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Regents Exam in Algebra I (Common Core)

Sample Items
May 2013

New York State Common Core Sample Questions: Regents Examination in Algebra I (Common Core)

With the adoption of the New York P-12 Common Core Learning Standards (CCLS) in ELA/Literacy and Mathematics, the Board of Regents signaled a shift in both instruction and assessment. Educators around the state have already begun instituting Common Core instruction in their classrooms. To aid in this transition, we are providing sample Regents Examination in Algebra I (Common Core) questions to help students, parents, and educators better understand the instructional shifts demanded by the Common Core and the rigor required to ensure that all students are on track to college and career readiness.

These Questions Are Teaching Tools

The sample questions emphasize the instructional shifts demanded by the Common Core. For Algebra I (Common Core) we have provided five questions. These questions include multiple-choice and constructed response. The sample questions are teaching tools for educators and can be shared freely with students and parents. They are designed to help clarify the way the Common Core should drive instruction and how students will be assessed starting with the June 2014 administration of Regents Exams measuring CCLS. NYSED is eager for feedback on these sample questions. Your input will guide us as we develop future exams.

These Questions Are NOT Test Samplers

While educators from around the state have helped craft these sample questions, they have not undergone the same extensive review, vetting, and field testing that occurs with actual questions used on the State exams. The sample questions were designed to help educators think about content, NOT to show how operational exams look exactly or to provide information about how teachers should administer the test.

How to Use the Sample Questions

- Interpret how the standards are conceptualized in each question.
- Note the multiple ways the standard is assessed throughout the sample questions.
- Look for opportunities for mathematical modeling, i.e., connecting mathematics with the real world by conceptualizing, analyzing, interpreting, and validating conclusions in order to make decisions about situations in everyday life, society, or the workplace.
- Consider the instructional changes that will need to occur in your classroom.

- Notice the application of mathematical ways of thinking to real-world issues and challenges.
- Pay attention to the strong distractors in each multiple-choice question.
- **Don't** consider these questions to be the only way the standard will be assessed.
- **Don't** assume that the sample questions represent a mini-version of future State exams.

Understanding Math Sample Questions

Multiple-Choice Questions

Sample multiple-choice math questions are designed to assess CCLS math standards and incorporate both standards and math practices in real-world applications. Math multiple-choice questions assess procedural and conceptual standards. Unlike questions on past math exams, many require the use of multiple skills and concepts. Answer choices are also different from those on past exams. Within the sample questions, all distractors will be based on plausible missteps.

Constructed Response Questions

Math constructed response questions are similar to past questions, asking students to show their work in completing one or more tasks or more extensive problems. Constructed response questions allow students to show their understanding of math procedures, conceptual understanding, and application.

Format of the Math Sample Questions Document

The Math Sample Questions document is formatted so that headings appear below each item to provide information for teacher use to help interpret the item, understand alignment with the CCLS, and inform instruction. A list of the headings with a brief description of the associated information is shown below.

Key: This is the correct response or, in the case of multiple-choice items, the correct option.

Aligned to CCLS: This is the NYS P-12 Common Core Learning Standard to which the item is aligned.

Mathematical Practices: If applicable, this is a list of mathematical practices associated with the item.

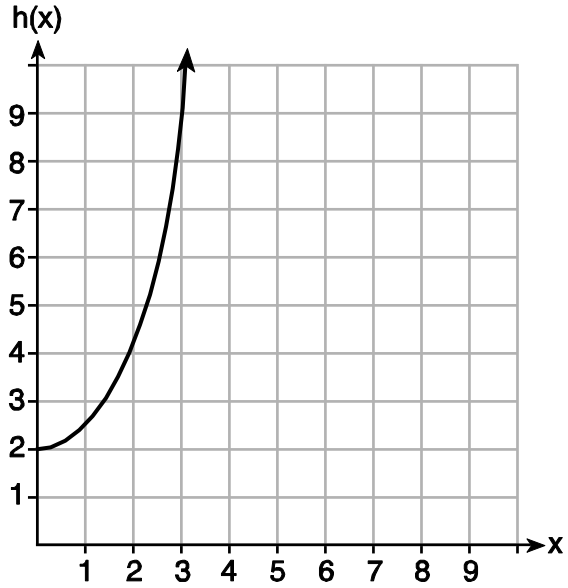
Commentary: This is an explanation of how the item aligns with the listed standard.

Rationale: For multiple-choice items, this section provides the correct option and demonstrates one method for arriving at that response. For constructed response items, one possible approach to solving the item is shown followed by the scoring rubric that is specific to the item. Note that there are often multiple approaches to solving each problem. The rationale section provides only one example. The scoring rubrics should be used to evaluate the efficacy of different methods of arriving at a solution.

1. Given the functions g(x), f(x), and h(x) shown below:

$g(x) = x^2 - 2x$

x	f(x)
0	1
1	2
2	5
3	7



The correct list of functions ordered from greatest to least by average rate of change over the interval $0 \le x \le 3$ is

(1) f(x), g(x), h(x)
(2) h(x), g(x), f(x)
(3) g(x), f(x), h(x)
(4) h(x), f(x), g(x)

Key: 4

Aligned to CCLS: F.IF.6

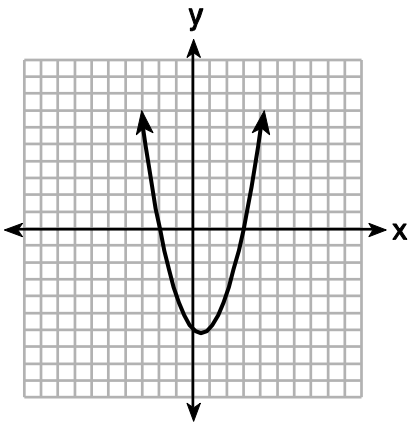
Mathematical Practices: 2

Commentary: This question aligns to F.IF.6 because it assesses a student's ability to calculate the average rate of change of a function presented symbolically, as a table, and graphically.

