



Colorado Measures of Academic Success



Grade 8 Math

Answer Key with Scoring Rubrics, Sample Responses & Annotations

Practice Resource for Students

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ITEM INFORMATION

Colorado Academic Standard (CAS) Evidence Outcome

Describes the evidence that demonstrates that a student is meeting the grade level expectation at a mastery level.

Evidence Statement

Describes the knowledge or skills that an assessment item/task elicits from students. Full descriptions of Evidence Statements and their alignment to the Colorado Academic Standards are located at

http://cde.state.co.us/assessment/cmas_testdesign.

Subclaim

The reporting category of the associated CAS.

- Math
 - Subclaim A – Major Content
 - Subclaim B – Supporting Content
 - Subclaim C – Expressing Mathematical Reasoning
 - Subclaim D – Modeling and Application

ITEM TYPES

Items are questions that appear on the assessments. They are presented in three different ways.

Selected Response (Multiple Choice, Multiple Response, and Fill in the Blank)

For multiple choice and multiple response items, students select a correct answer out of provided choices. For fill in the blank items, students type/write their answer in a blank box.

Technology-Enhanced (Bar Graph, Drag and Drop, Inline Choice, Hot Spot, and Match Table Grid)

Students show their answer using technology, such as by creating a bar graph using a template provided by the online testing system or on the paper-based test. Drag and drop items require students to drag answer choices into correct answer bays (draw lines or write corresponding letters for paper-based testing). Inline choice items require students to select their answer from a drop-down menu (circle answer from a list of choices for paper-based testing) to complete a sentence or sentences. Hot spot items require students to select the correct response from its location in an image (write corresponding letters or circle answer for paper-based testing). Match table grid items require students to check checkboxes in cells to indicate a match between the column and row labels.

Constructed Response

Students construct an open-ended response.

STUDENT PERFORMANCE

P Value – Selected Response Only

The P value represents the percentage of students who answered each selected response question correctly. For example, if the P value associated with a question is 0.64, then 64% of students responded to the question with the correct answer.

Score Point Distribution – Constructed Response Only

The score point distribution provides the percentage of students who scored at each possible score point for constructed response questions.

In addition to score point distribution, the scoring guide, scoring rubric, and sample student responses at each score point are provided for constructed response items.

Note: P values and score point distributions are only available for released items (i.e., questions that previously appeared on CMAS assessments administered statewide). Items without this information were developed as sample items.

ANSWER KEY: ITEM SET 1

Item Set 1 – Question 1 (Selected Response)

Which decimal is equivalent to $\frac{11}{15}$?

- ☐ A. $0.\overline{733}$
- ☐ B. 0.73
- ☒ C. $0.\overline{73}$
- ☐ D. 0.733

Item Information

- Answer – C
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.NS.A.1
 - Demonstrate informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number. Define irrational numbers as numbers that are not rational.
- Evidence Statement – 8.NS.1
 - Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion, which repeats eventually into a rational number. i) Tasks do not have a context. ii) 50% of tasks require students to write a fraction a/b as a repeating decimal by showing, filling in, or otherwise producing the steps of a long division $a \div b$. iii) 50% of tasks require students to write a given repeating decimal as a fraction. iv) For tasks that involve writing a repeating decimal as a fraction, the given decimal should include no more than two repeating decimals without non-repeating digits after the decimal point (i.e., 2.16666..., 0.23232323...).
- Subclaim – B – Supporting Content
 - The student solves problems involving the Additional and Supporting Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.627

Item Set 1 – Question 2 (Multiple Select)

Which input-output table represents a nonlinear function?

Select **each** nonlinear function.

☐ A.

Input (x)	Output (y)
2	3
3	7
4	11

☐ B.

Input (x)	Output (y)
2	4
4	8
6	12

☒ C.

Input (x)	Output (y)
2	2
4	14
6	34

☒ D.

Input (x)	Output (y)
2	5
3	10
4	17

☐ E.

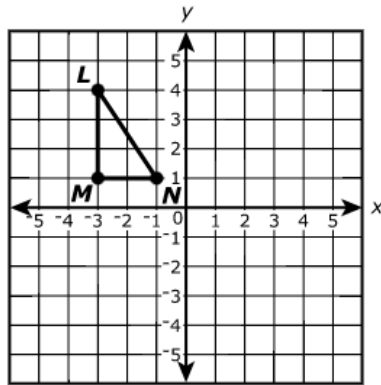
Input (x)	Output (y)
2	2
4	3
6	4

Item Information

- Answer – C, D
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.F.A.3
 - 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.
- Evidence Statement – 8.F.3-2
 - Give examples of functions that are not linear and prove that they are not linear. i) Tasks have “thin context” or no context. ii) Tasks require students to demonstrate understanding of function nonlinearity, for example by recognizing or producing equations that do not define linear functions, or by recognizing or producing pairs of points that belong to the graph of the function yet do not lie on a straight line. iii) Tasks do not require students to produce a proof; for that aspect of standard 8.F.3, see 8.C.3.1. iv) Tasks involving symbolic representations are limited to polynomial functions i.e., $y = 3x^2 + 2$.
- Subclaim – A – Major Content
 - The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.275

Item Set 1 – Question 3 (Selected Response)

Triangle LMN is shown on the coordinate plane.



Triangle $L'M'N'$ is the image of triangle LMN after a reflection.

Which statement is true about the line segments in the two triangles?

- ☐ A. \overline{NL} is the same length as $\overline{M'N'}$.
- ☒ B. \overline{NL} is the same length as $\overline{N'L'}$.
- ☐ C. \overline{LM} is shorter than $\overline{L'M'}$.
- ☐ D. \overline{MN} is longer than $\overline{L'M'}$.

Item Information

- Answer – B
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.G.A.1.a
 - Lines are taken to lines, and line segments to line segments of the same length.
- Evidence Statement – 8.G.1a
 - Verify experimentally the properties of rotations, reflections, and translations: a. Lines are taken to lines, and line segments to line segments of the same length. i) Tasks do not have a context.
- Subclaim – A – Major Content
 - The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.787

Item Set 1 – Question 4 (Fill in the Blank)

An ant's mass is 5×10^{-3} grams. A bee's mass is 1×10^{-1} grams.

Based on this information, how many ants equal the mass of one bee?

Enter your answer in the box.

Item Information

- Answer – See Image
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.EE.A.3
 - 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.
- Evidence Statement – 8.EE.3
 - 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 3×10^8 and the population of the world as 7×10^9 , and determine that the world population is more than 20 times larger.
- Subclaim – A – Major Content
 - The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.15

Solve the system of equations.

$$4x + 5y = 20$$

$$3x + 10y = 20$$

Enter your answer in the space provided. Enter **only** your answer.

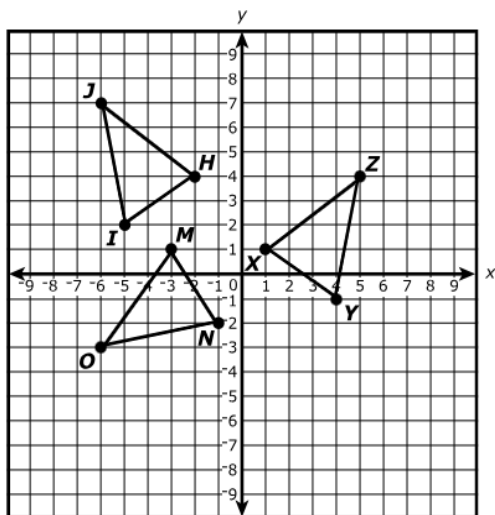
(4, 0.8)

Item Information

- Answer – See Image
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.EE.C.8.b
 - Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.
- Evidence Statement – 8.EE.8b-1
 - Analyze and solve pairs of simultaneous linear equations. b. Solve systems of two linear equations in two variables algebraically. i) 20% of tasks have a zero coefficient, e.g., as in the system $-s + (3/4)t = 2$, $t = 6$. ii) 20% of tasks have non-zero whole-number coefficients, and whole-number solutions. iii) 20% of tasks have non-zero whole-number coefficients, and at least one fraction among the solutions. iv) 20% of tasks have non-zero integer coefficients (with at least one coefficient negative). v) 20% of tasks have non-zero rational coefficients (with at least one coefficient a non-integer and at least one coefficient negative).
- Subclaim – A – Major Content
 - The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.111

Item Set 1 – Question 6 (Selected Response)

Consider $\triangle HIJ$, $\triangle MNO$, and $\triangle XYZ$ on the coordinate plane. All three triangles are congruent.



Part A

Which sequence of transformations can be applied to $\triangle HIJ$ to prove that $\triangle HIJ \cong \triangle MNO$?

- ☒ A. a rotation 90° counterclockwise about the origin and then a translation up 3 units and right 1 unit
- ☐ B. a rotation 90° clockwise about the origin and then a translation up 3 units and right 1 unit
- ☐ C. a reflection across the x-axis and then a translation up 5 units and left 1 unit
- ☐ D. a reflection across the x-axis and then a translation right 4 units

Part B

Which sequence of transformations can be applied to $\triangle HIJ$ to prove that $\triangle HIJ \cong \triangle XYZ$?

