ . Below the text input is a numeric keypad and a function key area. The numeric keypad has four rows: the first row contains 1, 2, 3, +, -, •, and ÷; the second row contains 4, 5, 6, <, ≤, =, ≥, and >; the third row contains 7, 8, 9,  $\square^2$ , ( ), | |,  $\sqrt{\square}$ ,  $\sqrt[3]{\square}$ , and π; the fourth row contains a blank space, 0, and  $\frac{\square}{\square}$ . The function key area includes left and right arrow keys, a backspace key, and a clear key. The number 6 is highlighted in the numeric keypad, indicating it is the current input or selection.

### Notes on Scoring

This response earns full credit (1 point). The student may recognize the inverse operation of a square is the square root. The student may solve the equation by taking the positive square root of both sides of the equation, to get  $a = 6$ .

## Sample Response: 1 point

An equation is given.

$$a^2 = 36$$

What is a solution to the equation?

$$a = -6$$

The calculator interface includes a numeric keypad (1-9, 0, decimal point) and a set of operators: +, -, ×, ÷, <, ≤, =, ≥, >. It also features square root ( $\sqrt{x}$ ), cube root ( $\sqrt[3]{x}$ ), and pi ( $\pi$ ) buttons.

### Notes on Scoring

This response earns full credit (1 point). The student may recognize the inverse operation of a square is the square root. The student may solve the equation by taking the positive square root of both sides of the equation, to get  $a = 6$ . Then the student may recognize  $a = -6$  is also a solution because a negative number multiplied by a negative number is a positive number.

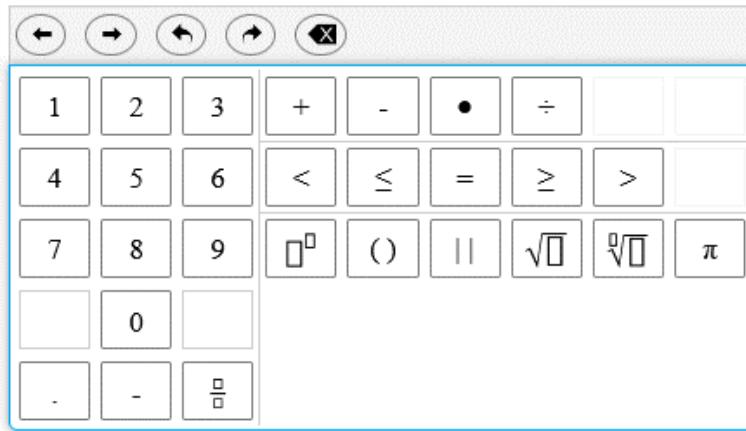
## Sample Response: 0 points

An equation is given.

$$a^2 = 36$$

What is a solution to the equation?

$$a = \boxed{18}$$



### Notes on Scoring

This response earns no credit (0 points). The student may think the inverse operation of a square is division. The student may incorrectly solve by dividing both sides of the equation by 2, to get  $a = 18$ .

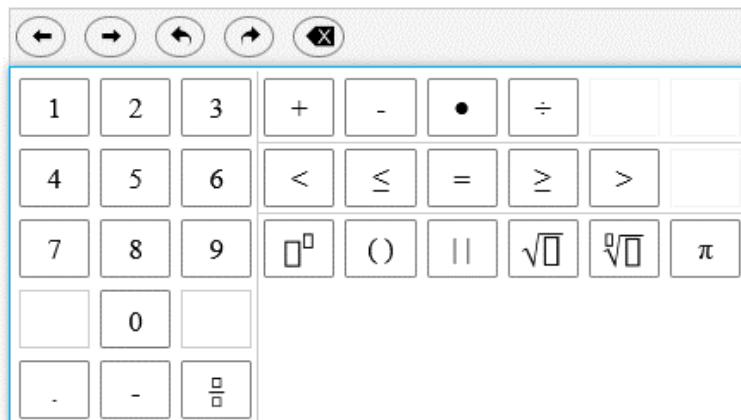
## Sample Response: 0 points

An equation is given.

$$a^2 = 36$$

What is a solution to the equation?

$a = 1296$



### Notes on Scoring

This response earns no credit (0 points). The student may think squaring both sides of the equation will solve for  $a$ . The student may square 36, to get 1,296, but the student should have taken the square root of 36, so 1,296 is incorrect.

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**Question 10**

**Question and Scoring Guidelines**

## Question 10

Which set of ordered pairs represents a function?

- (A)  $(1, 1), (2, 5), (2, 8), (3, 15)$
- (B)  $(-1, 2), (0, 0), (1, 2), (2, 4)$
- (C)  $(1, -2), (2, 3), (1, 4), (3, -5)$
- (D)  $(-1, -1), (-1, 1), (-1, 3), (-1, 4)$

**Points Possible:** 1

**Content Cluster:** Define, evaluate, and compare functions.

**Content Standard:** Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. Function notation is not required in Grade 8. (8.F.1)

**Depth of Knowledge:** Level 1

**Modeling and Reasoning:** No

## Scoring Guidelines

Rationale for Option A: This is incorrect. The student may think that a set of ordered pairs is a function if all the x- and y-values are positive.

Rationale for Option B: Key – The student correctly identifies that since all x-values (or first coordinates) in the ordered pairs correspond to exactly one y-value (or second coordinate) in the ordered pairs, the set of ordered pairs represents a function.

Rationale for Option C: This is incorrect. The student may think that a set of ordered pairs is a function if all the x-values are positive.

Rationale for Option D: This is incorrect. The student may think that a set of ordered pairs is a function if all the x-values are the same.

### Sample Response: 1 point

Which set of ordered pairs represents a function?

A (1, 1), (2, 5), (2, 8), (3, 15)

B (−1, 2), (0, 0), (1, 2), (2, 4)

C (1, −2), (2, 3), (1, 4), (3, −5)

D (−1, −1), (−1, 1), (−1, 3), (−1, 4)

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**Question 11**

**Question and Scoring Guidelines**

## Question 11

A pebble weighs  $3 \times 10^{-2}$  pound. A large boulder weighs  $9 \times 10^3$  pounds.

How many times larger is the weight of the boulder than the weight of the pebble?

The calculator interface includes a numeric keypad (1-9, 0, .) and a set of function keys: +, -, ×, ÷, <, ≤, =, ≥, >,  $\sqrt{x}$ ,  $\sqrt[3]{x}$ , and π. Above the numeric keypad are four arrow keys and a clear button (X).

**Points Possible:** 1

**Content Cluster:** Work with radicals and integer exponents.

**Content Standard:** Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities and to express how many times as much one is than the other. For example, estimate the population of the United States as  $3 \times 10^8$ ; and the population of the world as  $7 \times 10^9$ ; and determine that the world population is more than 20 times larger. (8.EE.3)

**Depth of Knowledge:** Level 2

**Modeling and Reasoning:** No

## **Scoring Guidelines**

For this item, a full-credit response includes:

- the correct value (1 point).

### Exemplar Response

- 300,000  
or
- $3 \times 10^5 = 300,000$   
or
- any equivalent value

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**Question 11**

**Sample Responses**

## Sample Response: 1 point

A pebble weighs  $3 \times 10^{-2}$  pound. A large boulder weighs  $9 \times 10^3$  pounds.

How many times larger is the weight of the boulder than the weight of the pebble?

300000

### Notes on Scoring

This response earns full credit (1 point). The student may recognize to determine how many times larger the weight of the boulder is than the weight of the pebble they should use division. The student may use the Laws of Exponents correctly and divide  $9 \times 10^3$  by  $3 \times 10^{-2}$ , to get  $3 \times 10^5$ . Then the student may express the answer as its numerical value: 300,000.

## Sample Response: 1 point

A pebble weighs  $3 \times 10^{-2}$  pound. A large boulder weighs  $9 \times 10^3$  pounds.

How many times larger is the weight of the boulder than the weight of the pebble?

$$3 \cdot 10^5$$

A digital calculator interface. At the top, there is a display showing the number  $3 \cdot 10^5$ . Below the display is a row of five small circular arrows pointing in various directions, followed by a small 'X' icon. The main part of the calculator is a grid of buttons. The first three rows contain digits 1-9, 0, and a decimal point (.). The fourth row contains a power of ten button ( $10^x$ ), a left parenthesis button (()), a right parenthesis button ()), a square root button ( $\sqrt{x}$ ), a cube root button ( $\sqrt[3]{x}$ ), and a pi button ( $\pi$ ). The fifth row contains additional operators: a plus sign (+), a minus sign (-), a multiplication sign (×), a division sign (÷), a less than sign (<), a less than or equal to sign ( $\leq$ ), an equals sign (=), a greater than or equal to sign ( $\geq$ ), and a greater than sign (>).

### Notes on Scoring

This response earns full credit (1 point). The student may recognize to determine how many times larger the weight of the boulder is than the weight of the pebble they should use division. The student may use the Laws of Exponents correctly and divide  $9 \times 10^3$  by  $3 \times 10^{-2}$ , to get  $3 \times 10^5$ .

## Sample Response: 0 points

A pebble weighs  $3 \times 10^{-2}$  pound. A large boulder weighs  $9 \times 10^3$  pounds.

How many times larger is the weight of the boulder than the weight of the pebble?

270

The calculator interface shows the number 270 entered. The screen has a light gray background with a white input field containing '270'. Above the input field is a row of small circular buttons with arrows and symbols. Below the input field is a grid of buttons. The first four rows of the grid contain numerical digits (1-9), arithmetic operators (+, -, ×, ÷), and comparison operators (<, ≤, =, ≥). The fifth row contains a square root button ( $\sqrt{x}$ ), a parentheses button (()), a fraction button ( $\frac{x}{y}$ ), and a pi symbol ( $\pi$ ). The bottom row contains a decimal point button (.) and a fraction bar button ( $\frac{\Box}{\Box}$ ).

### Notes on Scoring

This response earns no credit (0 points). The student may incorrectly think to determine how many times larger the weight of the boulder is than the weight of the pebble they should use multiplication. The student may use the Laws of Exponents correctly, but multiply  $9 \times 10^3$  by  $3 \times 10^{-2}$ , to get  $27 \times 10^1$ . Then the student may express the answer as its numerical value, 270.

## Sample Response: 0 points

A pebble weighs  $3 \times 10^{-2}$  pound. A large boulder weighs  $9 \times 10^3$  pounds.

How many times larger is the weight of the boulder than the weight of the pebble?

270000

The calculator interface shows the number 270000 entered into the display. Above the display are five small circular arrows pointing in various directions, likely for navigating between fields or clearing the screen. Below the display is a standard numeric keypad with digits 1 through 9, 0, and decimal points. To the right of the keypad are various mathematical operators: addition (+), subtraction (-), multiplication (•), division (÷), less than (<), less than or equal to (≤), equals (=), greater than or equal to (≥), greater than (>), a power button (with a small superscript 'n' icon), a parentheses button (()), a fraction button (with a horizontal bar and two boxes for numerator and denominator), and a pi symbol (π).

### Notes on Scoring

This response earns no credit (0 points). The student may incorrectly think to determine how many times larger the weight of the boulder is than the weight of the pebble they should use multiplication. The student may use the Laws of Exponents incorrectly and multiply  $9 \times 10^3$  by  $3 \times 10^{-2}$ , to get  $27 \times 10^5$ . Then the student may express  $27 \times 10^5$  incorrectly as the numerical value: 270,000.

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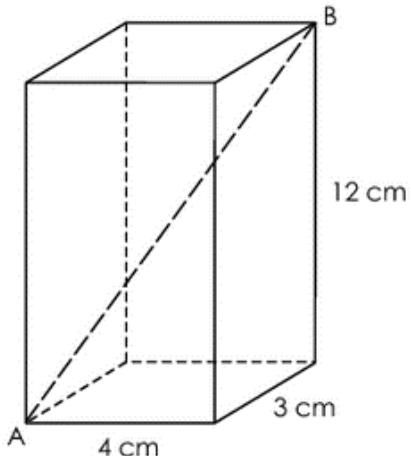
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**Question 12**

**Question and Scoring Guidelines**

## Question 12

A right rectangular prism is shown.



What is the length of  $\overline{AB}$ , to the nearest tenth of a centimeter (cm)?

(A) 5.0cm

(B) 12.2cm

(C) 12.4cm

(D) 13.0cm

**Points Possible:** 1

**Content Cluster:** Understand and apply the Pythagorean Theorem.

**Content Standard:** Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. (8.G.7)

**Depth of Knowledge:** Level 2

**Modeling and Reasoning:** Yes

## Scoring Guidelines

Rationale for Option A: This is incorrect. The student may correctly use the Pythagorean Theorem, but incorrectly calculate the diagonal of the base to get 5cm.