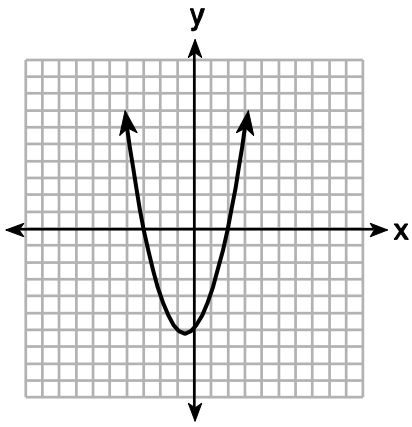
Rationale:

Option 4 is correct. Over the interval $0 \le x \le 3$, the average rate of change for $g(x) = \frac{3}{3} = 1$, $f(x) = \frac{6}{3} = 2$, and $h(x) = \frac{7}{3} = 2\frac{1}{3}$. Ordering these values from greatest to least results in the list of functions: h(x), f(x), g(x).

2. The graphs below represent functions defined by polynomials. For which function are the zeros of the polynomials 2 and –3?



(1)



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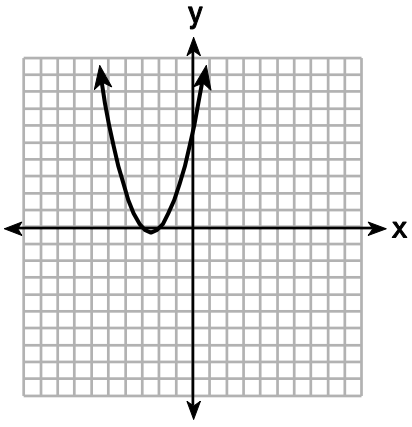
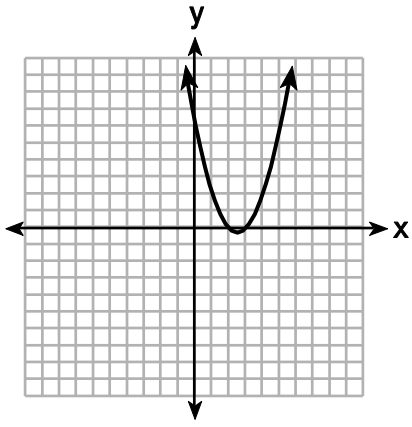


(2)



(4)

Key: 3

Aligned to CCLS: A.APR.3

Commentary: This question aligns to A.APR.3 because it requires a student to identify the graph of a polynomial with two given zeros.

Rationale: Option 3 is correct. The graph of the polynomial intersects the *x*-axis at points (–3, 0) and (2, 0). These are the only points on the graph where $y = 0$.

3. For which function defined by a polynomial are the zeros of the polynomial –4 and –6?

(1) $y = x^2 - 10x - 24$
(2) $y = x^2 + 10x + 24$
(3) $y = x^2 + 10x - 24$
(4) $y = x^2 - 10x + 24$

Key: 2

Aligned to CCLS: A.APR.3

Mathematical Practices: 2

Commentary: This question aligns to A.APR.3 because it requires a student to identify the equation of a polynomial with two given zeros.

Rationale: Option 2 is correct.

$x = -4$ and $x = -6$
$x + 4 = 0$ and $x + 6 = 0$
$0 = (x + 4)(x + 6)$
$0 = x^2 + 4x + 6x + 24$
$0 = x^2 + 10x + 24$

4. The length of the shortest side of a right triangle is 8 inches. The lengths of the other two sides are represented by consecutive odd integers. Which equation could be used to find the lengths of the other sides of the triangle?

(1) $8^2 + (x + 1) = x^2$
(2) $x^2 + 8^2 = (x + 1)^2$
(3) $8^2 + (x + 2)^2 = x^2$
(4) $x^2 + 8^2 = (x + 2)^2$

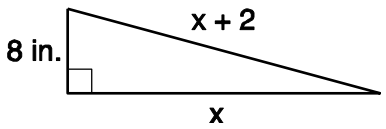
Key: 4

Aligned to CCLS: A.CED.1

Mathematical Practices: 1 and 2

Commentary: This item aligns to A.CED.1 because the student creates an equation in one variable that can be used to solve a problem.

Rationale: Option 4 is correct.



$a^2 + b^2 = c^2$
$x^2 + 8^2 = (x + 2)^2$

5. Donna wants to make trail mix made up of almonds, walnuts and raisins. She wants to mix one part almonds, two parts walnuts, and three parts raisins. Almonds cost $12 per pound, walnuts cost $9 per pound, and raisins cost $5 per pound.

   Donna has $15 to spend on the trail mix. Determine how many pounds of trail mix she can make. [Only an algebraic solution can receive full credit.]

   Key: 2 pounds of trail mix

   Aligned to CCLS: A.CED.1

   Mathematical Practices: 1 and 2

   Commentary: This question aligns to A.CED.1 because the student creates equations in one variable and uses them to solve a problem.