- ☐ A. a rotation 180° about the origin and then a translation down 1 unit and left 1 unit
- ☐ B. a rotation 180° about the origin and then a translation up 5 units and left 1 unit
- ☒ C. a reflection across the y-axis and then a translation down 3 units and left 1 unit
- ☐ D. a reflection across the y-axis and then a translation up 3 units and left 1 unit

Item Information

- Part A Answer – A
- Part A Answer – C
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.G.A.2
 - Demonstrate 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.
- Evidence Statement – 8.G.2
 - 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. i) Tasks do not have a context. ii) Tasks do not reference similarity (this relationship will be assessed in 8.C.3.2). iii) Tasks should not focus on coordinate Geometry; figures may be drawn in the coordinate plane, but do not include the use of coordinates. iv) Tasks should elicit student understanding of the connection between congruence and transformations i.e., tasks may provide two congruent figures and require the description of a sequence of transformations that exhibits the congruence or tasks may require students to identify whether two figures are congruent using a sequence of transformations.
- Subclaim – A – Major Content
 - The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.504

Item Set 1 – Question 7 (Selected Response)

Which expression is equivalent to $4^5 \times 4^{-3}$?

- ☐ A. 4^8
- ☒ B. 4^2
- ☐ C. 4^{-2}
- ☐ D. 4^{-8}

Item Information

- Answer – B
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.EE.A.1
 - Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.
- Evidence Statement – 8.EE.1
 - Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, $3^2 \times 3^{-5} = 1/3^3 = 1/27$. i) Tasks do not have a context. ii) Tasks center on the properties and equivalence, not on simplification. For example, a task might ask a student to classify expressions according to whether or not they are equivalent to a given expression. iii) 50% of expressions should involve one property. iv) 30% of expressions should involve two properties. v) 20% of expressions should involve three properties. vi) Tasks should involve a single common base or a potential common base, such as, a task that includes 3, 9 and 27.
- Subclaim – A – Major Content
 - The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.641

Select a point on the number line that **best** approximates the location of $\sqrt{10}$.

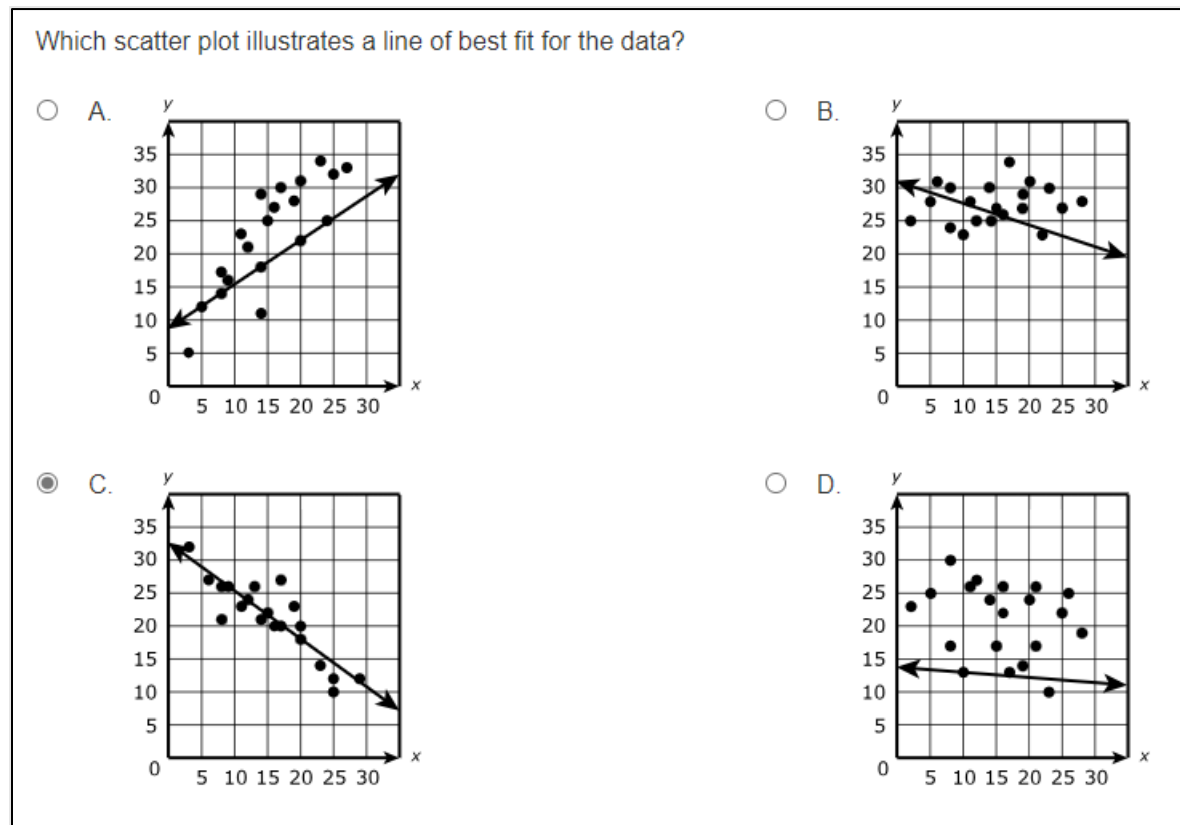
Select **one** place on the number line to plot the point.



Item Information

- Answer – See Image
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.NS.A.2
 - 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., π^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.
- Evidence Statement – 8.NS.2
 - Use rational approximations of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^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. i) Tasks do not have a context.
- Subclaim – B – Supporting Content
 - The student solves problems involving the Additional and Supporting Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – This item was developed as a sample item and has no P value.

Item Set 1 – Question 9 (Selected Response)



Item Information

- Answer – C
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.SP.A.2
 - Know 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.
- Evidence Statement – 8.SP.2
 - Know 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. i) Tasks might have technology features such as the ability to adjust the position of a line and rotate it. ii) Tasks do not require students to write or identify an equation.
- Subclaim – B – Supporting Content
 - The student solves problems involving the Additional and Supporting Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.703

Item Set 1 – Question 10 (Selected Response)

The $\sqrt{55}$ is between which two values?

☐ A. 6.5 and 7

☒ B. 7 and 7.5

☐ C. 7.5 and 8

☐ D. 8 and 8.5

Item Information

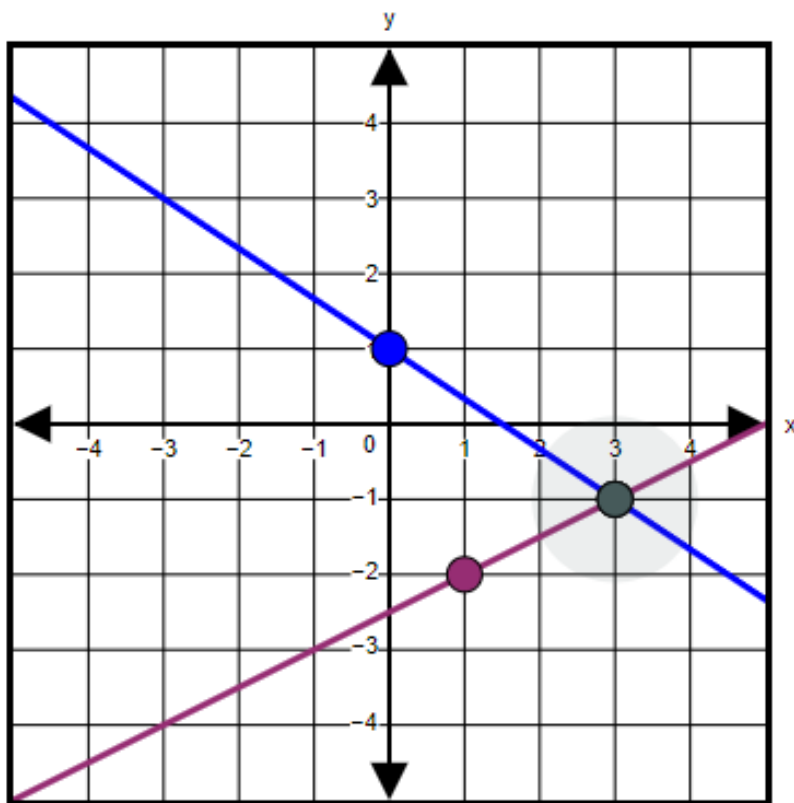
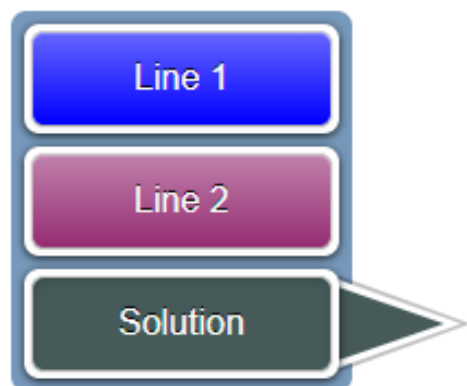
- Answer – B
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.NS.A.2
 - Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2). For example, by truncating 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.
- Evidence Statement – 8.NS.2
 - Use rational approximations of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^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. i) Tasks do not have a context.
- Subclaim – B – Supporting Content
 - The student solves problems involving the Additional and Supporting Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.427

Use graphing to determine the solution to the system of equations shown.

$$\begin{cases} y = -\frac{2}{3}x + 1 \\ y = \frac{1}{2}x - \frac{5}{2} \end{cases}$$

Graph the solution to the system of linear equations on the coordinate plane by

- selecting the “Line 1” button to graph $y = -\frac{2}{3}x + 1$,
- selecting the “Line 2” button to graph $y = \frac{1}{2}x - \frac{5}{2}$,
- selecting the “Solution” button to graph the solution to the system.