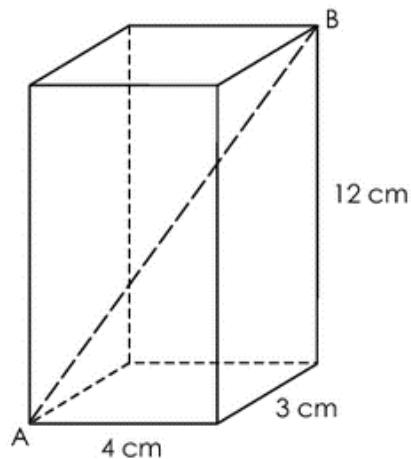
Rationale for Option B: This is incorrect. The student may correctly use the Pythagorean Theorem, but incorrectly use 4 and 12 as the leg lengths, to get 12.2cm.

Rationale for Option C: This is incorrect. The student may correctly use the Pythagorean Theorem, but incorrectly use 3 and 12 as the leg lengths, to get 12.4cm.

Rationale for Option D: Key – The student recognizes that  $\overline{AB}$  is the hypotenuse of a triangle with one side length of 12cm and the other side length equal to the length of the diagonal of the base. The student understands that the diagonal of the base is the hypotenuse of a right triangle with legs 3cm and 4cm and uses the Pythagorean Theorem to find the diagonal of the base is 5cm. Then the student uses the Pythagorean Theorem again to calculate the hypotenuse of the triangle with 5cm and 12cm, finding the length of AB is 13cm.

**Sample Response: 1 point**

A right rectangular prism is shown.



What is the length of  $\overline{AB}$ , to the nearest tenth of a centimeter (cm)?

(A) 5.0cm

(B) 12.2cm

(C) 12.4cm

(D) 13.0cm

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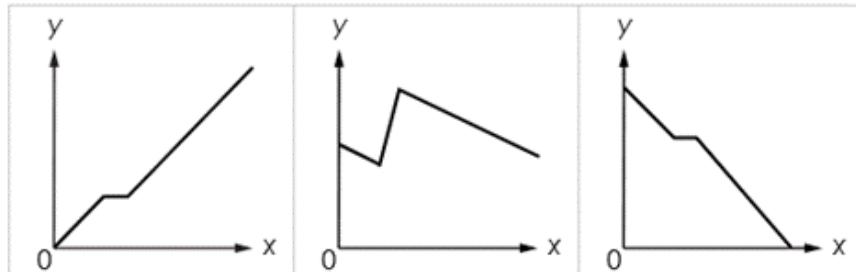
**Question 13**

**Question and Scoring Guidelines**

## Question 13

Kristie drives from Columbus, Ohio, to Cincinnati, Ohio.

Match each graph to the quantity which would best represent the value of  $y$  with respect to time,  $x$ , in minutes, during Kristie's drive.



<b>Amount of gas in gas tank</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Distance from Cincinnati</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Distance from Columbus</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Points Possible:** 1

**Content Cluster:** Use functions to model relationships between quantities.

**Content Standard:** Describe qualitatively the functional relationship between two quantities by analyzing a graph, e.g., where the function is increasing or decreasing, linear or nonlinear. Sketch a graph that exhibits the qualitative features of a function that has been described verbally. (8.F.5)

**Depth of Knowledge:** Level 3

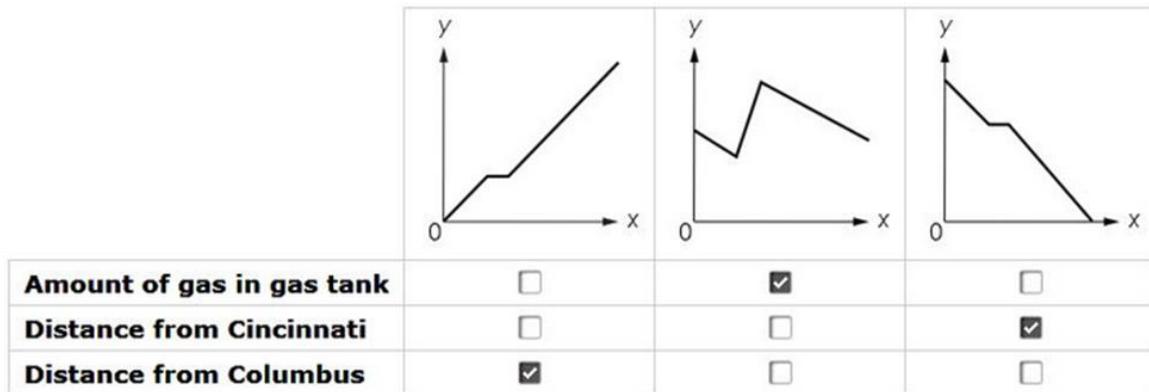
**Modeling and Reasoning:** Yes

## Scoring Guidelines

For full credit (1 point), the student's response satisfies the bullet below.

- The student chooses the correct answer, providing evidence of the ability to use key features to identify the quantity that a graph could represent in a real-world context.

### Exemplar Response



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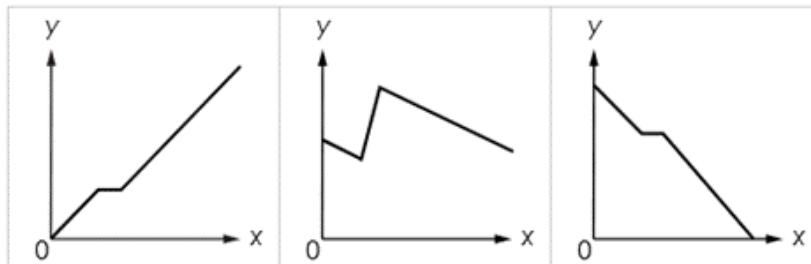
**Question 13**

**Sample Responses**

## Sample Response: 1 point

Kristie drives from Columbus, Ohio, to Cincinnati, Ohio.

Match each graph to the quantity which would best represent the value of  $y$  with respect to time,  $x$ , in minutes, during Kristie's drive.



<b>Amount of gas in gas tank</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>Distance from Cincinnati</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Distance from Columbus</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### Notes on Scoring

This response earns full credit (1 point). The student may correctly identify the middle graph best represents the amount of gas in the gas tank as the value of  $y$  because as time increases the value of  $y$  shows a decrease and then an increase. The student may recognize this represents gas being used in the tank and then the gas tank being filled back up.

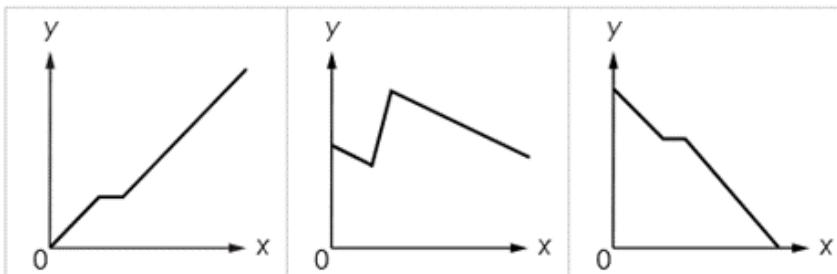
The student may match the first graph to represent the distance from Columbus as the value of  $y$  because as time increases the distance away from the city where Kristie started increases, since she gets farther away.

The student may match the last graph with the distance from Cincinnati as the value of  $y$  because as time increases the distance away from the city Kristie is traveling to decreases, since she gets closer.

## Sample Response: 0 points

Kristie drives from Columbus, Ohio, to Cincinnati, Ohio.

Match each graph to the quantity which would best represent the value of  $y$  with respect to time,  $x$ , in minutes, during Kristie's drive.



<b>Amount of gas in gas tank</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Distance from Cincinnati</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>Distance from Columbus</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

### Notes on Scoring

This response earns no credit (0 points). The student may have mistakenly matched the amount of gas in the gas tank with the first graph confusing increasing with decreasing for the value of  $y$ . The student may have incorrectly thought as  $x$  was increasing, the amount of gas in the gas tank was increasing.

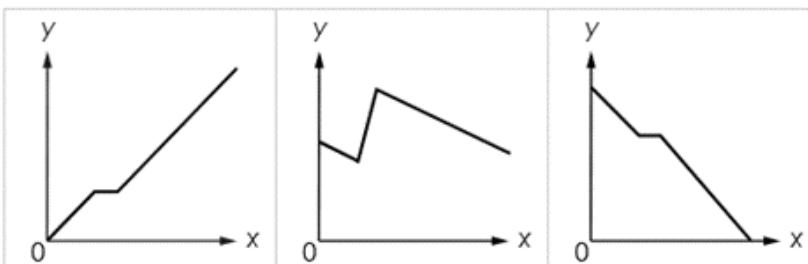
The student may have mistakenly matched the distance from Cincinnati with the second graph and did not realize that when the line increases that would indicate backtracking farther from where Kristie started.

The student may have mistakenly matched the distance from Columbus with the last graph, confusing decreasing with increasing for the value of  $y$ . The student may have incorrectly thought as  $x$  was increasing, the distance from Columbus was also increasing.

## Sample Response: 0 points

Kristie drives from Columbus, Ohio, to Cincinnati, Ohio.

Match each graph to the quantity which would best represent the value of  $y$  with respect to time,  $x$ , in minutes, during Kristie's drive.



<b>Amount of gas in gas tank</b>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Distance from Cincinnati</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Distance from Columbus</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

### Notes on Scoring

This response earns no credit (0 points). The student may have mistakenly matched the amount of gas in the gas tank with the first graph confusing increasing with decreasing for the value of  $y$ . The student may have incorrectly interpreted the graph as  $x$  was increasing, the amount of gas in the gas tank was decreasing.

The student may have correctly matched the distance from Cincinnati with the last graph, since as time increases the distance away from the city Kristie is traveling to decreases, since she gets closer.

The student may have mistakenly matched the distance from Columbus with the second graph, confusing the line moving off to the right with a car traveling. The student may have incorrectly thought as  $x$  was increasing, the distance from Columbus was increasing because the line gets further away from the  $y$ -axis.

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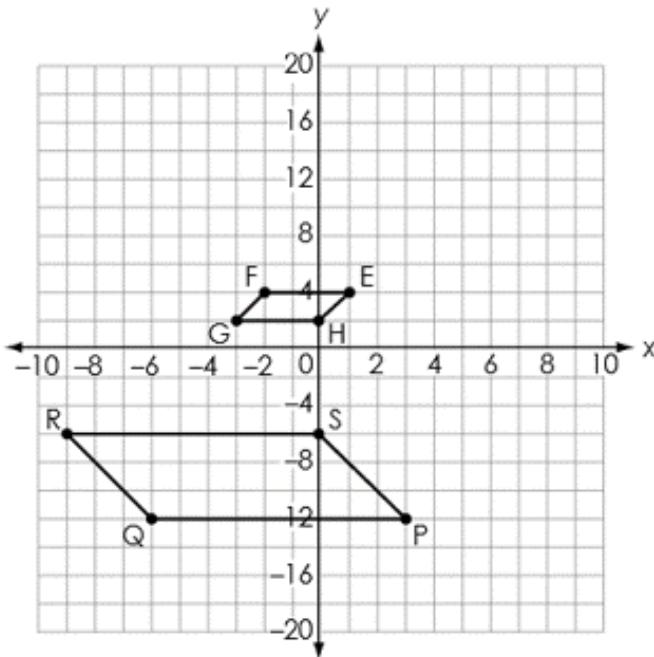
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**Question 14**

**Question and Scoring Guidelines**

## Question 14

Similar parallelograms EFGH and PQRS are shown.



Which sequence of transformations can be performed on EFGH to prove that the parallelograms are similar?

- (A) a reflection across the  $x$ -axis and then a dilation by a scale factor of 3 centered at the origin
- (B) a reflection across the  $x$ -axis and then a dilation by a scale factor of  $\frac{1}{3}$  centered at the origin
- (C) a  $180^\circ$  clockwise rotation about the origin and then a dilation by a scale factor of 3 centered at the origin
- (D) a  $180^\circ$  clockwise rotation about the origin and then a dilation by a scale factor of  $\frac{1}{3}$  centered at the origin

**Points Possible:** 1

**Content Cluster:** Understand congruence and similarity using physical models, transparencies, or geometry software.

**Content Standard:** Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them. (Include examples both with and without coordinates.) (8.G.4)

**Depth of Knowledge:** Level 2

**Modeling and Reasoning:** Yes

## Scoring Guidelines

Rationale for Option A: Key – The student correctly finds the image of the parallelogram EFGH. The coordinates of the image of EFGH under the first transformation are  $E'(1, -4), F'(-2, -4), G'(-3, -2)$ . Since the coordinates of the image of  $E'F'G'H'$  under the second transformation are  $P(3, -12), Q(-6, -12)R(-9, -6), S(0, -6)$ , the second transformation is a dilation. Thus, the student calculates the scale factor by dividing the x-coordinate of the vertex P by the x-coordinate of the corresponding vertex  $E'$  as  $3 \div 1 = 3$ .