   Rationale: Let x = pounds of an ingredient. Then the number of pounds of trail mix is represented by the expression $x + 2x + 3x$. Therefore, the number of pounds of trail mix is $6x$. Then,

$$\begin{aligned} 12x + 9(2x) + 5(3x) &= 15 \\ 45x &= 15 \\ x &= \frac{1}{3} \end{aligned}$$

   So, $6\left(\frac{1}{3}\right) = 2$ pounds.

   Rubric:

   [2] 2 and appropriate work is shown.

   [1] Appropriate work is shown, but one computational error is made, but an appropriate number of pounds is stated.

   or

   [1] Appropriate work is shown, but one conceptual error is made, but an appropriate number of pounds is stated.

   or

   [1] 2, but no work is shown.

   [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

6. A high school drama club is putting on their annual theater production. There is a maximum of 800 tickets for the show. The costs of the tickets are \$6 before the day of the show and \$9 on the day of the show. To meet the expenses of the show, the club must sell at least \$5,000 worth of tickets.

   a) Write a system of inequalities that represent this situation.

   b) The club sells 440 tickets before the day of the show. Is it possible to sell enough additional tickets on the day of the show to at least meet the expenses of the show? Justify your answer.

Key: a) $x + y \leq 800$
$6x + 9y \geq 5000$

b) Yes with appropriate work shown to justify the answer.

Aligned to CCLS: A.CED.3

Commentary: This question aligns to A.CED.3 because a student writes a system of inequalities to determine a viable solution.

Mathematical Practices: 4 and 6

Rationale:

a) Let x = number of presale tickets
y = number of day of show tickets

$x + y \leq 800$
$6x + 9y \geq 5000$

b) $6(440) + 9y \geq 5000$
$2640 + 9y \geq 5000$
$9y \geq 2360$
$y \geq 262.\overline{2}$

263 tickets

440 advance purchase tickets added to 263 day of show tickets is 703 tickets, which is below the 800 ticket maximum. So yes, it is possible.

Rubrics:

(a) [2] $x + y \leq 800$ and $6x + 9y \geq 5000$.

[1] $x + y \leq 800$ or $6x + 9y \geq 5000$.

or

[1] $x + y = 800$ and $6x + 9y = 500$.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

(b) [2] Yes, and appropriate work is shown.

[1] Appropriate work is shown, but "yes" is not stated.

[1] Appropriate work is shown, but one computational error is made, but an appropriate determination is made.

or

[1] Appropriate work is shown, but one conceptual error is made, but an appropriate determination is made.

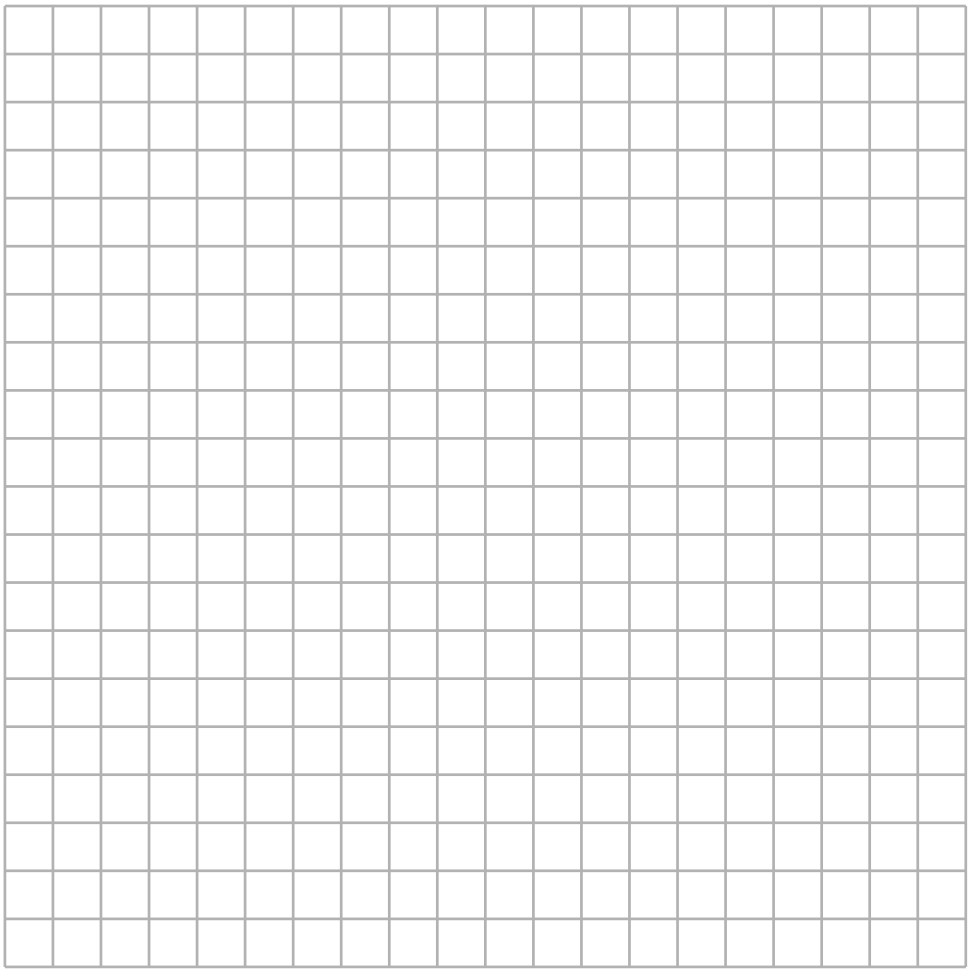
[0] Yes, but no work is shown.

or

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

7. During a snowstorm, a meteorologist tracks the amount of accumulating snow. For the first three hours of the storm, the snow fell at a constant rate of one inch per hour. The storm then stopped for two hours and then started again at a constant rate of one-half inch per hour for the next four hours.

   a) On the grid below, draw and label a graph that models the accumulation of snow over time using the data the meteorologist collected.



   b) If the snowstorm started at 6 p.m., how much snow had accumulated by midnight?