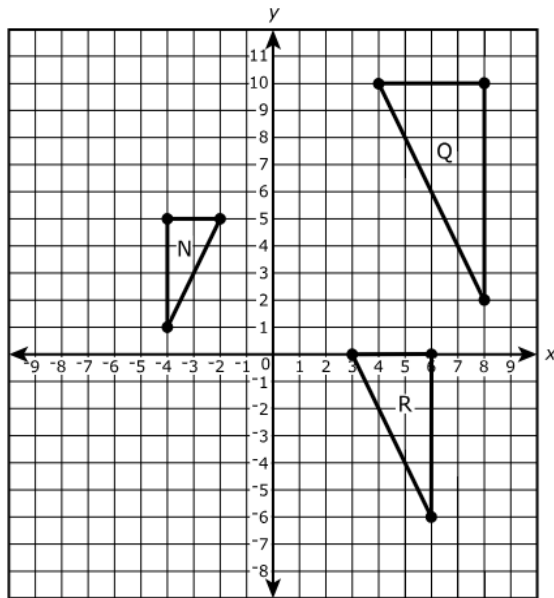


Item Information

- Answer – See Image
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.EE.C.8.b
 - Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.
- Evidence Statement – 8.EE.8b-2
 - Analyze and solve pairs of simultaneous linear equations. b. Estimate solutions [to systems of two linear equations in two variables] by graphing the equations. i) Tasks present students with technology that allows them to (1) graph a point based on coordinates of their choosing; (2) graph a line based on the equation (3) zoom in if the student wishes to do so, rescaling the axes automatically. ii) 20% of tasks have a zero coefficient, e.g., as in the system $-s + (3/4)t = 2$, $t = 6$. iii) 20% of tasks have non-zero whole-number coefficients, and whole-number solutions. iv) 20% of tasks have non-zero whole-number coefficients, and at least one fraction among the solutions. v) 20% of tasks have non-zero integer coefficients (with at least one coefficient negative). vi) 20% of tasks have non-zero rational coefficients (with at least one coefficient a non-integer and at least one coefficient negative).
- Subclaim – A – Major Content
 - The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.148

Item Set 1 – Question 12 (Multiple Select, Selected Response)

The coordinate plane shows three similar right triangles.



Part A

Which two transformations on triangle N result in triangle Q?

Select the **two** correct transformations.

- ☐ A. a rotation 180° clockwise about the origin
- ☐ B. a rotation 90° clockwise about the origin
- ☒ C. a dilation with the center at the origin
- ☒ D. a reflection across the y -axis
- ☐ E. a reflection across the x -axis
- ☐ F. a translation to the right

Part B

A sequence of two transformations on triangle Q results in triangle R.

The second transformation is a dilation centered at the origin.

What is the first transformation?

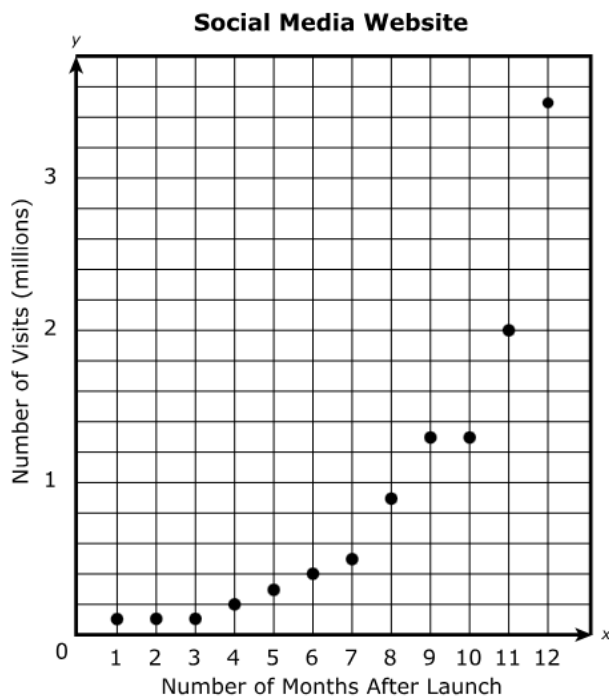
- ☒ A. a translation down 10 units
- ☐ B. a translation up 10 units
- ☐ C. a translation right 1 unit
- ☐ D. a translation left 1 unit

Item Information

- Part A Answer – C, D
- Part B Answer – A
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.G.A.4
 - Demonstrate 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.
- Evidence Statement – 8.G.4
 - 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. i) Tasks do not have a context. ii) Tasks do not reference congruence (this relationship will be assessed in 8.C.3.2). iii) Tasks should not focus on coordinate Geometry; figures may be drawn in the coordinate plane, but do not include the use of coordinates. iv) Tasks should elicit student understanding of the connection between similarity and transformations i.e., tasks may provide two similar figures and require the description of a sequence of transformations that exhibits the similarity or tasks may require students to identify whether two figures are similar using a sequence of transformations. v) Similarity should not be obtained through the proportionality of corresponding sides.
- Subclaim – A – Major Content
 - The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.451

Item Set 1 – Question 13 (Selected Response)

The graph shows the number of visits to a social media website.



Which phrase is true about the graph?

- ☐ A. increases quickly during the first few months and increases slowly during the later months
- ☒ B. increases slowly during the first few months and increases quickly during the later months
- ☐ C. increases at a constant rate
- ☐ D. remains constant

Item Information

- Answer – B
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.F.B.5
 - 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.
- Evidence Statement – 8.F.5-1
 - Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). i) Pool should contain tasks with and without contexts.
- Subclaim – A – Major Content
 - The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.845

Item Set 1 – Question 14 (Multiple Select)

The table shows a function composed of the given input and output values.

Function	
Input	Output
2	1
3	3
4.5	6
?	?

Which sets of values could be included in the function?

Select **all** possible sets of values.

☒ A.

Input	Output
1	2

☐ B.

Input	Output
2	3

☐ C.

Input	Output
3	2

☒ D.

Input	Output
-3	3

☒ E.

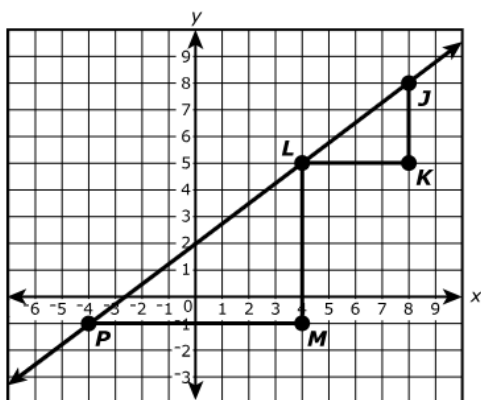
Input	Output
-4.5	6

Item Information

- Answer – A, D, E
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.F.A.1
 - Define a function as a rule that assigns to each input exactly one output. Show that the graph of a function is the set of ordered pairs consisting of an input and the corresponding output. (Function notation is not required for Grade 8.)
- Evidence Statement – 8.F.1-1
 - Understand that a function is a rule that assigns to each input exactly one output. i) Tasks do not involve the coordinate plane or the “vertical line test.” ii) Tasks do not require knowledge of the concepts or terms domain and range. iii) 20% of functions in tasks are non-numerical, e.g., the input could be a person and the output could be his or her month of birth. iv) Tasks should involve clearly defined inputs and outputs.
- Subclaim – A – Major Content
 - The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.108

Item Set 1 – Question 15 (Selected Response)

The coordinate plane shows two similar triangles located on the same line.



Which statement explains why the slope of \overline{PL} is the same as the slope of \overline{LJ} ?

- ☐ A. The ratio of \overline{JK} to \overline{PM} is equal to the ratio of \overline{LK} to \overline{LM} .
- ☒ B. The ratio of \overline{JK} to \overline{LK} is equal to the ratio of \overline{LM} to \overline{PM} .
- ☐ C. The ratio of \overline{LM} to \overline{JK} is equal to the ratio of \overline{PM} to \overline{LJ} .
- ☐ D. The ratio of \overline{LM} to \overline{LK} is equal to the ratio of \overline{PL} to \overline{LK} .