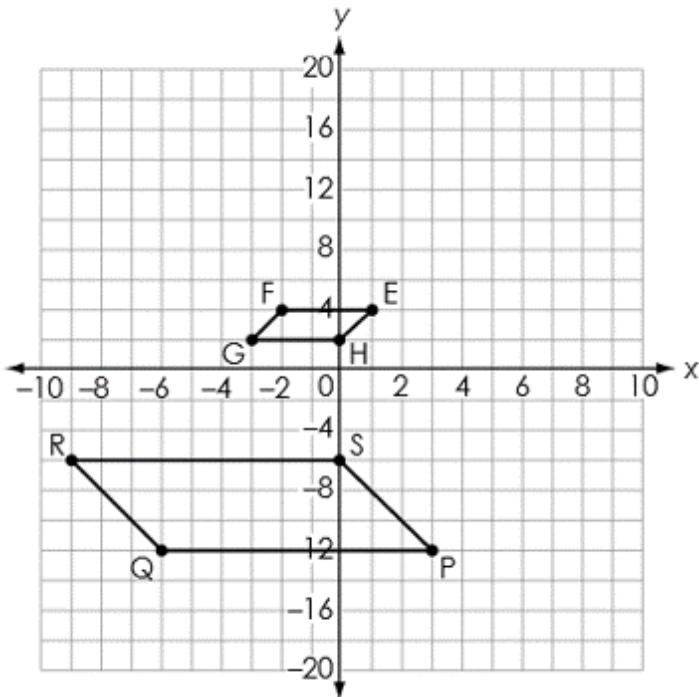
Rationale for Option B: This is incorrect. The student may correctly identify the image of the parallelogram EFGH after the first transformation as  $E'(1, -4), F'(-2, -4), G'(-3, -2)$ . The student may then calculate the scale factor by dividing the x-coordinates of the vertices of the image of EFGH after the first transformation by the x-coordinates of the vertices of PQRS. Thus, the student calculates the scale factor as  $1 \div 3 = \frac{1}{3}$ .

Rationale for Option C: This is incorrect. The student may assume that after a rotation of  $180^\circ$  clockwise about the origin, the coordinates  $(x, y)$  changes to  $(x, -y)$ . The student may then calculate the scale factor by dividing the x-coordinate of the vertex P by the x-coordinate image of the vertex E after the rotation as  $3 \div 1 = 3$ .

Rationale for Option D: This is incorrect. The student may assume that after a rotation of  $180^\circ$  about the origin, the coordinates  $(x, y)$  changes to  $(x, -y)$ . The student may then calculate the scale factor by dividing the x-coordinate image of the vertex E after the rotation by the x-coordinate of the vertex P as  $1 \div 3 = \frac{1}{3}$ .

## Sample Response: 1 point

Similar parallelograms EFGH and PQRS are shown.



Which sequence of transformations can be performed on EFGH to prove that the parallelograms are similar?

- A a reflection across the  $x$ -axis and then a dilation by a scale factor of 3 centered at the origin
- B a reflection across the  $x$ -axis and then a dilation by a scale factor of  $\frac{1}{3}$  centered at the origin
- C a  $180^\circ$  clockwise rotation about the origin and then a dilation by a scale factor of 3 centered at the origin
- D a  $180^\circ$  clockwise rotation about the origin and then a dilation by a scale factor of  $\frac{1}{3}$  centered at the origin

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**Question 19**

**Question and Scoring Guidelines**

## Question 19

An equation is shown.

$$12x - (3x + 7) = -3(4 - 3x)$$

How many solutions does the equation have?

(A) no solutions

(B) one solution

(C) two solutions

(D) infinitely many solutions

**Points Possible:** 1

**Content Cluster:** Analyze and solve linear equations and pairs of simultaneous linear equations.

**Content Standard:** Solve linear equations in one variable.

a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form  $x = a$ ,  $a = a$ , or  $a = b$  results (where  $a$  and  $b$  are different numbers).  
(8.EE.7)

**Depth of Knowledge:** Level 2

**Modeling and Reasoning:** No

## Scoring Guidelines

Rationale for Option A: Key – The student correctly determines that having  $9x$  on both sides of the equation and different  $y$ -intercepts means there are no solutions.

Rationale for Option B: This is incorrect. The student may fail to distribute the negative sign of 3 when multiplying.

Rationale for Option C: This is incorrect. The student may not know how to identify the number of solutions.

Rationale for Option D: This is incorrect. The student may think that having  $9x$  on both sides means there are infinitely many solutions.

### Sample Response: 1 point

An equation is shown.

$$12x - (3x + 7) = -3(4 - 3x)$$

How many solutions does the equation have?

A no solutions

B one solution

C two solutions

D infinitely many solutions

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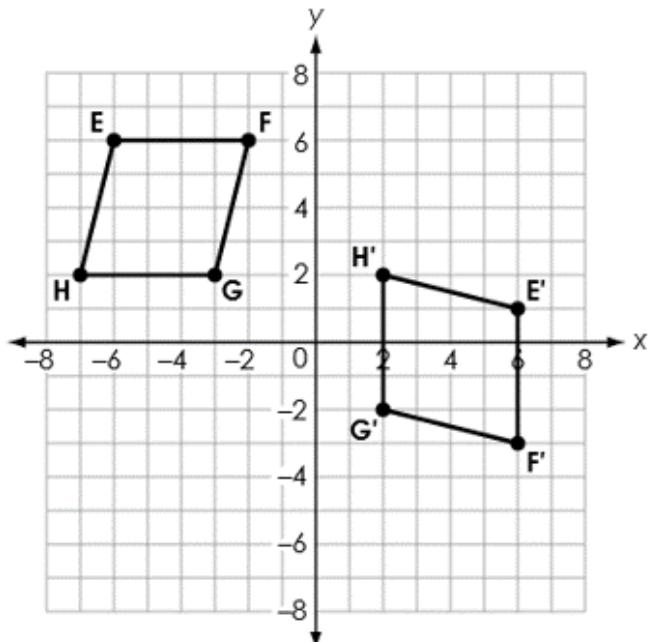
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**Question 20**

**Question and Scoring Guidelines**

## Question 20

Quadrilaterals EFGH and E'F'G'H' are shown on the coordinate grid.



Which sequence of transformations shows that the quadrilaterals are congruent?

- (A) reflect EFGH across the  $y$ -axis and then translate the image 5 units to the right
- (B) reflect EFGH across the  $y$ -axis and then translate the image 5 units down
- (C) rotate EFGH  $90^\circ$  clockwise about the origin and then translate the image 5 units to the right
- (D) rotate EFGH  $90^\circ$  clockwise about the origin and then translate the image 5 units down

**Points Possible:** 1

**Content Cluster:** Understand congruence and similarity using physical models, transparencies, or geometry software.

**Content Standard:** Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them. (Include examples both with and without coordinates.) (8.G.2)

**Depth of Knowledge:** Level 2

**Modeling and Reasoning:** Yes

## Scoring Guidelines

Rationale for Option A: This is incorrect. The student may think that EFGH was reflected across the y-axis because E'F'G'H' crossed over the y-axis but did not notice the orientation of the figure by comparing the vertices. The student may refer back to EFGH rather than the image and think the quadrilateral was translated to the right 5 units by comparing vertex G to vertex H'.

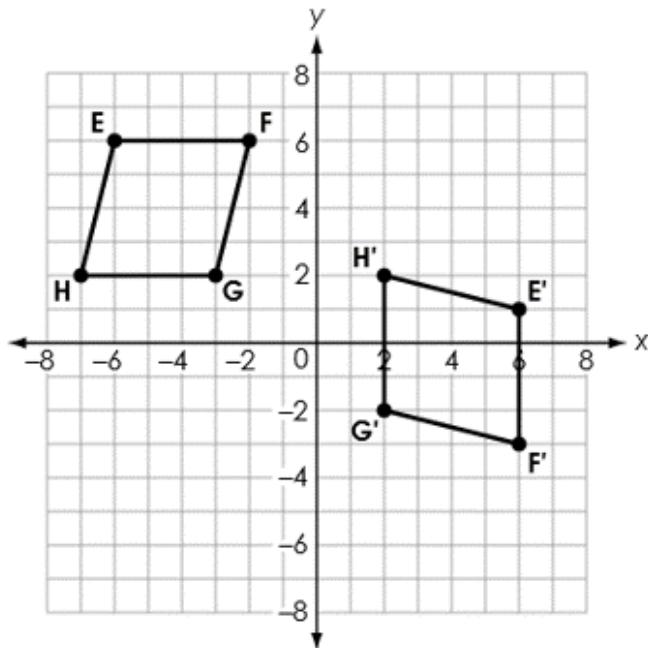
Rationale for Option B: This is incorrect. The student may think that EFGH was reflected across the y-axis because E'F'G'H' crossed over the y-axis but did not notice the orientation of the figure by comparing the vertices. The student may then recognize that the image E would map onto E' if the image was translated 5 units down.

Rationale for Option C: This is incorrect. The student may recognize that EFGH was rotated about the origin 90° clockwise but mistakenly refers back to EFGH rather than the image and thinks the quadrilateral was translated to the right 5 units by comparing vertex G to vertex H'.

Rationale for Option D: Key – The student may determine EFGH was rotated about the origin by comparing the orientation of the vertices of EFGH and E'F'G'H', and rotates EFGH 90 degrees clockwise into Quadrant 1 with points at  $E(6,6), F(6,2), G(2,3), H(2,7)$ . The student may then recognize that the image of EFGH can be translated downward 5 units to map onto E'F'G'H' by comparing the y-coordinates of the image of EFGH and E'F'G'H'.

## Sample Response: 1 point

Quadrilaterals EFGH and E'F'G'H' are shown on the coordinate grid.



Which sequence of transformations shows that the quadrilaterals are congruent?

- A reflect EFGH across the  $y$ -axis and then translate the image 5 units to the right
- B reflect EFGH across the  $y$ -axis and then translate the image 5 units down
- C rotate EFGH  $90^\circ$  clockwise about the origin and then translate the image 5 units to the right
- D rotate EFGH  $90^\circ$  clockwise about the origin and then translate the image 5 units down

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**Question 25**

**Question and Scoring Guidelines**

## Question 25

Match the expression in each row of the table to its equivalent expression.

	$5^9$	$5^{18}$	$5^{216}$
$(5^6)^3$	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
$5^6 \cdot 5^3$	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Points Possible:** 1

**Content Cluster:** Work with radicals and integer exponents.

**Content Standard:** Understand, explain, and apply the properties of integer exponents to generate equivalent numerical expressions. For example,  $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$ . (8.EE.1)

**Depth of Knowledge:** Level 1

**Modeling and Reasoning:** No

## Scoring Guidelines

For full credit (1 point), the student's response satisfies the bullet below.

- The student understands that the exponents in  $(5^6)^3$  should be multiplied and the exponents in  $5^6 \cdot 5^3$  should be added, providing evidence of the ability to apply the properties of integer exponents to generate equivalent numerical expressions.

### Exemplar Response

	$5^9$	$5^{18}$	$5^{216}$
$(5^6)^3$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
$5^6 \cdot 5^3$	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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**Question 25**

**Sample Responses**

## Sample Response: 1 point

Match the expression in each row of the table to its equivalent expression.

	$5^9$	$5^{18}$	$5^{216}$
$(5^6)^3$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
$5^6 \cdot 5^3$	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### Notes on Scoring

This response earns full credit (1 point). For the expression,  $(5^6)^3$ , the student may correctly apply the properties of exponents. The student may multiply the exponents, 6 and 3, to get  $5^{18}$ . For the expression,  $5^6 \cdot 5^3$ , the student may also correctly apply the properties of exponents. The student may add the exponents, 6 and 3, to get  $5^9$ .

## Sample Response: 0 points

Match the expression in each row of the table to its equivalent expression.

	$5^9$	$5^{18}$	$5^{216}$
$(5^6)^3$	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
$5^6 \cdot 5^3$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

### Notes on Scoring

This response earns no credit (0 points). For the expression,  $(5^6)^3$ , the student may incorrectly apply the properties of exponents. The student may add the exponents instead of multiply, to get  $5^9$ . For the expression,  $5^6 \cdot 5^3$ , the student may also incorrectly apply the properties of exponents. The student may multiply the exponents instead of adding, to get  $5^{18}$ .

## Sample Response: 0 points

Match the expression in each row of the table to its equivalent expression.

	$5^9$	$5^{18}$	$5^{216}$
$(5^6)^3$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
$5^6 \cdot 5^3$	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

### Notes on Scoring

This response earns no credit (0 points). For the expression,  $(5^6)^3$ , the student may correctly apply the properties of exponents. The student may multiply the exponents, 6 and 3, to get  $5^{18}$ . For the expression,  $5^6 \cdot 5^3$ , the student may incorrectly apply the properties of exponents. The student may think to raise 6 to the power of 3 to get  $5^{216}$ .