Key: a) See graph in rationale below.

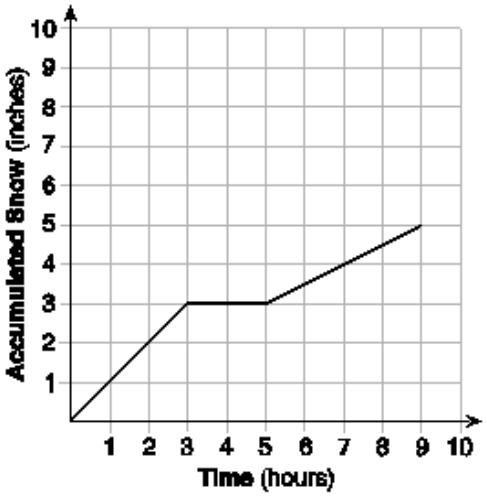
b) $3\frac{1}{2}$

Aligned to CCLS: F.IF.4

Commentary: This question aligns to F.IF.4 because the students sketch a graph based on a verbal description of the snowstorm.

Mathematical practices: 4

Rationale:



Rubric:

[4] A correct graph is drawn, the axes are labeled correctly, and $3\frac{1}{2}$ is stated.

[3] Appropriate work is shown, but one graphing or labeling error is made, but an appropriate amount of snow is stated.

or

[3] A correct graph is drawn, the axes are labeled correctly, but the amount of snow is missing or is incorrect.

[2] Appropriate work is shown, but two or more graphing or labeling errors are made, but an appropriate amount of snow is stated.

or

[2] Appropriate work is shown, but one conceptual error is made, but an appropriate amount of snow is stated.

or

[2] Appropriate work is shown, but one graphing or labeling error is made, and the amount of snow is missing or is incorrect.

[1] Appropriate work is shown, but two or more graphing or labeling errors are made, and the amount of snow is missing or incorrect.

or

[1] Appropriate work is shown, but one conceptual error and one graphing or labeling error are made, but an appropriate amount of snow is stated.

or

[1] Appropriate work is shown, but one conceptual error is made, and the amount of snow is missing or is incorrect.

or

[1] $3\frac{1}{2}$, but no work is shown.

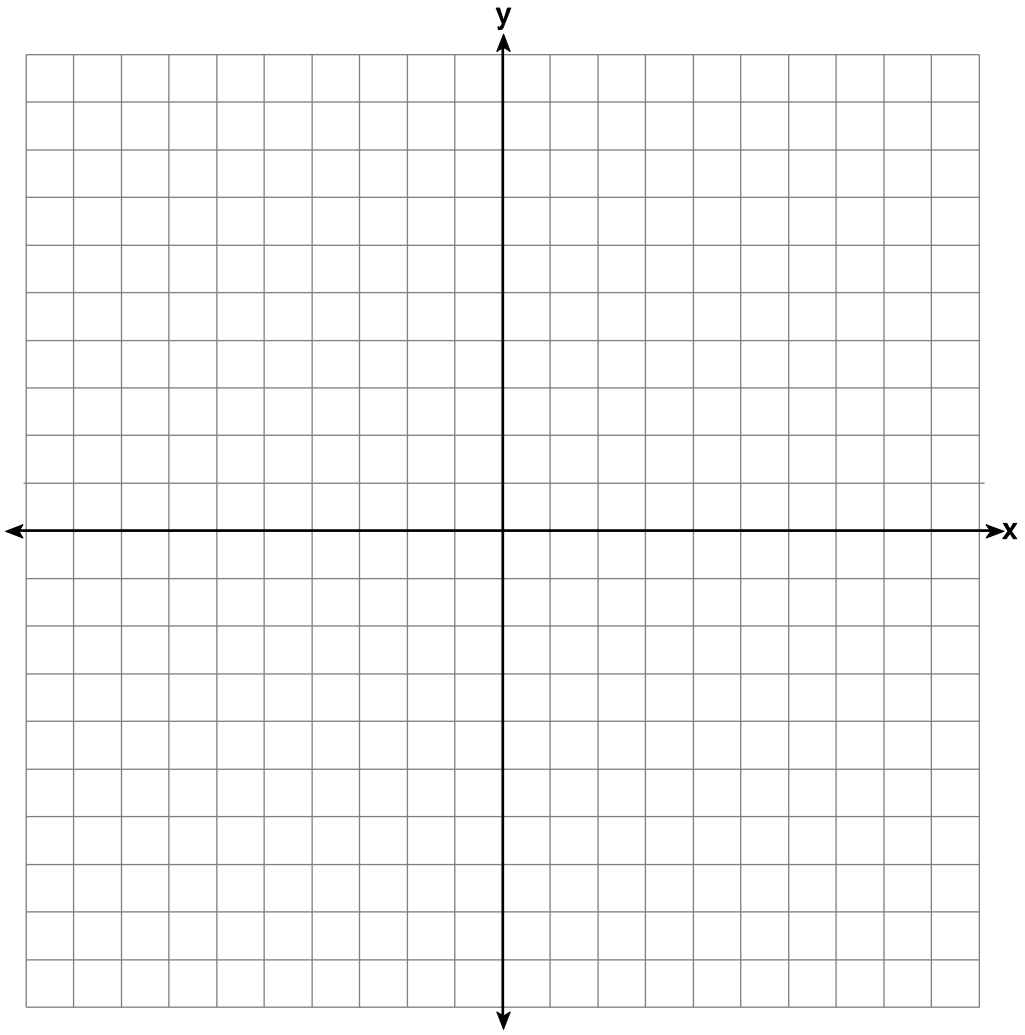
[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