Item Information

- Answer – B
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.EE.B.6
 - 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 .
- Evidence Statement – 8.EE.6
 - 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. i) Tasks do not have a context. ii) Given a non-vertical line in the coordinate plane, tasks might for example require students to choose two pairs of points and record the rise, run, and slope relative to each pair and verify that they are the same. iii) For the aspect of standard 8.EE.6 about explaining this in general, see 8.C.5.1. iv) The testing interface can provide students with a calculation aid of the specified kind for these tasks. v) Tasks may assess simple graphing of lines from a linear equation in slope-intercept form.
- Subclaim – A – Major Content
 - The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.53

Item Set 1 – Question 16 (Multiple Select)

A survey was given to a sample of 3,000 randomly chosen college students. The survey asked about their participation in online classes and whether they have a job. The results of the survey are shown in the table.

Survey Results for College Students

	Has a Job	Does Not Have a Job
Takes At Least One Class Online	562	708
Does Not Take Any Classes Online	128	1,602

Based on the data in the table, which statement is true about the college students?

Select **all** correct statements.

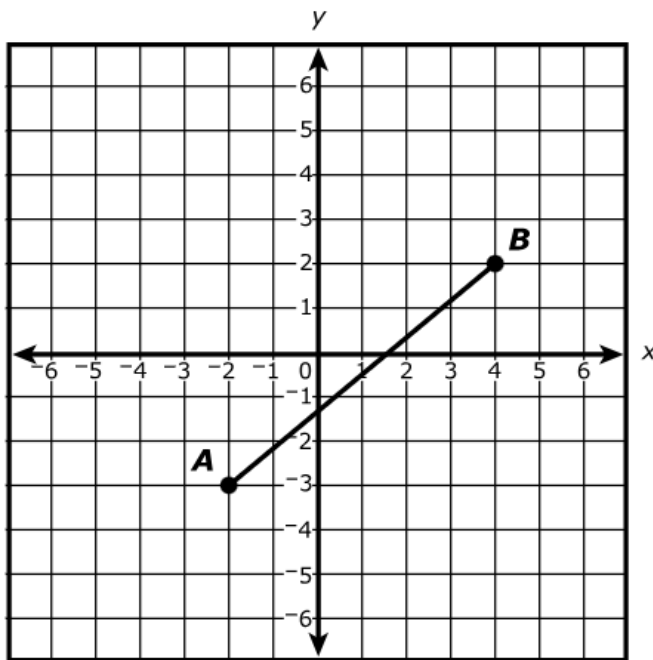
- ☒ A. It is likely that a student who does not take any classes online also does not have a job.
- ☒ B. More than 50% of the students who have a job take at least one class online.
- ☐ C. There are about 500 more students who have a job than do not have a job.
- ☐ D. More than 50% of the students surveyed take at least one class online.
- ☐ E. It is likely that a college student has a job.

Item Information

- Answer – A, B
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.SP.A.4
 - Explain that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?
- Evidence Statement – 8.SP.4
 - Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores? i) One-third of tasks involve basic comprehension questions about a two-way table, such as “How many students who don’t have chores have a curfew?” ii) One-third of tasks involve computing marginal sums or marginal percentages. iii) One-third of tasks involve interpretation or patterns of association. iv) Tasks that require finding missing values within the categories are excluded. v) Tasks are limited to two categorical variables with two subcategories each. vi) The testing interface can provide students with a calculation aid of the specified kind for these tasks. vii) The joint frequencies must be provided either in a table or within the context. The marginal frequencies do not need to be provided.
- Subclaim – B – Supporting Content
 - The student solves problems involving the Additional and Supporting Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.325

Item Set 1 – Question 17 (Fill in the Blank)

The coordinate plane shows \overline{AB} .



What is the length of \overline{AB} ? Round your answer to three decimal places.

Enter your answer in the box.

7.810

Item Information

- Answer – See Image
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.G.B.8
 - Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.
- Evidence Statement – 8.G.8
 - Apply the Pythagorean Theorem to find the distance between two points in a coordinate system. i) The testing interface can provide students with a calculation aid of the specified kind for these tasks.
- Subclaim – A – Major Content
 - The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.126

ANSWER KEY: ITEM SET 2

Item Set 2 – Question 1 (Selected Response)

Two linear functions are described.

Function Q	Function R						
$y = 2x + 7$	<table><tr><td>x</td><td>0</td><td>1</td></tr><tr><td>y</td><td>0</td><td>6</td></tr></table>	x	0	1	y	0	6
x	0	1					
y	0	6					

Which statement is true about the rate of change of Function Q?

☐ A. It is 3 times the rate of change of Function R.

☐ B. It is 2 times the rate of change of Function R.

☐ C. It is $\frac{1}{2}$ the rate of change of Function R.

☒ D. It is $\frac{1}{3}$ the rate of change of Function R.

Item Information

- Answer – D
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.F.A.2
 - 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.
- Evidence Statement – 8.F.2
 - 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 greatest rate of change. i) Tasks have “thin context” or no context. ii) The testing interface can provide students with a calculation aid of the specified kind for these tasks. iii) Equations can be presented in forms other than $y = mx + b$, for example, $2x + 2y = 7$.
- Subclaim – A – Major Content
 - The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.328

Item Set 2 – Question 2 (Constructed Response)

A customer spends \$21.50 on cupcakes and muffins. The number of muffins purchased is 1 fewer than the number of cupcakes.

Each cupcake costs \$2, and each muffin costs \$1.25.

- Create a system of equations that relates c , the number of cupcakes, and m , the number of muffins, the customer purchased.
- Determine the total cost of the muffins the customer purchased. Show or explain your work.

Enter your equations, your answer, and your work or explanation in the space provided.

Item Information

- Answer – See Sample Student Responses and Scoring Rubric
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.EE.C.8.c
 - Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.
- Evidence Statement – 8.D.1
 - Solve multi-step contextual word problems with degree of difficulty appropriate to Grade 8, requiring application of knowledge and skills articulated in Type I, Sub-Claim A Evidence Statements. i) Tasks may have scaffolding if necessary in order to yield a degree of difficulty appropriate to Grade 8.
- Subclaim – D – Modeling and Application
 - The student solves real-world problems with a degree of difficulty appropriate to the grade/course by applying knowledge and skills articulated in the standards for the current grade/course (or for more complex problems, knowledge and skills articulated in the standards for previous grades/courses), engaging particularly in the Modeling practice, and where helpful making sense of problems and persevering to solve them (MP. 1), reasoning abstractly and quantitatively (MP. 2), using appropriate tools strategically (MP.5), looking for and making use of structure (MP.7), and/or looking for and expressing regularity in repeated reasoning (MP.8).
- Score Point Distribution
 - 1.0% of students earned 3 points.
 - 5.2% of students earned 2 points.
 - 23.9% of students earned 1 point.
 - 69.9% of students earned 0 points.

Points	Attributes
3	<p>Student response includes each of the following 3 elements.</p> <ul style="list-style-type: none"> • Computation component: Correct total cost of the muffins the customer purchased, \$7.50 • Modeling component: Valid work or explanation on how to determine the total cost of the muffins the customer purchased and/or valid work for solving their system of equations • Modeling component: Correct system of equations <p>Note: Student does not need to show or explain how they got their system of equations.</p>
2	Student response includes 2 of the 3 elements.
1	Student response includes 1 of the 3 elements.
0	Student response is incorrect or irrelevant.
Sample Student Response:	<p>Sample Solution 1:</p> $2c + 1.25m = 21.50$ $m = c - 1$ $2c + 1.25(c - 1) = 21.50$ <p>The equation needs to be solved to see how many cupcakes and muffins the customer purchased.</p> $2c + 1.25(c - 1) = 21.50$ $2c + 1.25c - 1.25 = 21.50$ $3.25c - 1.25 = 21.50$ <p>Add 1.25 to each side and you get:</p> $3.25c = 22.75$ <p>Divide each side by 3.25, you get 7 as your answer to cupcakes. Since muffins are one less than cupcakes you take one off, so it makes 7 cupcakes and 6 muffins. To find the total cost of muffins the customer purchased multiply 6 by the amount each muffin costs, \$1.25. The total cost of the muffins that the customer bought was \$7.50.</p>
Annotation for Sample Student Response:	<p>Solution 1, Score Point 3</p> <p>The response receives full credit. It includes each of the 3 required elements.</p> <p>Computation Component:</p> <ul style="list-style-type: none"> • Student Response: The total cost of the muffins that the customer bought was \$7.50 <ul style="list-style-type: none"> ○ Rationale for Score: The correct total cost of the muffins that the customer purchased is provided (\$7.50). <p>Modeling Component:</p> <ul style="list-style-type: none"> • Student Response: $2c + 1.25(c - 1) = 21.50$, $2c + 1.25c - 1.25 = 21.50$, $3.25c - 1.25 = 21.50$, add 1.25 to each side . . . $3.25c = 22.75$, divide each side by 3.25, you get 7 as your answer to cupcakes. Since muffins are one less than cupcakes you take one off, so it makes 7 cupcakes and 6 muffins . . . you multiply 6 by the amount each muffin costs, \$1.25 <ul style="list-style-type: none"> ○ Rationale for Score: The student provides valid work [$2c + 1.25(c - 1) = 21.50$, $2c + 1.25c - 1.25 = 21.50$, $3.25c - 1.25 = 21.50$, add 1.25 to each side . . . $3.25c = 22.75$, divide each side by 3.25, you get 7 as your answer to cupcakes] and explanation (Since muffins are one less than cupcakes you take one off, so it makes 7 cupcakes and 6 muffins . . . you multiply 6 by the amount each muffin costs, \$1.25) of how to determine the total cost of muffins. <p>Modeling Component:</p> <ul style="list-style-type: none"> • Student Response: $2c + 1.25(c - 1) = 21.50$, $2c + 1.25c - 1.25 = 21.50$ <ul style="list-style-type: none"> ○ Rationale for score: The student provides the correct system of equations ($2c + 1.25(c - 1) = 21.50$, $2c + 1.25c - 1.25 = 21.50$). <p>Note: Sample student responses are not representative of all correct answers for an item and are only provided as a guide to assist teachers with scoring.</p>

Item Set 2 – Question 3 (TEI Fill in the Blank, Selected Response)

Part A

According to the model, how many ounces of ice cream are in the container before any scoops are sold?