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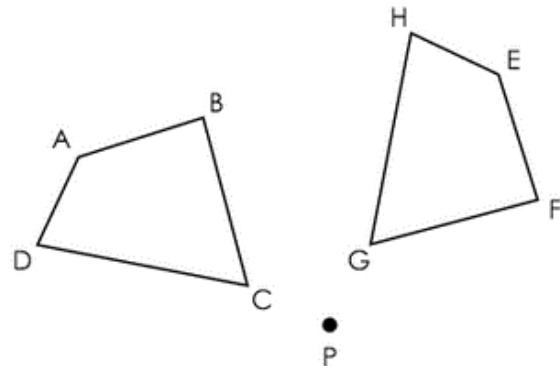
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**Question 28**

**Question and Scoring Guidelines**

## Question 28

Quadrilateral ABCD is rotated about point P to create quadrilateral EFGH.



Select all of the statements that correctly compare the two quadrilaterals.

$\overline{AB} \cong \overline{EF}$

$\overline{DA} \cong \overline{GH}$

$\overline{CD} \cong \overline{FG}$

$\overline{BC} \cong \overline{FG}$

$\overline{CD} \cong \overline{GH}$

**Points Possible:** 1

**Content Cluster:** Understand congruence and similarity using physical models, transparencies, or geometry software.

**Content Standard:** Verify experimentally the properties of rotations, reflections, and translations (include examples both with and without coordinates).

a. Lines are taken to lines, and line segments are taken to line segments of the same length. (8.G.1)

**Depth of Knowledge:** Level 1

**Modeling and Reasoning:** No

## Scoring Guidelines

Rationale for First Option: **Key** – The student correctly identifies congruent segments after a rotation.

Rationale for Second Option: This is incorrect. The student may not recognize how the figure was rotated.

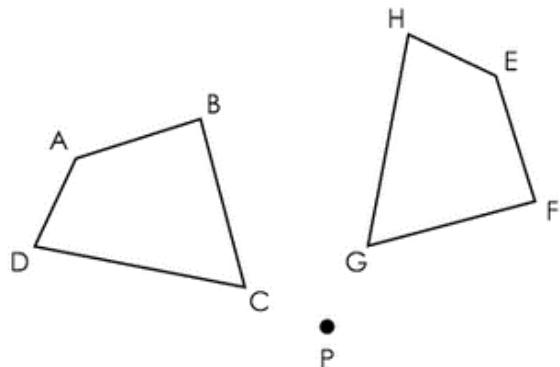
Rationale for Third Option: This is incorrect. The student may choose one of the two longest sides.

Rationale for Fourth Option: **Key** – The student correctly identifies congruent segments after a rotation.

Rationale for Fifth Option: **Key** – The student correctly identifies congruent segments after a rotation.

## Sample Response: 1 point

Quadrilateral ABCD is rotated about point P to create quadrilateral EFGH.



Select all of the statements that correctly compare the two quadrilaterals.

$\overline{AB} \cong \overline{EF}$

$\overline{DA} \cong \overline{GH}$

$\overline{CD} \cong \overline{FG}$

$\overline{BC} \cong \overline{FG}$

$\overline{CD} \cong \overline{GH}$

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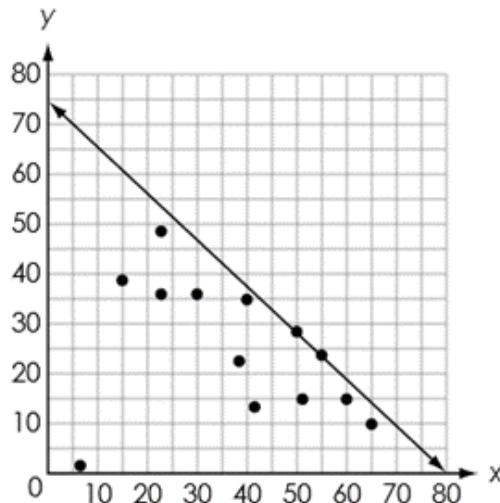
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**Question 30**

**Question and Scoring Guidelines**

## Question 30

A linear model is drawn on a scatterplot, as shown.



Which statement **best** describes how the linear model fits the data on the scatterplot?

- (A) The model is a bad fit for the data because many data points are below the line.
- (B) The model is a bad fit for the data because the line only passes through two points.
- (C) The model is a good fit for the data because the line passes through some data points.
- (D) The model is a good fit for the data because the slope of the line follows the trend of the data.

**Points Possible:** 1

**Content Cluster:** Investigate patterns of association in bivariate data.

**Content Standard:** Understand that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. (GAISE Model, steps 3 and 4) (8.SP.2)

**Depth of Knowledge:** Level 2

**Modeling and Reasoning:** No

## Scoring Guidelines

Rationale for Option A: Key – The student recognizes that most of the data is below the line, making the linear model not a good fit for the data.

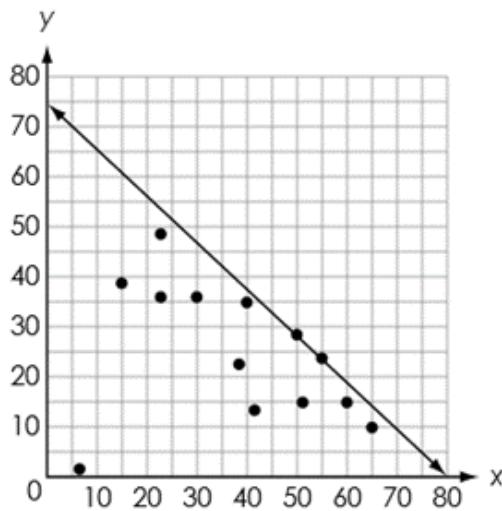
Rationale for Option B: This is incorrect. The student may recognize that the line does not fit the data well but may think that the line needs to go through more of the data points when this is not necessarily the case.

Rationale for Option C: This is incorrect. The student may think any model that passes through a few data points must be a good fit for the data but fails to recognize that the majority of the data is below the line so it is not a good fit.

Rationale for Option D: This is incorrect. The student may recognize that the slope of the line correctly follows the downward trend of the data with increasing x-values but does not recognize that the line should remain as close to as many of the data points as possible, usually with data points both above and below the line.

## Sample Response: 1 point

A linear model is drawn on a scatterplot, as shown.



Which statement **best** describes how the linear model fits the data on the scatterplot?

- A The model is a bad fit for the data because many data points are below the line.
- B The model is a bad fit for the data because the line only passes through two points.
- C The model is a good fit for the data because the line passes through some data points.
- D The model is a good fit for the data because the slope of the line follows the trend of the data.

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**Question 32**

**Question and Scoring Guidelines**

## Question 32

Create an equation for the line that passes through (2, 4) and (3, 6).

$y =$

A digital calculator interface with a numeric keypad, arithmetic operators (+, -, ×, ÷), comparison operators (<, ≤, =, ≥, >), and various mathematical symbols like square root and pi. The letter 'x' is positioned above the numeric keypad.

**Points Possible:** 1

**Content Cluster:** Understand the connections between proportional relationships, lines, and linear equations.

**Content Standard:** Use similar triangles to explain why the slope  $m$  is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation  $y = mx$  for a line through the origin and the equation  $y = mx + b$  for a line intercepting the vertical axis at  $b$ . (8.EE.6)

**Depth of Knowledge:** Level 2

**Modeling and Reasoning:** Yes

## **Scoring Guidelines**

For full credit (1 point), the student's response satisfies the bullet below.

- The student identifies that the equation is  $y = 2x$ , providing evidence of the ability to derive the equation  $y = mx$  for a line through the origin.

### Exemplar Response

- $y = 2x$

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**Question 32**

**Sample Responses**

## Sample Response: 1 point

Create an equation for the line that passes through  $(2, 4)$  and  $(3, 6)$ .

$$y = 2x$$

The calculator interface shows the equation  $y = 2x$  entered. The numeric keypad includes digits 1-9, 0, and decimal points. The function keys include  $x$ ,  $+$ ,  $-$ ,  $\cdot$ ,  $\div$ ,  $<$ ,  $\leq$ ,  $=$ ,  $\geq$ ,  $>$ ,  $\square^2$ ,  $( )$ ,  $| |$ ,  $\sqrt{\square}$ ,  $\sqrt[3]{\square}$ , and  $\pi$ .

### Notes on Scoring

This response earns full credit (1 point). The student may calculate the rate of change, or slope, from the origin to the points  $(2, 4)$  and  $(3, 6)$  to determine the equation of the line. The student may calculate the rate of change to the first point,  $(2, 4)$ , from the origin as  $\frac{4}{2}$  or 2. Then the student may calculate the rate of change to the second point,  $(3, 6)$ , from the origin as  $\frac{6}{3}$  or 2. Since the rates of change from  $(0, 0)$  are equivalent, the student may determine the equation to be  $y = 2x$ .

## Sample Response: 1 point

Create an equation for the line that passes through (2, 4) and (3, 6).

$$y = \frac{2}{1}x$$

A digital calculator interface with a light gray background. At the top, there are four circular arrows (left, right, up, down) and a delete key. Below is a numeric keypad with columns for 1, 2, 3 and x; columns for 4, 5, 6 and arithmetic operators +, -, ×, ÷; columns for 7, 8, 9 and comparison operators <, ≤, =, ≥, >; and a column for 0 and functions x², ( ), | |, √, ∛, and π.

### Notes on Scoring

This response earns full credit (1 point). The student may calculate the rate of change, or slope, from the origin to the points (2, 4) and (3, 6) to determine the equation of the line. The student may calculate the rate of change to the first point, (2, 4), from the origin as  $\frac{4}{2}$  or  $\frac{2}{1}$ . Then the student may calculate the rate of change to the second point, (3, 6), from the origin as  $\frac{6}{3}$  or  $\frac{2}{1}$ . Since the rates of change from (0, 0) are equivalent, the student may determine the equation to be  $y = \frac{2}{1}x$ .

## Sample Response: 0 points

Create an equation for the line that passes through (2, 4) and (3, 6).

$$y = \frac{1}{2}x$$

A digital calculator interface is shown. At the top, there are five small circular buttons with arrows pointing left, right, up, down, and diagonally. Below them is a numeric keypad with columns for 1, 2, 3 and 4, 5, 6. To the right of the keypad is a variable 'x'. The next row contains arithmetic operators: +, -, ×, ÷. The following row contains comparison operators: <, ≤, =, ≥, >. The bottom row contains function keys: a square root symbol, a parentheses pair, a fraction bar, and symbols for π, √, and ∛.

### Notes on Scoring

This response earns no credit (0 points). The student may calculate the rate of change, or slope, from the origin to the points (2, 4) and (3, 6) to determine the equation of the line. The student may incorrectly calculate the rate of change to the first point, (2, 4), from the origin as  $\frac{2}{4}$  or  $\frac{1}{2}$ . Then the student may also incorrectly calculate the rate of change to the second point, (3, 6), from the origin as  $\frac{3}{6}$  or  $\frac{1}{2}$ . Since the rates of change from (0, 0) are equivalent, the student may incorrectly determine the equation to be  $y = \frac{1}{2}x$ .

## Sample Response: 0 points

Create an equation for the line that passes through (2, 4) and (3, 6).

$$y = 10x$$

### Notes on Scoring

This response earns no credit (0 points). The student may incorrectly find slope by first multiplying the coordinates of each point. The student may multiply 2 and 4 to get 8 and 3 and 6 to get 18. Then the student may subtract 18 and 8 to incorrectly determine 10 as the slope of the line. Finally, the student may incorrectly enter the equation of the line as  $y = 10x$ .

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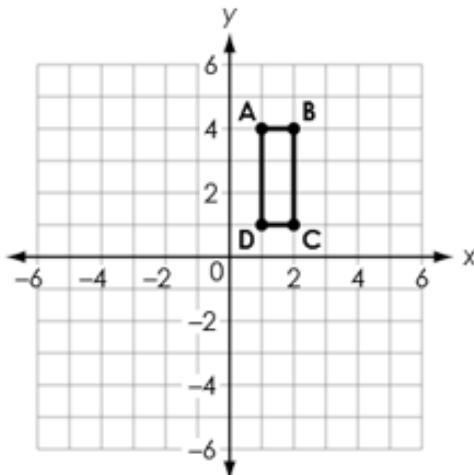
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**Question 33**

**Question and Scoring Guidelines**

## Question 33

Rectangle ABCD is shown.



Stella rotates ABCD 90 degrees counterclockwise around the origin. Then, she translates the rectangle to the right by  $k$  units to create rectangle WXYZ. One side of WXYZ lies on the  $y$ -axis.

What is a possible value of  $k$ ?