8. Next weekend Marnie wants to attend either carnival *A* or carnival *B*. Carnival *A* charges \$6 for admission and an additional \$1.50 per ride. Carnival *B* charges \$2.50 for admission and an additional \$2 per ride.

   a) In function notation, write A(x) to represent the total cost of attending carnival *A* and going on x rides. In function notation, write B(x) to represent the total cost of attending carnival *B* and going on x rides.

   b) Determine the number of rides Marnie can go on such that the total cost of attending each carnival is the same. [Use of the set of axes below is optional.]

   c) Marnie wants to go on five rides. Determine which carnival would have the lower total cost. Justify your answer.



Key: a) $A(x) = 1.50x + 6$
$B(x) = 2x + 2.50$

b) 7 rides

c) Carnival *B* with appropriate justification.

Aligned to CCLS: A.REI.11

Mathematical Practices: 2, 3, and 4

Commentary: This question aligns to A.REI.11 because the answer to the problem requires the student to solve $A(x) = B(x)$, either algebraically or graphically.

Rationale:

a) $A(x) = 1.50x + 6$
$B(x) = 2x + 2.50$

b) $A(x) = B(x)$
$1.50x + 6 = 2x + 2.5$
$x = 7$

c) Carnival *A* cost $= 1.50x + 6$
$= 1.50(5) + 6$
$= \$13.50$

Carnival *B* cost $= 2x + 2.50$
$= 2(5) + 2.50$
$= \$12.50$

Carnival *B* because it costs \$12.50 and carnival *A* costs \$13.50.

Rubrics:

(a) [2] $A(x) = 1.50x + 6$ and $B(x) = 2x + 2.50$

[1] Either $A(x) = 1.50x + 6$ or $B(x) = 2x + 2.50$ is written.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

(b) [2] 7 and appropriate work is shown.

[1] Appropriate work is shown, but one computational or graphing error is made, but an appropriate number of rides is stated.

or

[1] Appropriate work is shown, but one conceptual error is made, but an appropriate number of rides is stated.

or

[1] 7, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

(c) [2] Carnival *B* and an appropriate justification is given, such as showing that carnival *B* costs \$12.50 and carnival *A* costs \$13.50.

[1] Carnival *B*, but the justification is incomplete or incorrect.

[0] Carnival *B*, but no explanation is given.

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Regents Examination in Algebra I (Common Core)

Sample Questions
Fall 2013

THE STATE EDUCATION DEPARTMENT /
THE UNIVERSITY OF THE STATE OF NEW YORK / ALBANY, NY 12234

New York State Common Core Sample Questions: Regents Examination in Algebra I (Common Core)

With the adoption of the New York P-12 Common Core Learning Standards (CCLS) in ELA/Literacy and Mathematics, the Board of Regents initiated a shift in both instruction and assessment. Educators around the state have begun providing Common Core instruction in their classrooms. To aid in this transition, additional sample Regents Examination in Algebra I (Common Core) questions have been developed to help students, parents, and educators better understand the instructional shifts demanded by the Common Core and the rigor required to ensure that all students are on track to college and career readiness.

Like the sample questions provided in the Spring of 2013, these questions emphasize instructional shifts demanded by the CCLS. They are teaching tools for educators and can be shared freely with students and parents. The sample questions are designed to help clarify the way the CCLS should drive instruction and how students will be assessed starting with the June 2014 administration of the Regents Examination in Algebra I (Common Core). Feedback on these sample questions will inform future test development efforts and can be sent to emscassessinfo@mail.nysed.gov.

While educators from around the state have helped craft these sample questions, they have not undergone the same extensive review, vetting, and field testing that occur with actual questions used on the State exams. The sample questions were designed to help educators think about content, NOT to show how operational exams look exactly or to provide information about how teachers should administer the test.

What's New in these Sample Questions

These additional sample questions have been developed for the same purpose as the original set of sample questions, but also highlight some specific aspects of the Regents Examination in Algebra I (Common Core). Specifically, these questions:

- Are written to measure standards that introduce new content that is not part of the Integrated Algebra curriculum, but is included in Algebra I (Common Core)
- Address New York State Standards Clarifications, which can be found at www.engageny.org/resources/regents-exams-mathematics-algebra-i-standards-clarifications
- Present different approaches to assessing the same standard (i.e., multiple representations)

Teachers should note the expectations outlined in these sample items and use this information to inform their instructional practices. For example, Question 10 requires stating the domain and range of a given function. Students may use a variety of notational conventions in their answer. Teachers are encouraged to teach students multiple ways of denoting sets. Another example is in Question 4. A domain is specified and students are required to graph *only* over this given domain. Again, this practice should be emphasized in the classroom when applicable.