Enter your answer in the box.

220

Part B

What does the slope of the equation for the linear model represent?

- ☐ A. the change in the number of scoops of ice cream sold per ounce of ice cream remaining in the container
- ☒ B. the change in the number of ounces of ice cream remaining in the container per scoop of ice cream sold
- ☐ C. the number of ounces of ice cream remaining in the container
- ☐ D. the number of ice cream scoops sold

Part C

According to the model, how many ounces of ice cream remain after selling 43 scoops?

Enter your answer in the box.

48

Part D

The graph of the linear model intersects the x -axis at $(55, 0)$.

What does this intersection point represent in this situation?

- ☒ A. There are 0 ounces of ice cream remaining in the container after selling 55 scoops.
- ☐ B. There are 55 ounces of ice cream remaining in the container after selling 0 scoops.
- ☐ C. There are 55 scoops of ice cream remaining in the container.
- ☐ D. There are 55 ounces in each scoop of ice cream sold.

Item Information

- Part A Answer – See Image
- Part B Answer – B
- Part C Answer – See Image
- Part D Answer – A
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.SP.A.3
 - Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.
- Evidence Statement – 8.SP.3
 - Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height. i) Tasks are word problems based on bivariate measurement data that require students to use the equation of a linear model. ii) The testing interface can provide students with a calculation aid of the specified kind for these tasks.
- Subclaim – B – Supporting Content
 - The student solves problems involving the Additional and Supporting Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.426

Item Set 2 – Question 4 (TEI Equation Editor)

Half of the sum of x and 6.2 is the same as 19.6 less than x .

Create and solve an equation to find the value of x .

Enter your equation and your solution in the space provided. Enter **only** your equation and your solution.

Equation: $0.5(x + 6.2) = x - 19.6$

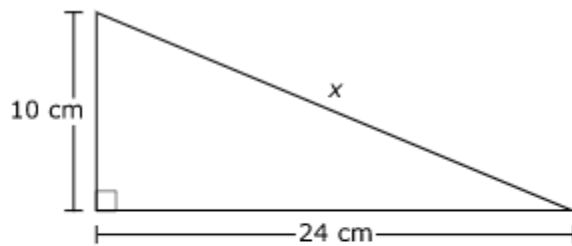
Solution: $x = 45.4$

Item Information

- Answer – See Image
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.EE.C.7.b
 - Solve linear equations with rational number coefficients, including equations with variables on both sides and whose solutions require expanding expressions using the distributive property and collecting like terms.
- Evidence Statement – 8.EE.C.Int.1
 - Solve word problems leading to linear equations in one variable whose solutions require expanding expressions using the distributive property and collecting like terms. i) At least 80% of tasks should involve contextual real-world word problems (a noncontextual word problem could be “the sum of two times a number and 8 is 16”).
- Subclaim – A – Major Content
 - The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.203

Item Set 2 – Question 5 (Selected Response)

A right triangle is shown.



What is the value of x , in centimeters?

- ☐ A. 17
- ☐ B. 22
- ☒ C. 26
- ☐ D. 34

Item Information

- Answer – C
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.G.B.7
 - Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
- Evidence Statement – 8.G.7-1
 - Apply the Pythagorean Theorem in a simple planar case. i) Tasks have “thin context” or no context. ii) Tasks require students to find one side of a right triangle in the plane, given the other two sides. iii) In 50% of tasks, the answer is a whole number and is to be given as a whole number. iv) In 50% of tasks, the answer is irrational and is to be given approximately to three decimal places. v) The testing interface can provide students with a calculation aid of the specified kind for these tasks.
- Subclaim – A – Major Content
 - The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.696

Item Set 2 – Question 6 (Constructed Response)

Two companies rent boats by the hour. The total cost, in dollars, c , depends on the number of hours, h . The equations that represent the rental rates of both companies are shown.

$$\text{Company A: } c = 15h + 20$$

$$\text{Company B: } c = 20h$$

- A person rents a boat from Company A for h hours and realizes they would have paid the same amount if they had rented the boat from Company B. How many hours, h , did the person rent the boat? Explain or show each step of your work.
- Verify that your solution for h hours of renting the boat is the same cost, c , for each company.

Enter your answer and your explanations or steps in the space provided.

Item Information

- Answer – See Sample Student Responses and Scoring Rubric
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.EE.C.8.c
 - Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.
- Evidence Statement – 8.C.4-1
 - Present solutions to multi-step problems in the form of valid chains of reasoning, using symbols such as equals signs appropriately (for example, rubrics award less than full credit for the presence of nonsense statements such as $1 + 4 = 5 + 7 = 12$, even if the final answer is correct), or identify or describe errors in solutions to multi-step problems and present corrected solutions. Content Scope: Knowledge and skills articulated in 8.EE.8c.
- Subclaim – C - Expressing Mathematical Reasoning
 - The student expresses grade/course-level appropriate mathematical reasoning by constructing viable arguments, critiquing the reasoning of others, and/or attending to precision when making mathematical statements.
- Score Point Distribution
 - 4.7% of students earned 3 points.
 - 20.0% of students earned 2 points.
 - 10.5% of students earned 1 point.
 - 64.9% of students earned 0 points.

Points	Attributes
3	<p>Student response includes each of the following 3 elements.</p> <ul style="list-style-type: none"> • Reasoning component: Valid work or explanation of how to determine the number of hours needed to rent a boat from either company for the cost to be the same. • Computation component: Correct number of hours, 4. • Reasoning component: Valid work or explanation that the solution for h hours of renting a boat is the same cost, c, for each company.
2	Student response includes 2 of the 3 elements.
1	Student response includes 1 of the 3 elements.
0	Student response is incorrect or irrelevant.
Sample Student Response:	<p>The person rented the boat for 4 hours. To figure this out I took the 2nd equation which was $c = 20h$ and plugged it into the first which was $c = 15h + 20$ to get this:</p> $20h = 15h + 20$ $-15h \quad -15h$ $5h = 20/5$ $h = 4$ <p>So then to check I plugged 4 into the equations separately.</p> <p>Company A:</p> $c = 20(4)$ $c = 80$ <p>Company B:</p> $c = 15(4) + 20$ $c = 60 + 20$ $c = 80$
Annotation for Sample Student Response:	<p>Score Point 3</p> <p>The response receives full credit. It includes each of the 3 required elements.</p> <p>Reasoning Component:</p> <ul style="list-style-type: none"> • Student Response: I took the 2nd equation which was $c = 20h$ and plugged it into the first which was $c = 15h + 20$ to get this: $20h = 15h + 20$, $-15h \quad -15h$, $5h = 20/5$, $h = 4$. <ul style="list-style-type: none"> ○ Rationale for Score: The student provides valid work to determine the number of hours needed to rent a boat from either company for the cost to be the same ($20h = 15h + 20$, $-15h \quad -15h$, $5h = 20/5$, $h = 4$). <p>Computation Component:</p> <ul style="list-style-type: none"> • Student Response: The person rented the boat for 4 hours <ul style="list-style-type: none"> ○ Rationale for score: The correct number of hours is provided (4 hours). <p>Reasoning Component:</p> <ul style="list-style-type: none"> • Student Response: to check I plugged 4 into the equations separately. Company A: $c = 20(4)$, $c = 80$. Company B: $c = 15(4) + 20$, $c = 60 + 20$, $c = 80$. <ul style="list-style-type: none"> ○ Rationale for score: The student provides valid work to show that the hours determined (4), is the same cost for both Company A and Company B (Company A: $c = 20(4)$, $c = 80$. Company B: $c = 15(4) + 20$, $c = 60 + 20$, $c = 80$). <p>Note: Sample student responses are not representative of all correct answers for an item and are only provided as a guide to assist teachers with scoring.</p>

ANSWER KEY: ITEM SET 3

Item Set 3 – Question 1 (Fill in the Blank)

Two different factories are building engine parts for a car company. Both factories are open 8 hours a day, 260 days a year.