<input type="button" value="↶"/>	<input type="button" value="↶"/>	<input type="button" value="↶"/>
<input type="button" value="↶"/>	<input type="button" value="↶"/>	<input type="button" value="↶"/>
<input type="button" value="1"/>	<input type="button" value="2"/>	<input type="button" value="3"/>
<input type="button" value="4"/>	<input type="button" value="5"/>	<input type="button" value="6"/>
<input type="button" value="7"/>	<input type="button" value="8"/>	<input type="button" value="9"/>
<input type="button" value="0"/>		
<input type="button" value="."/>	<input type="button" value="-"/>	<input type="button" value="÷"/>

**Points Possible:** 1

**Content Cluster:** Understand congruence and similarity using physical models, transparencies, or geometry software.

**Content Standard:** Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates. (8.G.3)

**Depth of Knowledge:** Level 2

**Modeling and Reasoning:** Yes

## Scoring Guidelines

For full credit (1 point), the student's response satisfies the bullet below.

- The student correctly determines the effect of the transformations on ABCD and calculates the value of  $k$  as 1 or 4, providing evidence of the ability to describe the effect of translations and rotations on two-dimensional figures using coordinates.

### Exemplar Response

- 1  
or
- 4  
or
- any equivalent values

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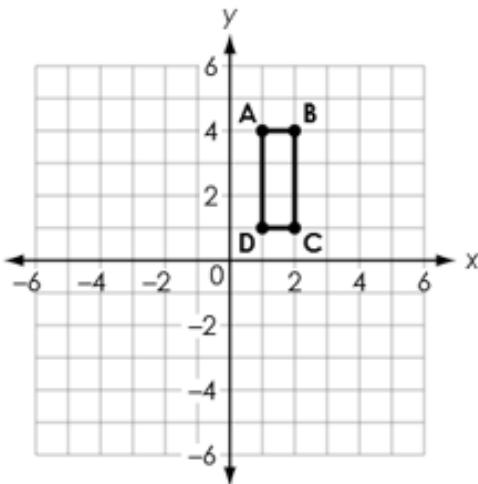
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**Question 33**

**Sample Responses**

**Sample Response: 1 point**

Rectangle ABCD is shown.



Stella rotates ABCD 90 degrees counterclockwise around the origin. Then, she translates the rectangle to the right by  $k$  units to create rectangle WXYZ. One side of WXYZ lies on the  $y$ -axis.

What is a possible value of  $k$ ?

1



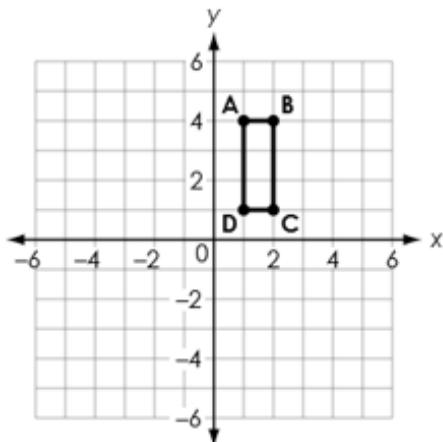
1	2	3
4	5	6
7	8	9
	0	
.	-	$\frac{\Box}{\Box}$

**Notes on Scoring**

This response earns full credit (1 point). The student may correctly determine, after a 90 degrees counterclockwise rotation about the origin, the vertices of the rotated rectangle would be at  $(-1, 1)$ ,  $(-1, 2)$ ,  $(-4, 2)$  and  $(-4, 1)$ . After this rotation, the student may recognize the right side of the rectangle is parallel to the  $y$ -axis. The student may then determine that translating the rectangle to the right by 1 unit would put the right side of the rectangle on the  $y$ -axis.

## Sample Response: 1 point

Rectangle ABCD is shown.



Stella rotates ABCD 90 degrees counterclockwise around the origin. Then, she translates the rectangle to the right by  $k$  units to create rectangle WXYZ. One side of WXYZ lies on the  $y$ -axis.

What is a possible value of  $k$ ?

4



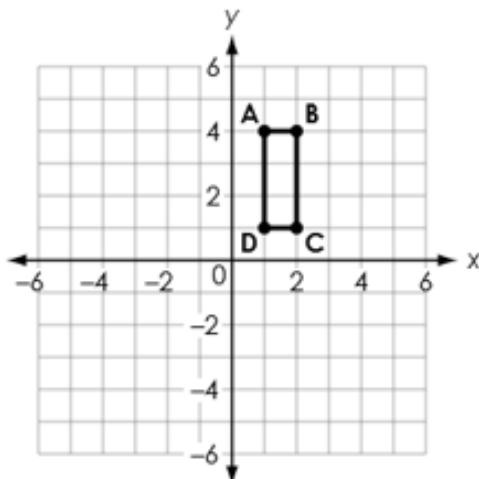
1	2	3
4	5	6
7	8	9
	0	
.	-	$\frac{\Box}{\Box}$

**Notes on Scoring**

This response earns full credit (1 point). The student may correctly determine, after a 90 degrees counterclockwise rotation about the origin, the vertices of the rotated rectangle would be at  $(-1, 1)$ ,  $(-1, 2)$ ,  $(-4, 2)$  and  $(-4, 1)$ . After this rotation, the student may recognize the left side of the rectangle is parallel to the  $y$ -axis. The student may then determine that translating the rectangle to the right by 4 units would put the left side of the rectangle on the  $y$ -axis.

## Sample Response: 0 points

Rectangle ABCD is shown.



Stella rotates ABCD 90 degrees counterclockwise around the origin. Then, she translates the rectangle to the right by  $k$  units to create rectangle WXYZ. One side of WXYZ lies on the  $y$ -axis.

What is a possible value of  $k$ ?

2

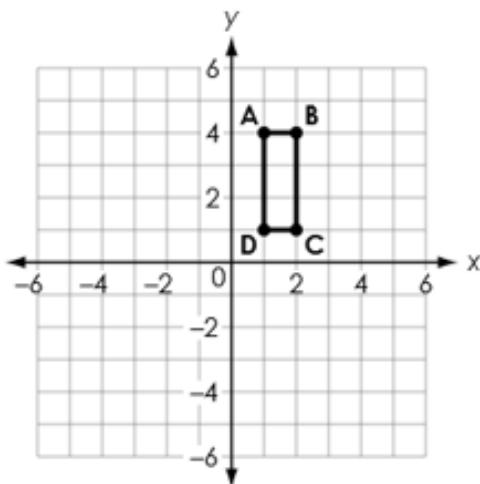
1	2	3
4	5	6
7	8	9
	0	
.	-	$\frac{\Box}{\Box}$

### **Notes on Scoring**

This response earns no credit (0 points). The student may incorrectly think a 90 degrees rotation counterclockwise about the origin  $(0, 0)$  is the same as reflecting the shape across the line  $y = x$ , since  $y = x$  also passes through  $(0,0)$ . The student may incorrectly determine the vertices of the rectangle to be  $(-1, -1)$ ,  $(-2, -1)$ ,  $(-1, -4)$  and  $(-2, -4)$ . The student may recognize the left side of the rectangle is parallel to the  $y$ -axis. The student may then recognize by translating the rectangle to the right by 2 units would put the left side of the rectangle on the  $y$ -axis.

## Sample Response: 0 points

Rectangle ABCD is shown.



Stella rotates ABCD 90 degrees counterclockwise around the origin. Then, she translates the rectangle to the right by  $k$  units to create rectangle WXYZ. One side of WXYZ lies on the  $y$ -axis.

What is a possible value of  $k$ ?

3



1	2	3
4	5	6
7	8	9
	0	
.	-	$\frac{\Box}{\Box}$

### **Notes on Scoring**

This response earns no credit (0 points). The student may correctly recognize a 90 degrees rotation counterclockwise will rotate the shape to its side, but incorrectly think the vertex closest to the origin must be on the origin. So, the student may incorrectly determine the vertices of the rectangle to be  $(0, 0)$ ,  $(0, 1)$ ,  $(-3, 0)$  and  $(-3, 1)$ . The student may recognize the right side of the rectangle is already on the  $y$ -axis. The student may then recognize by translating the rectangle to the right by 3 units would put the left side of the rectangle on the  $y$ -axis.

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**Question 34**

**Question and Scoring Guidelines**

## Question 34

A graph passes through the points  $(0, 0)$ ,  $(1, 2)$ , and  $(2, 5)$ .

Which statement about the graph is true?

- A It is linear because the graph passes through the origin.
- B It is not linear because the graph passes through the origin.
- C It is linear because a straight line can pass through the given points.
- D It is not linear because a straight line cannot pass through the given points.

**Points Possible:** 1

**Content Cluster:** Define, evaluate, and compare functions.

**Content Standard:** Interpret the equation  $y = mx + b$  as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function  $A = s^2$  giving the area of a square as a function of its side length is not linear because its graph contains the points  $(1, 1)$ ,  $(2, 4)$ , and  $(3, 9)$  which are not on a straight line. (8.F.3)

**Depth of Knowledge:** Level 2

**Modeling and Reasoning:** Yes

## Scoring Guidelines

Rationale for Option A: This is incorrect. The student may identify that the graph passes through the origin, but does not consider that the line cannot pass through all three points since the slope of a line going through the first two points is 2, but the slope of a line going through the second two points is 3.

Rationale for Option B: This is incorrect. The student may mistakenly believe that a linear function must have a nonzero y-intercept and therefore not pass through the origin.

Rationale for Option C: This is incorrect. The student may think that since the x-coordinate increases by 1 for each point, then a line can be drawn that intersects all three points. However, to determine whether three or more points are collinear, the slope of a line connecting each adjacent pair of points must be the same. For the three given points, slope of a line connecting the first two points is 2, but the slope of a line connecting the last two points is 3.

Rationale for Option D: Key – The student correctly recognizes that the function that passes through the given points is not a linear function since the slope of a line connecting the first two points is 2, but the slope of a line connecting the last two points is 3.

### Sample Response: 1 point

A graph passes through the points  $(0, 0)$ ,  $(1, 2)$ , and  $(2, 5)$ .

Which statement about the graph is true?

- A It is linear because the graph passes through the origin.
- B It is not linear because the graph passes through the origin.
- C It is linear because a straight line can pass through the given points.
- D It is not linear because a straight line cannot pass through the given points.

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**Question 36**

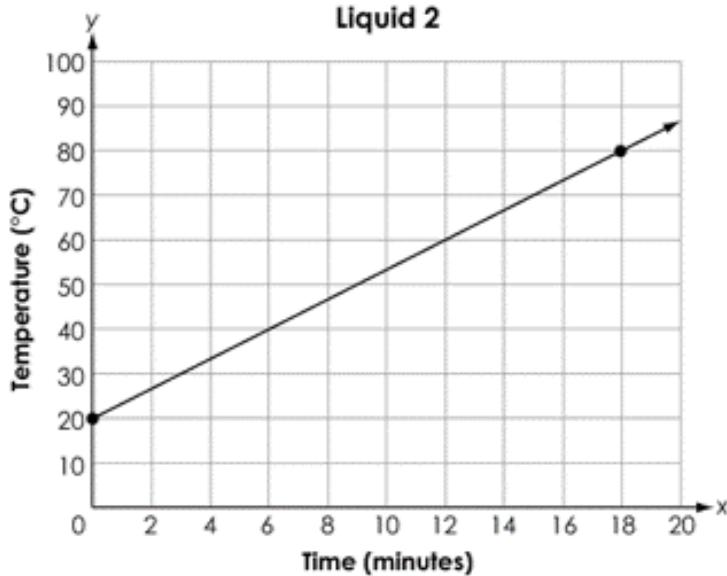
**Question and Scoring Guidelines**

## Question 36

Liquid 1

Time (minutes)	Temperature (°C)
0	18
5	35.5
10	53
15	70.5

Liquid 2



A scientist recorded the temperatures of two different liquids as they were heated. The results are shown in the table and graph.

Which statement is true?

- Ⓐ Liquid 1 heated at a slower rate than Liquid 2 and had a higher starting temperature than Liquid 2.
- Ⓑ Liquid 1 heated at a slower rate than Liquid 2 and had a lower starting temperature than Liquid 2.
- Ⓒ Liquid 1 heated at a faster rate than Liquid 2 and had a higher starting temperature than Liquid 2.
- Ⓓ Liquid 1 heated at a faster rate than Liquid 2 and had a lower starting temperature than Liquid 2.

**Points Possible:** 1

**Content Cluster:** Define, evaluate, and compare functions.

**Content Standard:** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change. (8.F.2)

**Depth of Knowledge:** Level 2

**Modeling and Reasoning:** Yes

## Scoring Guidelines

Rationale for Option A: This is incorrect. The student may misinterpret the starting temperature of one of the liquids and may have used just the coordinates of one point to calculate Liquid B, such as (12, 60), 60 divided by 12 equals 5.

Rationale for Option B: This is incorrect. The student may use just the coordinates of one point to calculate Liquid B, such as (12, 60), 60 divided by 12 equals 5.

Rationale for Option C: This is incorrect. The student may misinterpret the starting temperature of one of the liquids.