How to Use the Sample Questions

- Interpret how the standards are conceptualized in each question.
- Note the multiple ways the standard is assessed throughout the sample questions.
- Look for opportunities for mathematical modeling; i.e., connecting mathematics with the real world by conceptualizing, analyzing, interpreting and validating conclusions in order to make decisions about situations in everyday life, society, or the workplace.
- Consider the instructional changes that will need to occur in your classroom.
- Notice the application of mathematical ways of thinking to real world issues and challenges.
- Pay attention to the strong distractors in each multiple-choice question.
- **Don't** consider these questions to be the only way the standard will be assessed.
- **Don't** assume that the sample questions represent a mini-version of future State exams.

Format of the Mathematics Sample Questions Document

The Mathematics Sample Questions document is formatted so that headings appear below each question to provide information for the teacher to help interpret the question, understand its alignment with the CCLS, and inform instruction. A list of the headings with a brief description of the associated information is shown below.

Key: This is the correct response or, in the case of multiple-choice questions, the correct option.

Aligned to CCLS: This is the NYS P-12 Common Core Learning Standard measured by the question.

Secondary Standard: If applicable, this is the NYS P-12 Common Core Learning Standard that supports the primary standard measured by the question.

Mathematical Practices: If applicable, this is a list of Standards for Mathematical Practice associated with the question. Note that in classroom use, the questions included here can be used to highlight a variety of practice standards.

Multiple Representation Codes: This is a list of the multiple representation codes associated with the question.

Commentary: This is an explanation of how the question aligns with the listed content standard.

Rationale: For multiple-choice questions, this section provides the correct option and demonstrates one method for arriving at that answer. For constructed-response questions, one possible solution is shown followed by the scoring rubric that is specific to the question. Note that there are often multiple approaches to solving each problem. The rationale section provides only one example. In some cases, a constructed-response question requires a student to solve the question using a specific strategy. Constructed-response questions are written in this manner when the question is designed to measure a standard that calls for a specific strategy.

Rubrics: The scoring rubrics provided should be used to evaluate the efficacy of different methods used to arrive at a solution.

1 Which ordered pair is *not* in the solution set of $y > -\frac{1}{2}x + 5$ and $y \leq 3x - 2$?

(1) (5,3)
(2) (4,3)
(3) (3,4)
(4) (4,4)

Key: 2

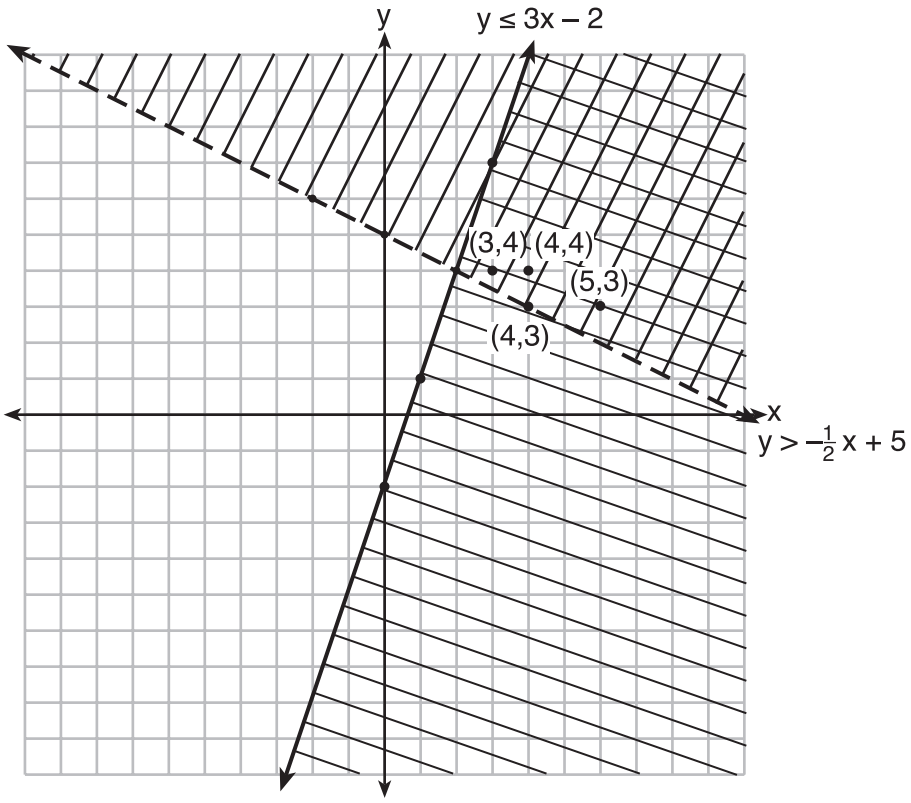
Aligned to CCLS: A.REI.3

Mathematical Practice: 2

MRC: Pl, Pj, A6

Commentary: This question aligns to A.REI.3 because it represents a system of inequalities where students need to determine viable solutions and a nonviable solution.

Rationale: Option 2 is correct.



(4,3) is on the boundary of $y > -\frac{1}{2}x + 5,$ therefore (4,3) is not a solution of the system of inequalities.

A student can also determine the answer to the question using substitution.