- Factory A makes 1,900 engine parts per hour.
- Factory B makes p parts in d days, which can be modeled by the equation $p = 13,500d$.

How many more engine components does Factory A make per year than Factory B?

Enter your answer in the box.

Item Information

- Answer – See Image
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.EE.B.5
 - 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.
- Evidence Statement – 8.EE.5-2
 - 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 a greater speed. i) Pool should contain tasks with and without contexts. ii) The testing interface can provide students with a calculation aid of the specified kind for these tasks.
- Subclaim – A – Major Content
 - The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.262

Item Set 3 – Question 2 (Constructed Response)

Line Q passes through the origin and $\left(\frac{3}{4}, 1\right)$.

A student claims that $\left(\frac{3}{4}, 1\right)$ shows that the constant of proportionality of line Q is $\frac{3}{4}$ and therefore the equation of line Q is $y = \frac{3}{4}x$.

- Explain the student's error in reasoning.
- Explain why line Q represents a proportional relationship.
- Write a correct equation for line Q in the form $y = mx$, where m is the constant of proportionality.
- Explain how you found the number you used for m .

Enter your explanations and your equation in the space provided.

Item Information

- Answer – See Sample Student Responses and Scoring Rubric
- Colorado Academic Standards (CAS) Evidence Outcomes
 - 7.RP.A.1 – Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units. For example, if a person walks $\frac{1}{2}$ mile in each $\frac{1}{4}$ hour, compute the unit rate as the complex fraction $\frac{1}{2} \div \frac{1}{4}$ miles per hour, equivalently 2 miles per hour.
 - 7.RP.A.2.c – Represent proportional relationships by equations. For example, if total cost t is proportional to the number n of items purchased at a constant price p , the relationship between the total cost and the number of items can be expressed as $t = pn$.
 - 7.RP.A.2.b – Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.
- Evidence Statement – 8.C.6
 - Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures.
Content Scope: Knowledge and skills articulated in 7.RP.A, 7.NS.A, 7.EE.A. i) Tasks may have scaffolding if necessary in order to yield a degree of difficulty appropriate to Grade 8.
- Subclaim – C - Expressing Mathematical Reasoning
 - The student expresses grade/course-level appropriate mathematical reasoning by constructing viable arguments, critiquing the reasoning of others, and/or attending to precision when making mathematical statements.
- Score Point Distribution
 - 1.0% of students earned 4 points.
 - 3.2% of students earned 3 points.
 - 3.9% of students earned 2 points.
 - 8.2% of students earned 1 point.
 - 83.8% of students earned 0 points.

Points	Attributes
4	<p>Student response includes the following 4 elements.</p> <ul style="list-style-type: none"> • Reasoning component = 1 point: Valid explanation of the student's error in reasoning. • Reasoning component = 1 point: Valid explanation for why line Q represents a proportional relationship. • Computation component = 1 point: Correct equation for line Q in the form $y = mx$: $y = \frac{4}{3}x$. • Reasoning Component = 1 point: Valid explanation for how you found the number you used for m, $\frac{4}{3}$. <p>Sample Student Response:</p> <p>The relationship is proportional because line Q goes through the origin.</p> <p>The student interpreted the ordered pair wrong and confused the meaning of $x = 1$ for $y = 1$ when identifying the constant of proportionality.</p> <p>The correct equation for line Q is shown.</p> $y = \frac{4}{3}x$ <p>Since line Q is proportional, the constant of proportionality can be found by choosing a point on the line and dividing the y-value of that point by its x-value. In this case, that would be $\frac{1}{\frac{3}{4}} = 1 \div \frac{3}{4} = 1 \times \frac{4}{3} = \frac{4}{3}$. The constant of proportionality is $\frac{4}{3}$ since $\frac{4}{3}$ times the x-value of a point on the line is equal to the y-value of that same point.</p>
3	Student response includes 3 of the 4 elements.
2	Student response includes 2 of the 4 elements.
1	Student response includes 1 of the 4 elements.
0	Student response is incorrect or irrelevant.

Sample Student Response:	<p>Sample Solution 1:</p> <p>The student's error was that $\frac{3}{4}$ is not the constant of proportionality or slope of the line. The student's mistake was because they found the x coordinate instead of the slope. The slope is the change in y over the change in x and not the x coordinate.</p> <p>Line Q represents a proportional relationship because the line goes through the origin.</p> <p>The correct equation of line Q is $y = \frac{4}{3}x$</p> <p>The way I found this equation and the constant of proportionality was by finding the change in y over the change in x with the two given points, (0,0) and $(\frac{3}{4}, 1)$. I then did $\frac{1-0}{\frac{3}{4}-0}$ which can be simplified down to $\frac{4}{3}$.</p>
Annotation for Sample Student Response:	<p>Solution 1, Score Point 4</p> <p>The response receives full credit. It includes each of the 4 required elements.</p> <p>Reasoning Component:</p> <ul style="list-style-type: none"> Student Response: $\frac{3}{4}$ is not the constant of proportionality or slope of the line . . . they found the x coordinate instead of the slope. <ul style="list-style-type: none"> Rationale for Score: A valid explanation of the student's error in reasoning is provided (The student's error was that $\frac{3}{4}$ is not the constant of proportionality or slope of the line. The student's mistake was because they found the x coordinate instead of the slope). <p>Reasoning Component:</p> <ul style="list-style-type: none"> Student Response: line goes through the origin <ul style="list-style-type: none"> Rationale for score: A valid explanation for why line Q represents a proportional relationship is given (Line Q represents a proportional relationship because the line goes through the origin). The explanation correctly identifies that the line passes through the origin, and therefore is proportional. <p>Computation Component:</p> <ul style="list-style-type: none"> Student Response: <ul style="list-style-type: none"> Rationale for score: A correct equation for line Q is given ($y = \frac{4}{3}x$). The equation must be in form $y = mx$, with m the correct constant of proportionality to receive credit for this element. <p>Reasoning Component:</p> <ul style="list-style-type: none"> Student Response: finding the change in y over the change in x with the two given points, (0,0) and $(\frac{3}{4}, 1)$. I then did $\frac{1-0}{\frac{3}{4}-0}$ which can be simplified down to $\frac{4}{3}$. <ul style="list-style-type: none"> Rationale for score: A valid explanation is provided for how the number used for m was found (The way I found this equation and the constant of proportionality was by finding the change in y over the change in x with the two given points, (0,0) and $(\frac{3}{4}, 1)$. I then did $\frac{1-0}{\frac{3}{4}-0}$ which can be simplified down to $\frac{4}{3}$). The response clearly shows how the fraction representing the constant of proportionality was determined. <p>Note: Sample student responses are not representative of all correct answers for an item and are only provided as a guide to assist teachers with scoring.</p>

Item Set 3 – Question 3 (Selected Response, Fill in the Blank)

Shopper A paid \$108.34 for 3 shirts and 1 pair of pants. Shopper B paid \$201.86 for 2 shirts and 4 pairs of pants. The price of each shirt is the same, and the price of each pair of pants is the same.

The system of equations that represents this situation is shown.

$$\begin{cases} 3x + y = 108.34 \\ 2x + 4y = 201.86 \end{cases}$$

Part A

What does $4y$ represent in the context of the problem?

- ☐ A. the number of pants and shirts Shopper B bought
- ☐ B. the number of pants Shopper B bought
- ☒ C. the price of 4 pairs of pants
- ☐ D. the price of 1 pair of pants

Part B

What is the price, in dollars, of 1 shirt?

Enter your answer in the box.

23.15

Item Information

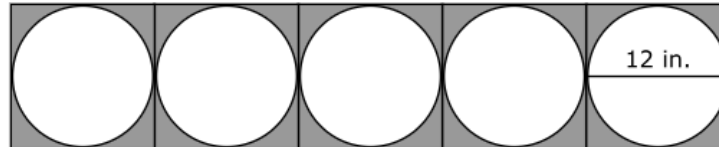
- Part A Answer – C
- Part B Answer – See Image
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.EE.C.8.c
 - Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.
- Evidence Statement – 8.EE.8c
 - Analyze and solve pairs of simultaneous linear equations. c. Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair. i) Mixture problems are no more than 20% of tasks. ii) Tasks may have three equations, but students are only required to analyze two equations at a time.
- Subclaim – A – Major Content
 - The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.238

Item Set 3 – Question 4 (Constructed Response)

Part A

Students are making decorations to display on a classroom wall. Each student begins with a square-shaped piece of cardboard with a circle drawn on it.

Each student will draw a design inside one of the circles. The diameter of each circle is 12 inches. A total of 25 decorations will be displayed on a classroom wall in a square arrangement, with 5 rows of 5 decorations. The figure shows a row of 5 decorations, with the sides of the circles touching but not overlapping.