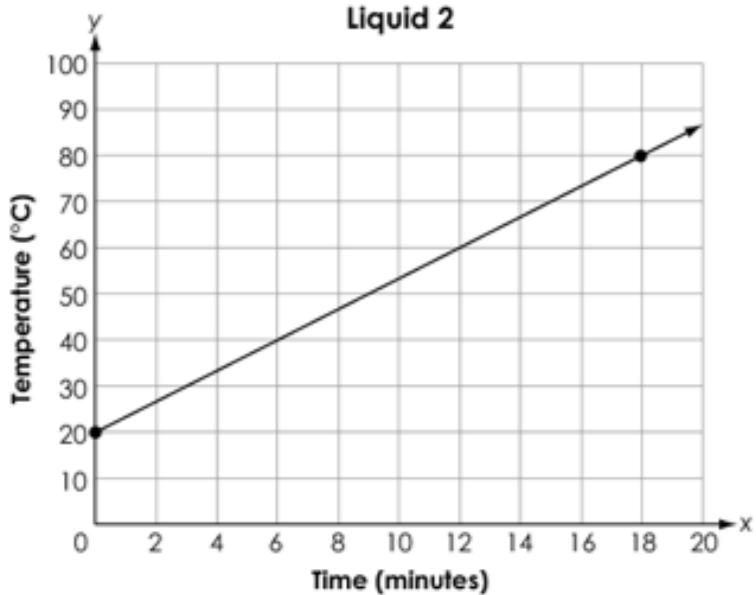
Rationale for Option D: Key – The student correctly compares the rates of 3.5 and  $\frac{10}{3}$  and the starting temperatures of 18 and 20 degrees.

## Sample Response: 1 point

Liquid 1

Time (minutes)	Temperature (°C)
0	18
5	35.5
10	53
15	70.5

Liquid 2



A scientist recorded the temperatures of two different liquids as they were heated. The results are shown in the table and graph.

Which statement is true?

- (A) Liquid 1 heated at a slower rate than Liquid 2 and had a higher starting temperature than Liquid 2.
- (B) Liquid 1 heated at a slower rate than Liquid 2 and had a lower starting temperature than Liquid 2.
- (C) Liquid 1 heated at a faster rate than Liquid 2 and had a higher starting temperature than Liquid 2.
- (D) Liquid 1 heated at a faster rate than Liquid 2 and had a lower starting temperature than Liquid 2.

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**Question 37**

**Question and Scoring Guidelines**

## Question 37

Mr. Miller presented his class with the following equation.

$$(7.5 \cdot 10^4)(p \cdot 10^q) = 1.5 \cdot 10^8$$

What are possible values of  $p$  and  $q$ ?

$p =$

$q =$



1	2	3
4	5	6
7	8	9
	0	
.	-	$\frac{\Box}{\Box}$

**Points Possible:** 1

**Content Cluster:** Work with radicals and integer exponents.

**Content Standard:** Perform operations with numbers expressed in scientific notation, including problems where both decimal notation and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities, e.g., use millimeters per year for seafloor spreading. Interpret scientific notation that has been generated by technology. (8.EE.4)

**Depth of Knowledge:** Level 3

**Modeling and Reasoning:** Yes

## **Scoring Guidelines**

For this item, a full-credit response includes:

- two correct values (1 point).

### Exemplar Response

- $p = 2, q = 3$   
or
- any values of  $p$  and  $q$  such that  $p \times 10^q = 2,000$

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**Question 37**

**Sample Responses**

## Sample Response: 1 point

Mr. Miller presented his class with the following equation.

$$(7.5 \cdot 10^4)(p \cdot 10^q) = 1.5 \cdot 10^8$$

What are possible values of  $p$  and  $q$ ?

$$p = 2$$

$$q = 3$$

The image shows a digital calculator interface. At the top, there is a row of five small circular buttons with arrows pointing left, right, up, down, and a clear button. Below this is a numeric keypad grid with four rows and three columns. The first row contains the numbers 1, 2, and 3. The second row contains 4, 5, and 6. The third row contains 7, 8, and 9. The fourth row contains a blank space, 0, and another blank space. Below the numeric keypad are three additional buttons: a decimal point button (.), a subtraction button (-), and a division button (÷).

### Notes on Scoring

This response earns full credit (1 point). The student may correctly identify that 7.5 multiplied by  $p$  must equal 1.5. The student may divide 1.5 by 7.5 to get 0.2. Next the student may correctly identify that the sum of the exponents 4 and  $q$  must equal 8. Therefore, the student may calculate the value of  $q$  by subtracting 8 and 4 to get 4. Next, the student may determine  $0.2 \cdot 10^4$  as the second factor on the left side of the equation. This means that  $p = 0.2$  and  $q = 4$ . Finally, the student may prefer that 0.2 be a whole number to be in standard scientific notation and correctly determine that  $0.2 \cdot 10^4 = 2 \cdot 10^3$ . This means that  $p = 2$  and  $q = 3$  will work in this equation.

## Sample Response: 1 point

Mr. Miller presented his class with the following equation.

$$(7.5 \cdot 10^4) (p \cdot 10^q) = 1.5 \cdot 10^8$$

What are possible values of  $p$  and  $q$ ?

$$p = 0.2$$

$$q = 4$$

The calculator interface shows the following layout:

- Top row: Backspace, Forward, Left, Right, Clear.
- Second row: 1, 2, 3.
- Third row: 4, 5, 6.
- Fourth row: 7, 8, 9.
- Fifth row: Blank, 0, Blank.
- Sixth row: ., -,  $\frac{\Box}{\Box}$ .

### Notes on Scoring

This response earns full credit (1 point). The student may correctly identify that 7.5 multiplied by  $p$  must equal 1.5. The student may divide 1.5 by 7.5 to get 0.2. Next the student may correctly identify that the sum of the exponents 4 and  $q$  must equal 8. Therefore, the student may calculate the value of  $q$  by subtracting 8 and 4 to get 4. Next, the student may determine  $0.2 \cdot 10^4$  as the second factor on the left side of the equation. This means that  $p = 0.2$  and  $q = 4$ .

## Sample Response: 0 points

Mr. Miller presented his class with the following equation.

$$(7.5 \cdot 10^4)(p \cdot 10^q) = 1.5 \cdot 10^8$$

What are possible values of  $p$  and  $q$ ?

$$p = -6$$

$$q = 4$$

The calculator interface shows the following:

- Equation:  $(7.5 \cdot 10^4)(p \cdot 10^q) = 1.5 \cdot 10^8$
- Response:  $p = -6$
- Response:  $q = 4$
- Keypad:
  - Digits: 1, 2, 3, 4, 5, 6, 7, 8, 9, 0
  - Operations: ., -, ÷, ×, ÷, =
  - Other: ←, →, ↶, ↷, C

### Notes on Scoring

This response earns no credit (0 points). The student may incorrectly identify that 7.5 added to  $p$  results in 1.5. The student may subtract 7.5 from 1.5 to get  $-6$ . Next the student may correctly identify that the sum of the exponents 4 and  $q$  should equal 8. Therefore, the student may calculate the value of  $q$  by subtracting 8 and 4 to get 4. Finally, the student may determine  $-6 \cdot 10^4$  as the second factor, where  $p = -6$  and  $q = 4$ .

## Sample Response: 0 points

Mr. Miller presented his class with the following equation.

$$(7.5 \cdot 10^4)(p \cdot 10^q) = 1.5 \cdot 10^8$$

What are possible values of  $p$  and  $q$ ?

$$p = 6$$

$$q = 4$$

The calculator interface includes a numeric keypad with digits 1 through 9, 0, ., and -, and a denominator key  $\frac{\Box}{\Box}$ . Above the keypad are five function keys: backspace, forward slash, left arrow, right arrow, and clear.

### Notes on Scoring

This response earns no credit (0 points). The student may incorrectly identify that  $p$  should be subtracted from 7.5 to get 1.5. The student may subtract 1.5 from 7.5 to get 6. Next the student may correctly identify that the sum of the exponents 4 and  $q$ , when added should be 8. Therefore, the student may calculate the value of  $q$  by subtracting 8 and 4 to get 4. Finally, the student may determine  $6 \times 10^4$  as the second factor, where  $p = 6$  and  $q = 4$ .

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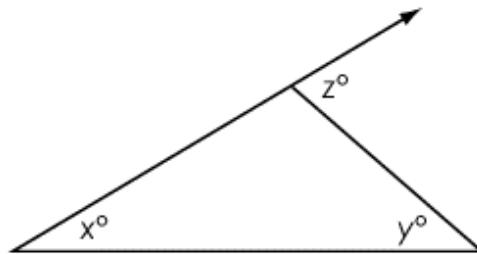
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**Question 40**

**Question and Scoring Guidelines**

## Question 40

A diagram is shown.



Create an equation for  $z$  in terms of  $x$  and  $y$ .

$z =$



1	2	3	$x$	$y$			
4	5	6	+	-	$\cdot$	$\div$	
7	8	9	<	$\leq$	=	$\geq$	>
	0		$\square^2$	( )		$\sqrt{ }$	$\sqrt[3]{ }$
.	-	$\frac{\Box}{\Box}$					$\pi$

**Points Possible:** 1

**Content Cluster:** Understand congruence and similarity using physical models, transparencies, or geometry software.

**Content Standard:** Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so. (8.G.5)

**Depth of Knowledge:** Level 2

**Modeling and Reasoning:** Yes

## Scoring Guidelines

For this item, a full-credit response includes:

- a correct equation (1 point).

### Exemplar Response

- $x + y$   
or
- any equivalent expression

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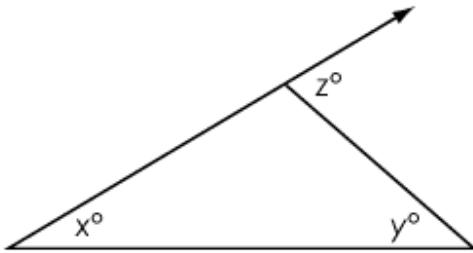
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**Question 40**

**Sample Responses**

**Sample Response: 1 point**

A diagram is shown.



Create an equation for  $z$  in terms of  $x$  and  $y$ .

$$z = x + y$$

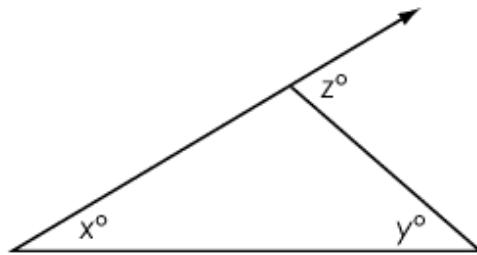
A digital calculator interface. At the top, there is a text input field containing the equation  $z = x + y$ . Below the input field is a numeric keypad with digits 1 through 9, 0, and decimal points. To the right of the digits are operators: addition (+), subtraction (-), multiplication (•), division (÷), less than (<), less than or equal to ( $\leq$ ), equals (=), greater than or equal to ( $\geq$ ), and greater than (>). Below the operators are square root ( $\sqrt{\square}$ ), cube root ( $\sqrt[3]{\square}$ ), parentheses ((), ||), and a pi symbol ( $\pi$ ). There are also backspace and clear buttons above the numeric keypad.

**Notes on Scoring**

This response earns full credit (1 point). The student may correctly determine the exterior angle,  $z$ , is equal to the sum of the measures of the two opposite interior angles of the triangle,  $x$  and  $y$ . The student may enter  $x + y$  to demonstrate their understanding of the exterior angle theorem, which states the exterior angle of a triangle is equal to the sum of the two opposite interior angles.

**Sample Response: 1 point**

A diagram is shown.



Create an equation for  $z$  in terms of  $x$  and  $y$ .

$$z = y + x$$

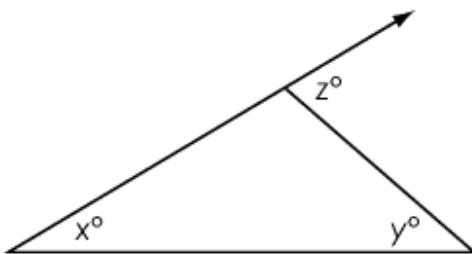
A digital calculator interface. At the top, there is a text input field containing the equation  $z = y + x$ . Below the input field is a row of five small circular buttons with arrows pointing left, right, up, down, and a clear button. Underneath is a numeric keypad with digits 1 through 9, 0, and a decimal point (.). To the right of the keypad are mathematical operators: addition (+), subtraction (-), multiplication (•), division (÷), less than (<), less than or equal to ( $\leq$ ), equals (=), greater than or equal to ( $\geq$ ), greater than (>), a square root symbol ( $\sqrt{\square}$ ), a cube root symbol ( $\sqrt[3]{\square}$ ), and the pi symbol ( $\pi$ ). There are also two empty boxes above the operators.