2 If the quadratic formula is used to find the roots of the equation $x^2 - 6x - 19 = 0,$ the correct roots are

(1) $3 \pm 2\sqrt{7}$

(2) $-3 \pm 2\sqrt{7}$

(3) $3 \pm 4\sqrt{14}$

(4) $-3 \pm 4\sqrt{14}$

Key: 1

Aligned to CCLS: A.REI.4b

Mathematical Practice: 6

MRC: Pa, Pd, Pl, Pn

Commentary: This question aligns to A.REI.4b and its NYS clarification (solutions may include simplifying radicals) because the student must solve a quadratic equation and understand the process of simplifying radicals.

Rationale: Option 1 is correct.

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

$$x = \frac{-(-6) \pm \sqrt{(-6)^2 - 4(1)(-19)}}{2(1)}$$

$$x = \frac{6 \pm \sqrt{36 + 76}}{2}$$

$$x = \frac{6 \pm \sqrt{112}}{2}$$

$$x = \frac{6 \pm \sqrt{16 \cdot 7}}{2}$$

$$x = \frac{6 \pm 4\sqrt{7}}{2}$$

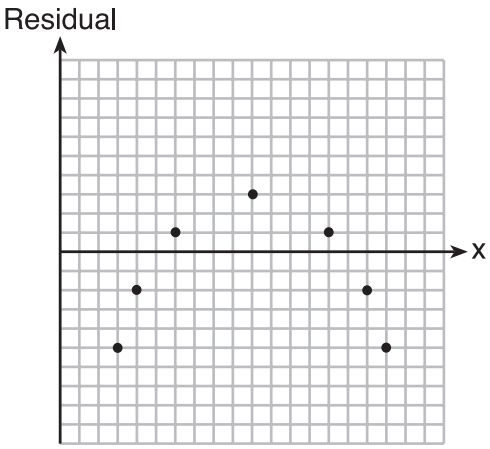
$$x = 3 \pm 2\sqrt{7}$$

3 Which statistic would indicate that a linear function would *not* be a good fit to model a data set?

(1) $r = -0.93$

(2) $r = 1$

(3)



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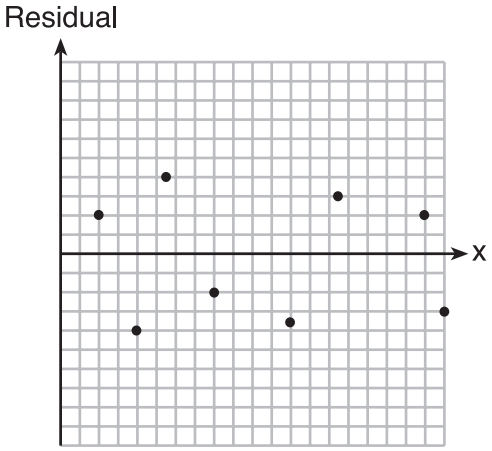