- Create an equation to find A , the total area of the wall, to the nearest square inch, covered by the circular areas of 25 decorations displayed on the wall.
- What is the total area, to the nearest square inch, of the circular areas of 25 decorations?
- What is the total area, to the nearest square inch, of the shaded area that will surround the 25 circular decorations? Show your work or explain your answer.

Enter your equation, your answers, and your work or explanation in the space provided.

Part B

The students give individual presentations about their design. The first 2 presentations take a total of 5 minutes.

- At this rate, approximately how long, to the nearest **hour**, will 25 presentations take?
- Show your work or explain your answer.

Enter your answer and your work or explanation in the space provided.

Item Information

- Answer – See Sample Student Responses and Scoring Rubric
- Colorado Academic Standards (CAS) Evidence Outcomes
 - 7.G.B.4 – State the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.
 - 7.RP.A.1 – Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units. For example, if a person walks $\frac{1}{2}$ mile in each $\frac{1}{4}$ hour, compute the unit rate as the complex fraction $(\frac{1}{2})/(\frac{1}{4})$ miles per hour, equivalently 2 miles per hour.
 - 7.EE.B.4 – Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.
- Evidence Statement – 8.D.2
 - Solve multi-step contextual problems with degree of difficulty appropriate to grade 8, requiring application of knowledge and skills articulated in 7.RP.A, 7.NS.3, 7.EE, 7.G, and 7.SP.B. i) Tasks may have scaffolding if necessary in order to yield a degree of difficulty appropriate to Grade 8.
- Subclaim – D – Modeling and Application
 - The student solves real-world problems with a degree of difficulty appropriate to the grade/course by applying knowledge and skills articulated in the standards for the current grade/course (or for more complex problems, knowledge and skills articulated in the standards for previous grades/courses), engaging particularly in the Modeling practice, and where helpful making sense of problems and persevering to solve them (MP. 1), reasoning abstractly and quantitatively (MP. 2), using appropriate tools strategically (MP.5), looking for and making use of structure (MP.7), and/or looking for and expressing regularity in repeated reasoning (MP.8).
- Score Point Distribution
 - 2.8% of students earned 6 points.
 - 4.1% of students earned 5 points.
 - 3.1% of students earned 4 points.
 - 3.5% of students earned 3 points.
 - 13.6% of students earned 2 points.
 - 18.8% of students earned 1 point.
 - 54.2% of students earned 0 points.

Scoring Rubric – Part A

Points	Attributes
4	<p>Student response includes the following 4 elements.</p> <ul style="list-style-type: none"> • Modeling component = 1 point: Valid equation that can be used to find A, the total area, to the nearest square inch, of the 25 circular decorations displayed on the wall. • Computation component = 1 point: Correct total area, to the nearest square inch, of the 25 circular decorations displayed on the wall. • Computation component = 1 point: Correct total area, to the nearest square inch, inside the rectangular arrangement created by the decorations that is not covered by the 25 circular decorations. • Modeling component = 1 point: Valid work or explanation for how student found the total area, to the nearest square inch, inside the rectangular arrangement created by the decorations that is not covered by the 25 circular decorations. <p>Sample Student Response:</p> <p>I used the formula for the area of a circle and multiplied that equation by 25 to find A, the total area, in square inches, of the 25 circular decorations displayed on the wall.</p> $A = 25 \times \pi r^2$ $A = 25 \times \pi \times 6 \times 6$ <p>The area of one side of 25 circular decorations can be found by multiplying the area by 25, $A = 36\pi(25) \approx 2,827.433388... \approx 2,827$ square inches.</p> <p>The total area, to the nearest square inches, inside the rectangular arrangement created by the decorations that is not covered by the 25 decorations is approximately 773 square inches.</p> <p>First, I found the total area of the rectangular arrangement created by 5 rows of decorations with 5 decorations in each row, in square inches, is $25 \times 12 \times 12$.</p> <p>Then I subtracted the total area of the 25 circular decorations: $25 \times 12 \times 12 - 36 \times \pi \times 25 = 3600 - 900\pi \approx 772.56. \approx 773$ square inches.</p>
3	Student response includes 3 of the 4 elements.
2	Student response includes 2 of the 4 elements.
1	Student response includes 1 of the 4 elements.
0	Student response is incorrect or irrelevant.

Scoring Rubric – Part B

Points	Attributes
2	<p>Student response includes the following 2 elements.</p> <ul style="list-style-type: none"> • Computation component = 1 point: Correct time for how long, to the nearest hour, 25 presentations will take, 1 hour. • Modeling component = 1 point: Valid work or explanation for finding how long, to the nearest hour, 25 presentations will take. <p>Sample Student Response:</p> <p>The approximate number of hours all 25 presentations will take is about 1 hour.</p> <p>First, I created a ratio based on 2 presentations compared to the total number of minutes 2 presentations took, $\frac{2}{5}$.</p> <p>Then I set up a ratio based on 25 presentations compared to x, the number of minutes all 25 presentations took, $\frac{25}{x}$.</p> <p>I set the two ratios equal to each other and solved for x. Then I divided the value by 60 to convert from minutes to hours.</p> $\frac{2}{5} = \frac{25}{x}$ $2x = 5(25)$

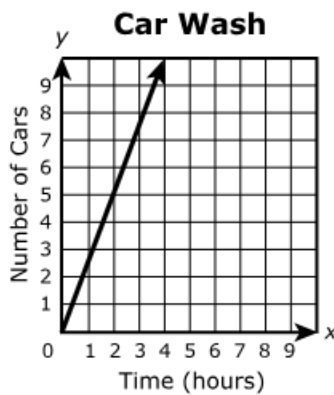
	$2x = 125$ $\frac{2x}{2} = \frac{125}{2}$ $x = 62.5$ minutes $\frac{62.5}{60} \approx 1.04... \approx 1$ hour
1	Student response includes 1 of the 2 elements.
0	Student response is incorrect or irrelevant.
Sample Student Response:	<p>Sample Solution 1:</p> <p>Each square is 12 inches by 12 inches.</p> <p>The total wall is a 5 by 5, where 25 of these squares can fit. $12 + 12 + 12 + 12 + 12 = 60$ (one side of the wall). $60 \times 60 = 3600$ square inches.</p> <p>$A = 25 (\pi(6)^2)$</p> <p>1 circular design = 36π</p> <p>25 designs: $36\pi \times 25 = 900\pi$</p> <p>$900\pi \approx 2827$</p> <p>$3600 - 2827 = 773$</p> <p>Area of wall not covered by circular decorations is 773 square inches.</p>
Annotation for Sample Student Response:	<p>Solution 1, Score Point 4</p> <p>The response receives full credit. It includes each of the 4 required elements.</p> <p>Modeling Component:</p> <ul style="list-style-type: none"> Student Response: $A = 25 (\pi(6)^2)$, $36\pi \times 25 = 900\pi$ <ul style="list-style-type: none"> Rationale for Score: A valid equation is provided to find the total area of the 25 circular decorations ($A = 25 (\pi(6)^2)$, $36\pi \times 25 = 900\pi$). Either equation would be sufficient to receive credit for this element. An equation is provided that shows 36π multiplied by 25, the number of decorations, being equal to 900π, the total area of the circular decorations. The variable A is not required to earn credit for this element. The equation provided must solve for the total area of the 25 circular decorations. <p>Computation Component:</p> <ul style="list-style-type: none"> Student Response: 2827 <ul style="list-style-type: none"> Rationale for score: A correct total area of the 25 circular decorations is provided (2827). Note that the prompt specifies the units for total area, square inches, and therefore no label is required on the student answer. <p>Computation Component:</p> <ul style="list-style-type: none"> Student Response: 773 <ul style="list-style-type: none"> Rationale for score: A correct total area not covered by the 25 circular decorations is provided (773). Note that the prompt specifies the units for total area, square inches, and therefore no label is required on the student answer. <p>Modeling Component:</p> <ul style="list-style-type: none"> Student Response: each square is 12 inches by 12 inches, total wall is 5 by 5, where 24 of these squares can fit, $12 + 12 + 12 + 12 + 12 = 60$, $60 \times 60 = 3600$, $3600 - 2827 = 773$. <ul style="list-style-type: none"> Rationale for score: Valid work for how the student found the total area not covered by the 25 circular decorations is provided [Each square is 12 inches by 12 inches. The total wall is a 5 by 5, where 25 of these squares can fit. $12 + 12 + 12 + 12 + 12 = 60$ (one side of the wall). $60 \times 60 = 3600$ square inches. $3600 - 2827 = 773$]. The response shows correct work to find total area, 3600, then subtracts the total area of circular decorations, 2827, to find the total area not covered by the circular decorations. <p>Note: Sample student responses are not representative of all correct answers for an item and are only provided as a guide to assist teachers with scoring.</p>

Item Set 3 – Question 5 (Selected Response)

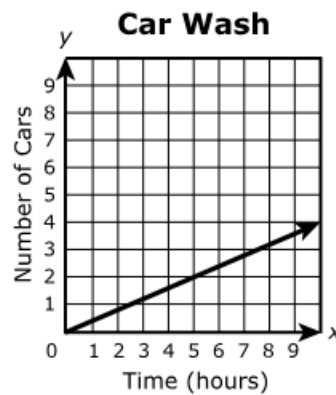
At a car wash, an average of 5 cars can be washed in 2 hours.