**Notes on Scoring**

This response earns full credit (1 point). The student may correctly determine the exterior angle,  $z$ , is equal to the sum of the measures of the two opposite interior angles of the triangle,  $x$  and  $y$ . The student may enter  $y + x$  to demonstrate their understanding of the exterior angle theorem.

## Sample Response: 0 points

A diagram is shown.



Create an equation for  $z$  in terms of  $x$  and  $y$ .

$$z = 180 - x - y$$

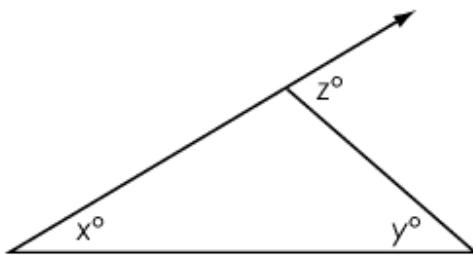
A digital calculator interface with a numeric keypad, arithmetic operators (+, -, ×, ÷), comparison operators (<, ≤, =, ≥, >), and various mathematical functions (square root, cube root, π). The equation  $z = 180 - x - y$  is entered into the display area.

### Notes on Scoring

This response earns no credit (0 points). The student may incorrectly determine the exterior angle,  $z$ , is equal to the measure of the unlabeled angle in the triangle. Therefore, the student may incorrectly think  $y + x + z = 180$ . The student may then solve this equation for  $z$ , and incorrectly determine  $z = 180 - x - y$ .

## Sample Response: 0 points

A diagram is shown.



Create an equation for  $z$  in terms of  $x$  and  $y$ .

$$z = 2(x+y)$$

A digital calculator interface. The display shows the equation  $z = 2(x+y)$ . Below the display is a numeric keypad with digits 1-9, 0, and decimal point (.). Above the numeric keypad are arithmetic operators (+, -, ×, ÷) and comparison operators (<, ≤, =, ≥, >). To the right of the numeric keypad are square root ( $\sqrt{\square}$ ), cube root ( $\sqrt[3]{\square}$ ), and pi ( $\pi$ ) buttons.

### Notes on Scoring

This response earns no credit (0 points). The student may incorrectly determine the exterior angle,  $z$ , is equal to two times the sum of the two opposite interior angles. Therefore, the student may incorrectly think  $z = 2(x + y)$ .

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**Question 43**

**Question and Scoring Guidelines**

## Question 43

A convenience store has 20 bottles of water. Each day, a supplier delivers the same number of bottles to the store. The store does not sell any bottles of water for 3 days and now has 110 bottles.

What is the rate of change in the store's supply of bottled water each day?

The form contains a digital calculator interface. At the top is a large empty text input field. Below it is a row of five small circular buttons with arrows pointing left, right, up, down, and a clear ('X') button. Below this is a 4x3 grid of numeric buttons (1-9, 0, .) and a row of function buttons (-, ÷, and a square root symbol).

**Points Possible:** 1

**Content Cluster:** Use functions to model relationships between quantities.

**Content Standard:** Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two ( $x, y$ ) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. (8.F.4)

**Depth of Knowledge:** Level 2

**Modeling and Reasoning:** Yes

## **Scoring Guidelines**

For full credit (1 point), the student's response satisfies the bullet below.

- The student determines that 30 bottles of water are received from the supplier each day, providing evidence of the ability to determine the rate of change of a function from a description of a relationship.

### Exemplar Response

- 30
- or
- any equivalent value

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**Question 43**

**Sample Responses**

## Sample Response: 1 point

A convenience store has 20 bottles of water. Each day, a supplier delivers the same number of bottles to the store. The store does not sell any bottles of water for 3 days and now has 110 bottles.

What is the rate of change in the store's supply of bottled water each day?

30

The calculator interface shows the digit '3' highlighted in blue. The numeric keypad is arranged in a 5x2 grid:

1	2	3
4	5	6
7	8	9
	0	
.	-	÷

### Notes on Scoring

This response earns full credit (1 point). The student may first think to calculate the number of water bottles delivered over the 3 days. So, the student may subtract 20, the amount the store already had, from 110 to get 90. The student may correctly identify 90 as the amount of water bottles delivered to the store over 3 days. Then the student may divide 90 by the 3 to get 30, the rate of change in the store's bottled water supply for 1 day.

## Sample Response: 1 point

A convenience store has 20 bottles of water. Each day, a supplier delivers the same number of bottles to the store. The store does not sell any bottles of water for 3 days and now has 110 bottles.

What is the rate of change in the store's supply of bottled water each day?

$$\frac{30}{1}$$

The calculator screen displays the fraction  $\frac{30}{1}$ . The numeric keypad shows digits 1 through 9, 0, and decimal points. The arithmetic operators include plus, minus, multiplication, division, and a fraction bar. Navigation keys like arrows and a clear button are also visible.

### Notes on Scoring

This response earns full credit (1 point). The student may first think to calculate the number of water bottles delivered over the 3 days. So, the student may subtract 20, the amount the store already had, from 110 to get 90. The student may correctly identify 90 as the amount of water bottles delivered to the store over 3 days. Then the student may divide 90 by the 3 to get 30, the rate of change in the store's bottled water supply for 1 day. The student may think that rates of change must always be written as a fraction and enter  $\frac{30}{1}$ .

## Sample Response: 0 points

A convenience store has 20 bottles of water. Each day, a supplier delivers the same number of bottles to the store. The store does not sell any bottles of water for 3 days and now has 110 bottles.

What is the rate of change in the store's supply of bottled water each day?

20

A digital calculator interface. The display shows the number 20. Below the display is a numeric keypad with digits 1 through 9, 0, and decimal points, along with standard arithmetic operators (+, -, ×, ÷) and a clear button (C).

### Notes on Scoring

This response earns no credit (0 points). The student may incorrectly interpret the first two sentences as 20 being the daily rate of water bottles delivered to the store instead of the amount of water bottles the store has to begin with.

## Sample Response: 0 points

A convenience store has 20 bottles of water. Each day, a supplier delivers the same number of bottles to the store. The store does not sell any bottles of water for 3 days and now has 110 bottles.

What is the rate of change in the store's supply of bottled water each day?

5.5

The image shows a digital calculator interface. At the top, the number "5.5" is displayed in a large white box. Below the display is a row of five small circular buttons with arrows pointing left, right, up, down, and a clear function. Underneath these are four rows of three square buttons each, representing a numeric keypad. The first row contains the digits 1, 2, and 3. The second row contains 4, 5, and 6. The third row contains 7, 8, and 9. The fourth row contains a blank space, 0, and another blank space. At the bottom of the keypad are three more square buttons labeled with the arithmetic operators +, - (with a minus sign), and × ÷ (with a division symbol).

### Notes on Scoring

This response earns no credit (0 points). The student may disregard 3 days and incorrectly think to find the rate of change the total number of water bottles, 110, should be divided by 20 bottles of water. The student may incorrectly identify 5.5 as the rate of change in the store's bottled water supply for 1 day.

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**Question 45**

**Question and Scoring Guidelines**

## Question 45

Match each expression to the range in which the value lies.

	<b>Between 7 and 8</b>	<b>Between 8 and 9</b>	<b>Between 9 and 10</b>
$\sqrt{80}$	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
$\sqrt{85}$	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
$\sqrt{90}$	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Points Possible:** 1

**Content Cluster:** Know that there are numbers that are not rational, and approximate them by rational numbers.

**Content Standard:** Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions, e.g.,  $\pi^2$ . For example, by truncating the decimal expansion of  $\sqrt{2}$ , show that  $\sqrt{2}$  is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations. (8.NS.2)

**Depth of Knowledge:** Level 1

**Modeling and Reasoning:** No

## Scoring Guidelines

For full credit (1 point), the student's response satisfies the bullet below.

- The student matches the radicals with the correct intervals, providing evidence of the ability to approximate irrational numbers by rational numbers.

### Exemplar Response

	<b>Between 7 and 8</b>	<b>Between 8 and 9</b>	<b>Between 9 and 10</b>
$\sqrt{80}$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
$\sqrt{85}$	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
$\sqrt{90}$	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

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**Question 45**

**Sample Responses**

## Sample Response: 1 point

Match each expression to the range in which the value lies.

	<b>Between 7 and 8</b>	<b>Between 8 and 9</b>	<b>Between 9 and 10</b>
$\sqrt{80}$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
$\sqrt{85}$	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
$\sqrt{90}$	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

### Notes on Scoring

This response earns full credit (1 point). The student may understand the relationship between the square of a number and the square root. The student may then find the perfect squares for 7, 8, 9, and 10 as 49, 64, 81, and 100 respectively. Next the student may determine since 80 is less than 9 squared and more than 8 squared, the value of  $\sqrt{80}$  must lie between 8 and 9. Then the student may determine since 85 and 90 are more than 9 squared and less than 10 squared, the value  $\sqrt{85}$  and  $\sqrt{90}$  must both lie between 9 and 10.

## Sample Response: 0 points

Match each expression to the range in which the value lies.

	<b>Between 7 and 8</b>	<b>Between 8 and 9</b>	<b>Between 9 and 10</b>
$\sqrt{80}$	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
$\sqrt{85}$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
$\sqrt{90}$	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

### Notes on Scoring

This response earns no credit (0 points). The student may correctly calculate 9 squared as 81 and 10 squared as 100. Then the student may determine the value of  $\sqrt{90}$  to be between 9 and 10, since 90 is between 81 and 100. Next the student may notice the other two expressions,  $\sqrt{85}$  and  $\sqrt{80}$ , are each less than the  $\sqrt{90}$ . Then the student may incorrectly assume the value of each must be consecutively less in the table, matching the value of  $\sqrt{85}$  as being between 8 and 9 and the value of  $\sqrt{80}$  as being between 7 and 8.

## Sample Response: 0 points

Match each expression to the range in which the value lies.

	<b>Between 7 and 8</b>	<b>Between 8 and 9</b>	<b>Between 9 and 10</b>
$\sqrt{80}$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
$\sqrt{85}$	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
$\sqrt{90}$	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

### Notes on Scoring

This response earns no credit (0 points). The student may correctly calculate 9 squared as 81 and 10 squared as 100. Then the student may determine the value of  $\sqrt{90}$  to be between 9 and 10, since 90 is between 81 and 100. The student may also correctly calculate 8 squared as 64. The student may determine the value of  $\sqrt{80}$  to be between 8 and 9, since 80 is between 64 and 81. Finally, the student may incorrectly assume the last expression,  $\sqrt{85}$ , must be between 7 and 8 because it is the only range in the table without a match.

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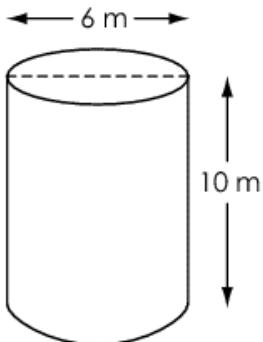
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**Question 47**

**Question and Scoring Guidelines**

## Question 47

A cylinder is shown.



What is the volume, in cubic meters ( $\text{m}^3$ ), of the cylinder?

(A)  $60 \pi$

(B)  $90 \pi$

(C)  $120 \pi$

(D)  $360 \pi$

**Points Possible:** 1

**Content Cluster:** Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.

**Content Standard:** Solve real-world and mathematical problems involving volumes of cones, cylinders, and spheres. (8.G.9)

**Depth of Knowledge:** Level 2

**Modeling and Reasoning:** Yes

## Scoring Guidelines

Rationale for Option A: This is incorrect. The student may use the formula for circumference, instead of area, of the base.

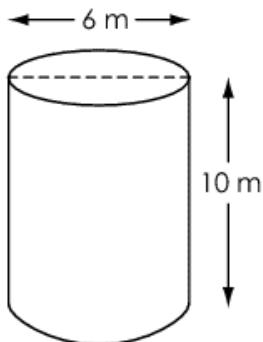
Rationale for Option B: Key – The student correctly finds the area of the base, then multiplies it by the height.

Rationale for Option C: This is incorrect. The student may use the diameter, instead of the radius, and the formula for circumference, instead of area, of the base.

Rationale for Option D: This is incorrect. The student may use the diameter instead of the radius to find the area of the base.

### Sample Response: 1 point

A cylinder is shown.



What is the volume, in cubic meters ( $\text{m}^3$ ), of the cylinder?

(A)  $60 \pi$

(B)  $90 \pi$

(C)  $120 \pi$

(D)  $360 \pi$

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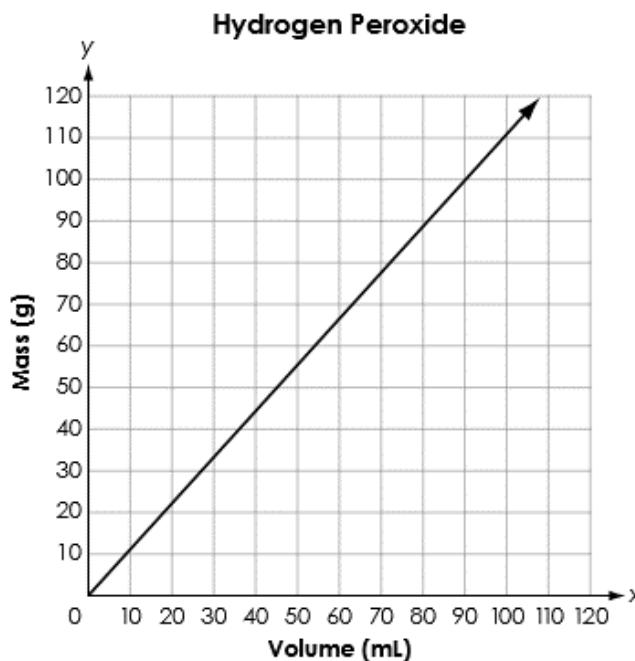
**Question 48**

**Question and Scoring Guidelines**

## Question 48

A teacher compares the masses of two samples of different liquids.

- The equation  $m = 0.674v$  models the mass,  $m$ , in grams (g), of liquid ammonia. The variable  $v$  is the volume, in milliliters (mL).
- The graph shown represents the relationship between mass and volume for hydrogen peroxide.

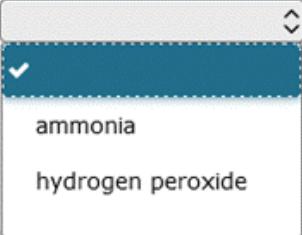


The teacher compares the masses of 10-milliliter samples of each liquid.

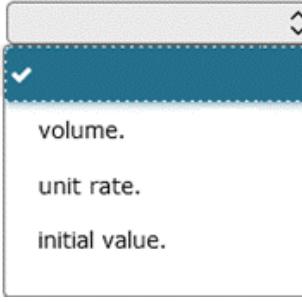
Select words or phrases to complete the statement to describe which sample of liquid has a greater mass.

The sample of  has a greater mass because it has the greater

## Drop Down Choices

The sample of  has a greater mass because it has the

ammonia  
 hydrogen peroxide

greater 

volume.  
 unit rate.  
 initial value.

**Points Possible:** 1

**Content Cluster:** Understand the connections between proportional relationships, lines, and linear equations.

**Content Standard:** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed. (8.EE.5)

**Depth of Knowledge:** Level 3

**Modeling and Reasoning:** Yes

## Scoring Guidelines

For full credit (1 point), the student's response satisfies the bullet below.

- The student correctly completes the statement, providing evidence of the ability to compare two different proportional relationships represented in different ways.

### Exemplar Response

- The sample of **hydrogen peroxide** has a greater mass because it has the greater **unit rate**.

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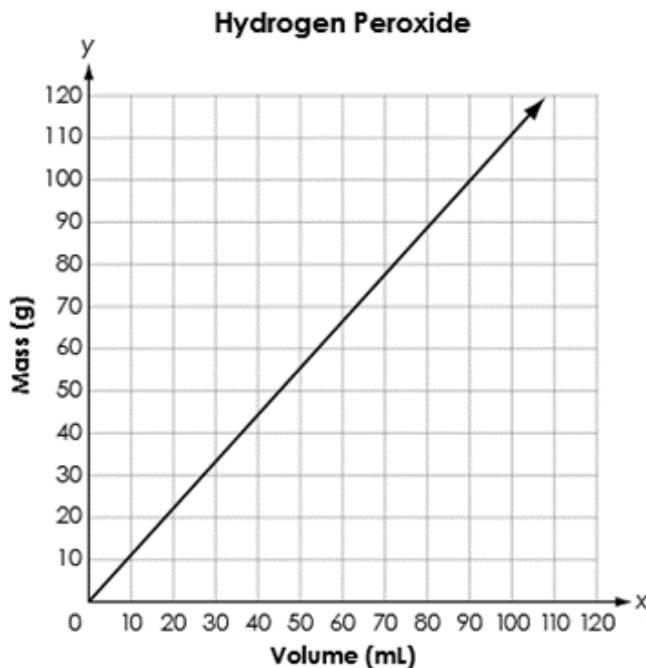
**Question 48**

**Sample Responses**

## Sample Response: 1 point

A teacher compares the masses of two samples of different liquids.

- The equation  $m = 0.674v$  models the mass,  $m$ , in grams (g), of liquid ammonia. The variable  $v$  is the volume, in milliliters (mL).
- The graph shown represents the relationship between mass and volume for hydrogen peroxide.



The teacher compares the masses of 10-milliliter samples of each liquid.

Select words or phrases to complete the statement to describe which sample of liquid has a greater mass.

The sample of hydrogen peroxide has a greater mass because it has the greater unit rate.

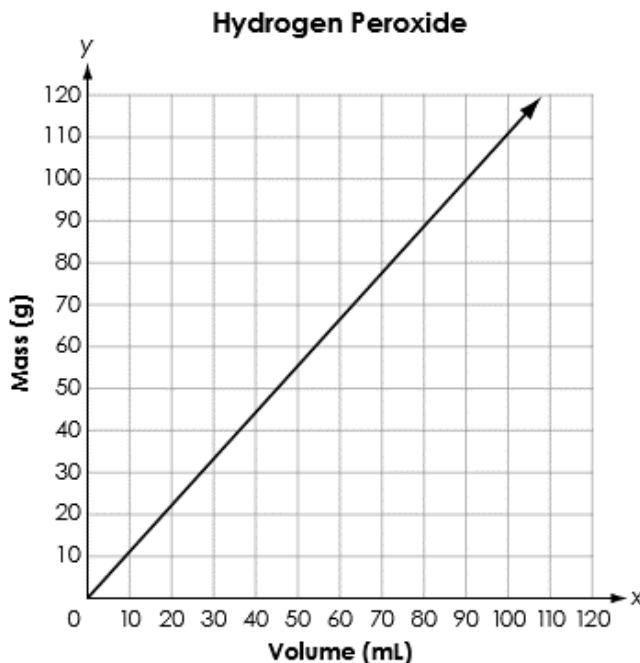
### **Notes on Scoring**

This response earns full credit (1 point). The student may correctly determine the liquid whose equation has a greater unit rate will also have a greater mass. The student may identify the unit rate of ammonia from the equation as 0.674. Then the student may use the graph to estimate the unit rate of hydrogen peroxide as the change in grams,  $y$ , over the change in milliliters,  $x$ . The student may determine the line starts at the origin and estimate the change in  $y$ -values as 10 and the change in  $x$ -values as 10. Next, the student may use these estimates to determine a unit rate of 1 for hydrogen peroxide, which is greater than 0.674.

## Sample Response: 0 points

A teacher compares the masses of two samples of different liquids.

- The equation  $m = 0.674v$  models the mass,  $m$ , in grams (g), of liquid ammonia. The variable  $v$  is the volume, in milliliters (mL).
- The graph shown represents the relationship between mass and volume for hydrogen peroxide.



The teacher compares the masses of 10-milliliter samples of each liquid.

Select words or phrases to complete the statement to describe which sample of liquid has a greater mass.

The sample of  has a greater mass because it has the greater

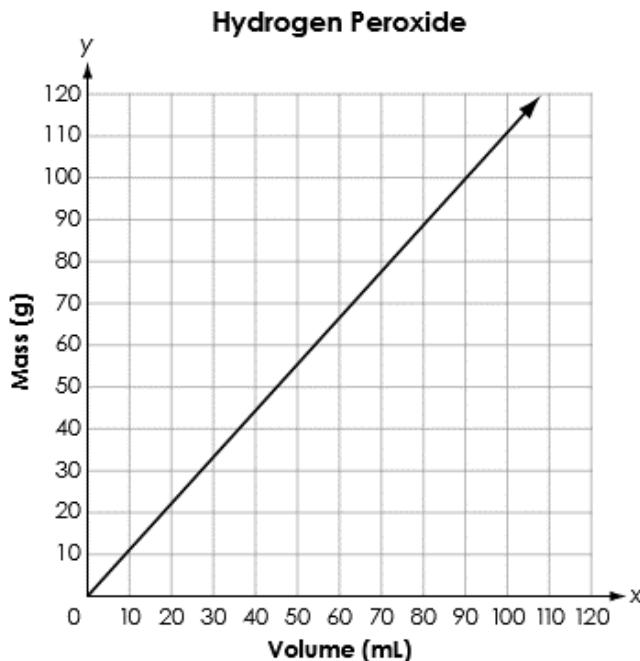
**Notes on Scoring**

This response earns no credit (0 points). The student may identify the unit rate of ammonia from the equation as 0.674. Then the student may use the graph to estimate the unit rate of hydrogen peroxide as the change in grams, y, over the change in milliliters, x. The student may determine the line starts at the origin and estimate the change in y-values as 10 and the change in x-values as 10. Next, the student may use these estimates to determine a unit rate of 1 for hydrogen peroxide, which is greater than 0.674. However, the student may not have realized that we are comparing the same volume, 10 mL, of both hydrogen peroxide and ammonia.

## Sample Response: 0 points

A teacher compares the masses of two samples of different liquids.

- The equation  $m = 0.674v$  models the mass,  $m$ , in grams (g), of liquid ammonia. The variable  $v$  is the volume, in milliliters (mL).
- The graph shown represents the relationship between mass and volume for hydrogen peroxide.



The teacher compares the masses of 10-milliliter samples of each liquid.

Select words or phrases to complete the statement to describe which sample of liquid has a greater mass.

The sample of ammonia  has a greater mass because it has the greater unit rate.

**Notes on Scoring**

This response earns no credit (0 points). The student may correctly determine the equation with the greater unit rate will also be the equation for the liquid with the greater mass. The student may correctly determine the unit rate of ammonia from the equation as 0.674. Then the student may incorrectly calculate the unit rate for the graph of the line. The student may incorrectly think the slope of the line is 1 over 10, or 0.1 since the liquid is measured in 10 mL increments. Therefore, incorrectly choosing ammonia as the liquid with the greater mass.

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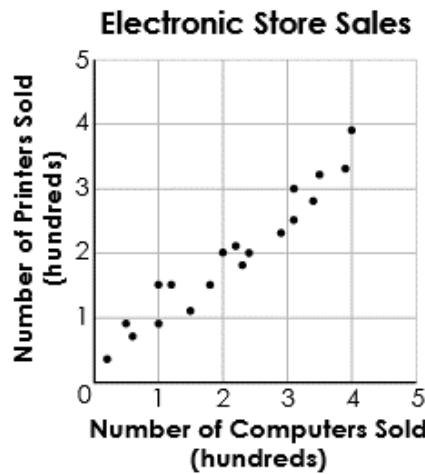
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**Question 51**

**Question and Scoring Guidelines**

## Question 51

The graph shows the relationship between the number of computers sold and the number of printers sold at different electronic stores in a city.



Which type of association **best** describes the relationship between the number of computers sold and the number of printers sold?

- A non-linear association
- B negative linear association
- C positive linear association
- D no association

**Points Possible:** 1

**Content Cluster:** Investigate patterns of association in bivariate data.

**Content Standard:** Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering; outliers; positive, negative, or no association; and linear association and nonlinear association. (GAISE Model, steps 3 and 4) (8.SP.1)

**Depth of Knowledge:** Level 1

**Modeling and Reasoning:** No

## Scoring Guidelines

Rationale for Option A: This is incorrect. The student may think that the points on the graph have an association that does not represent a line exactly but misses that there does not need to be a perfect line for there to be a linear association.

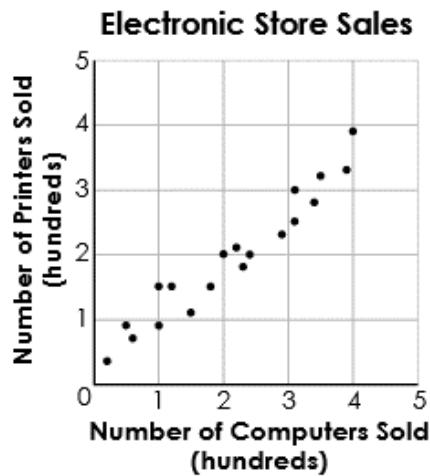
Rationale for Option B: This is incorrect. The student may think that since the data starts out on the lower part of the graph that the association must be negative.

Rationale for Option C; Key – The student correctly determines that the graph shows a positive linear association since the points are grouped around a line and the y-values of the points tend to increase as the x-values increase.

Rationale for Option D: This is incorrect. The student may think that there was no association between the number of computers sold and the number of printers sold because there is not a perfect linear association.

## Sample Response: 1 point

The graph shows the relationship between the number of computers sold and the number of printers sold at different electronic stores in a city.



Which type of association **best** describes the relationship between the number of computers sold and the number of printers sold?

- A non-linear association
- B negative linear association
- C positive linear association
- D no association