Which graph shows the relationship between the amount of time, in hours, and the number of cars washed?

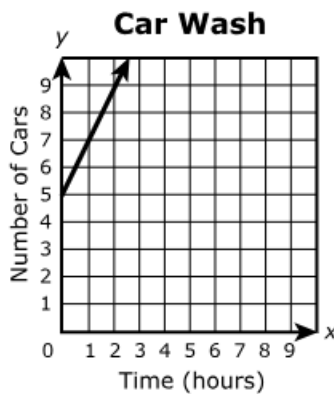
☒ A.



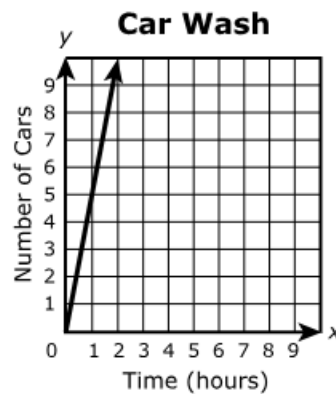
☐ B.



☐ C.



☐ D.



Item Information

- Answer – A
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.EE.B.5
 - 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.
- Evidence Statement – 8.EE.5-1
 - Graph proportional relationships, interpreting the unit rate as the slope of the graph. i) Pool should contain tasks with and without contexts. ii) The testing interface can provide students with a calculation aid of the specified kind for these tasks.
- Subclaim – A – Major Content
 - The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.66

Item Set 3 – Question 6 (Constructed Response)

An equation is shown.

$$\frac{1}{2}n + 5 = \frac{3}{4}n + 3$$

- Solve the equation for n . Show your work or explain your steps.
- Verify that your solution for n is true for $\frac{1}{2}n + 5 = \frac{3}{4}n + 3$.

Enter your answer and your explanations in the space provided.

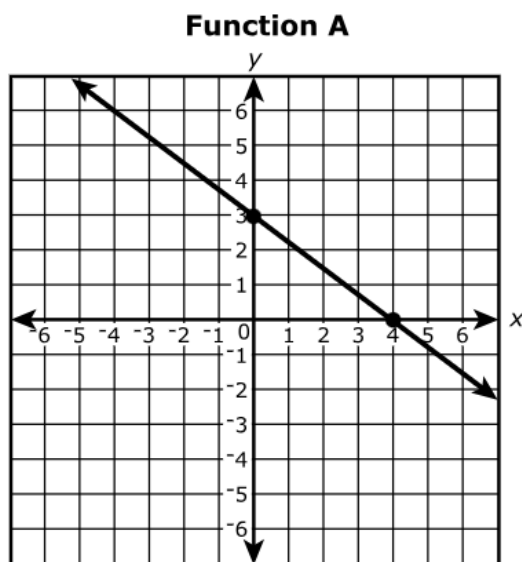
Item Information

- Answer – See Sample Student Responses and Scoring Rubric
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.EE.C.7.b
 - Solve linear equations with rational number coefficients, including equations with variables on both sides and whose solutions require expanding expressions using the distributive property and collecting like terms.
- Evidence Statement – 8.C.2
 - Given an equation or system of equations, present the solution steps as a logical argument that concludes with the set of solutions (if any). Content Scope: Knowledge and skills articulated in 8.EE.7a, 8.EE.7b, 8.EE.8b. i) Tasks may have three equations, but students are only required to analyze two equations at a time.
- Subclaim – C - Expressing Mathematical Reasoning
 - The student expresses grade/course-level appropriate mathematical reasoning by constructing viable arguments, critiquing the reasoning of others, and/or attending to precision when making mathematical statements.
- Score Point Distribution
 - 7.9% of students earned 3 points.
 - 12.2% of students earned 2 points.
 - 7.7% of students earned 1 point.
 - 72.2% of students earned 0 points.

Points	Attributes
3	<p>Student response includes the following 3 elements.</p> <ul style="list-style-type: none"> • Reasoning component = 1 point: Valid work or explanation on how to solve the equation for n. • Computation component = 1 point: Correct solution, $n = 8$. • Reasoning component = 1 point: Valid work or explanation which verifies the solution, $n = 8$, is true for $\frac{1}{2}n + 5 = \frac{3}{4}n + 3$. <p>Sample Student Response:</p> $\frac{1}{2}n + 5 = \frac{3}{4}n + 3$ <p>First, I isolated the variable on one side of the equal sign. I did this by using inverse operations. I started by subtracting $\frac{1}{2}n$ from both sides.</p> $\frac{1}{2}n - \frac{1}{2}n + 5 = \frac{3}{4}n - \frac{1}{2}n + 3$ $5 = \frac{1}{4}n + 3$ <p>Then, I subtracted 3 from both sides.</p> $5 - 3 = \frac{1}{4}n + 3 - 3$ $5 - 3 = \frac{1}{4}n$ $2 = \frac{1}{4}n$ <p>The final step was to multiply both sides by 4, resulting in $n = 8$.</p> $4(2) = 4\left(\frac{1}{4}n\right)$ $8 = n$ <p>I can use substitution to show my answer is correct. If I substitute $n = 8$ into the left side of the equation, I get $\frac{1}{2}(8) + 5 = 9$. Substituting into the right side of the equation, I get $\frac{3}{4}(8) + 3 = 9$. Since both sides result in the same answer and $9 = 9$, I know I am correct.</p>
2	Student response includes 2 of the 3 elements.
1	Student response includes 1 of the 3 elements.
0	Student response is incorrect or irrelevant.

Sample Student Response:	<p>Sample Solution 1:</p> $\frac{1}{2}n + 5 = \frac{3}{4}n + 3$ <p>–3 to both sides</p> $\frac{1}{2}n + 2 = \frac{3}{4}n$ <p>–$\frac{1}{2}n$ to both sides</p> $2 = \frac{1}{4}n$ <p>Divide both sides by $\frac{1}{4}$</p> $8 = n$ <p>CHECK:</p> $\frac{1}{2}(8) + 5 = \frac{3}{4}(8) + 3$ $4 + 5 = 6 + 3$ $9 = 9$
Annotation for Sample Student Response:	<p>Solution 1, Score Point 3</p> <p>The response receives full credit. It includes each of the 3 required elements.</p> <p>Reasoning Component:</p> <ul style="list-style-type: none"> Student Response: –3 to both sides, $\frac{1}{2}n + 2 = \frac{3}{4}n$, –$\frac{1}{2}n$ to both sides, $2 = \frac{1}{4}n$, Divide both sides by $\frac{1}{4}$, $8 = n$ <ul style="list-style-type: none"> Rationale for Score: Valid work to solve the equation for n is provided (–3 to both sides, $\frac{1}{2}n + 2 = \frac{3}{4}n$, –$\frac{1}{2}n$ to both sides, $2 = \frac{1}{4}n$, Divide both sides by $\frac{1}{4}$, $8 = n$). The work provided shows both necessary steps to solve the equation for n; isolating the constant and then isolating the variable. <p>Computation Component:</p> <ul style="list-style-type: none"> Student Response: $8 = n$ <ul style="list-style-type: none"> Rationale for score: A correct solution to the equation is given ($8 = n$). <p>Reasoning Component:</p> <ul style="list-style-type: none"> Student Response: $\frac{1}{2}(8) + 5 = \frac{3}{4}(8) + 3$, $4 + 5 = 6 + 3$, $9 = 9$ <ul style="list-style-type: none"> Rationale for score: A valid explanation that the correct solution to the equation verifies the solution is provided ($\frac{1}{2}(8) + 5 = \frac{3}{4}(8) + 3$, $4 + 5 = 6 + 3$, $9 = 9$). The response for this element clearly shows the solution of 8 being substituted for n in the equation to show each side of the equation is equivalent, and therefore verifying the solution. <p>Note: Sample student responses are not representative of all correct answers for an item and are only provided as a guide to assist teachers with scoring.</p>

Consider the two linear functions.



Function B

$$y = 4 - \frac{3}{4}x$$

Select from the drop-down menus to correctly complete each sentence.

The rate of change for Function A is the rate of change for Function B.

The y-intercept for Function A is the y-intercept for Function B.

Item Information

- Part A Answer – See Image
- Part B Answer – See Image
- Colorado Academic Standards (CAS) Evidence Outcomes – 8.F.A.2
 - 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.
- Evidence Statement – 8.F.2
 - 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 greatest rate of change. i) Tasks have “thin context” or no context. ii) The testing interface can provide students with a calculation aid of the specified kind for these tasks. iii) Equations can be presented in forms other than $y = mx + b$, for example, $2x + 2y = 7$.
- Subclaim – A – Major Content
 - The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
- P Value – 0.258