Key: 3

Aligned to CCLS: S.ID.6c

Secondary Standards: S.ID.6a and S.ID.8

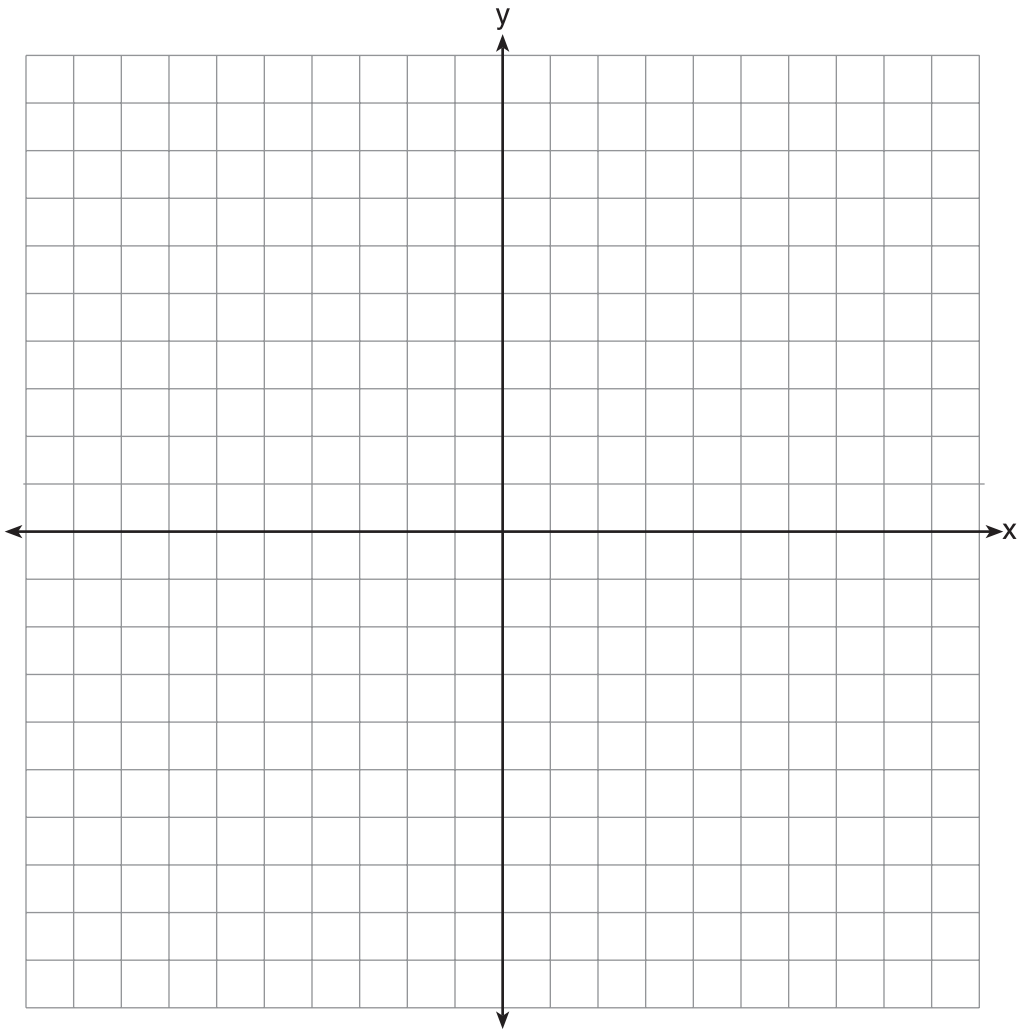
Mathematical Practices: 1 and 2

MRC: C2f, C3d

Commentary: This question aligns to S.ID.6c and its corresponding clarification (both correlation coefficient and residuals will be addressed in this standard) because the student must determine the fit of the data by interpreting a correlation coefficient and residual plots.

Rationale: Option 3 is correct. A correlation coefficient close to –1 or 1 indicates a good fit. For a residual plot, there should be no observable pattern and a similar distribution of residuals above and below the *x*-axis.

4 On the set of axes below, graph the function represented by $y = \sqrt[3]{x - 2}$ for the domain $-6 \leq x \leq 10$.



Key: See graph in the rationale.

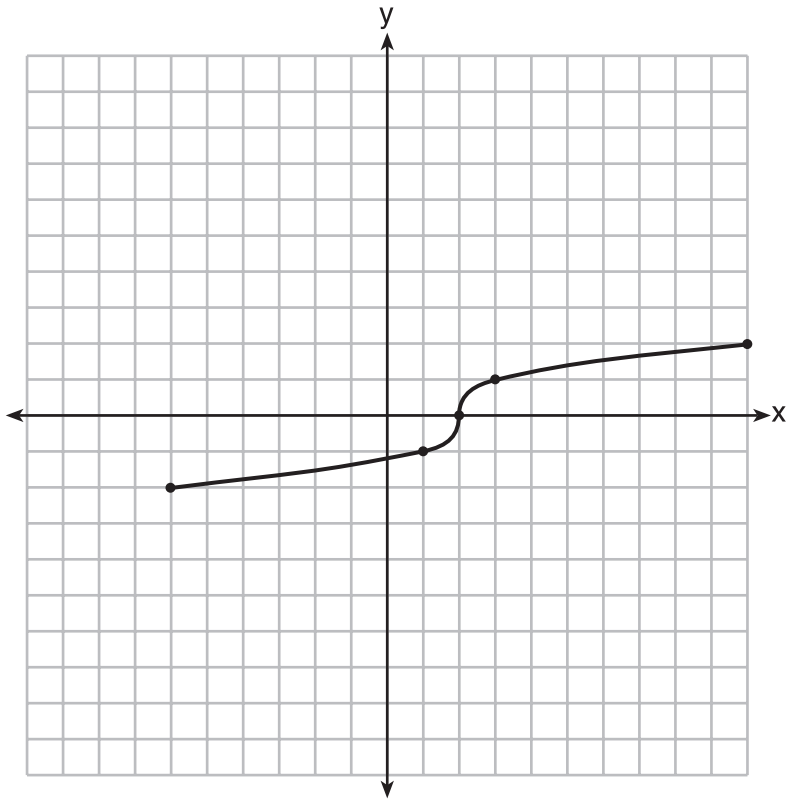
Aligned to CCLS: F.IF.7b

Mathematical Practice: 5

MRC: Pj, Pl

Commentary: This question aligns to F.IF.7b because the students will graph a cube root function.

Rationale:



The graph must be drawn for the given domain *only*. The graph must *not* include arrows.

Rubric:

[2] A correct graph is drawn for the given interval.

[1] One graphing error is made, such as the graph extending beyond the given interval.

or

[1] One conceptual error is made.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

5 Solve $8m^2 + 20m = 12$ for m by factoring.

Key: -3 and $\frac{1}{2}$

Aligned to CCLS: A.SSE.3a

Secondary Standard: A.REI.4b

Mathematical Practices: 1 and 7

MRC: Pj, Pn

Commentary: This question aligns to A.SSE.3a and its NYS clarification (includes trinomials with leading coefficients other than 1) because it requires the student to factor a quadratic with a leading coefficient other than 1.

Rationale:

$8m^2 + 20m = 12$

$8m^2 + 20m - 12 = 0$

$4(2m^2 + 5m - 3) = 0$

$4(m + 3)(2m - 1) = 0$

$m + 3 = 0 \qquad 2m - 1 = 0$

$m = -3 \qquad 2m = 1$

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

$m = -3$ and $\frac{1}{2}$

Rubric:

[2] -3 and $\frac{1}{2}$, and correct work is shown.

[1] Appropriate work is shown, but one computational or factoring error is made.

or

[1] Appropriate work is shown, but one conceptual error is made.

or

[1] Appropriate work is shown, but only one solution is found.

or

[1] $(4m - 2)(2m + 6)$ or an equivalent factored expression is written, but no further correct work is shown.

or

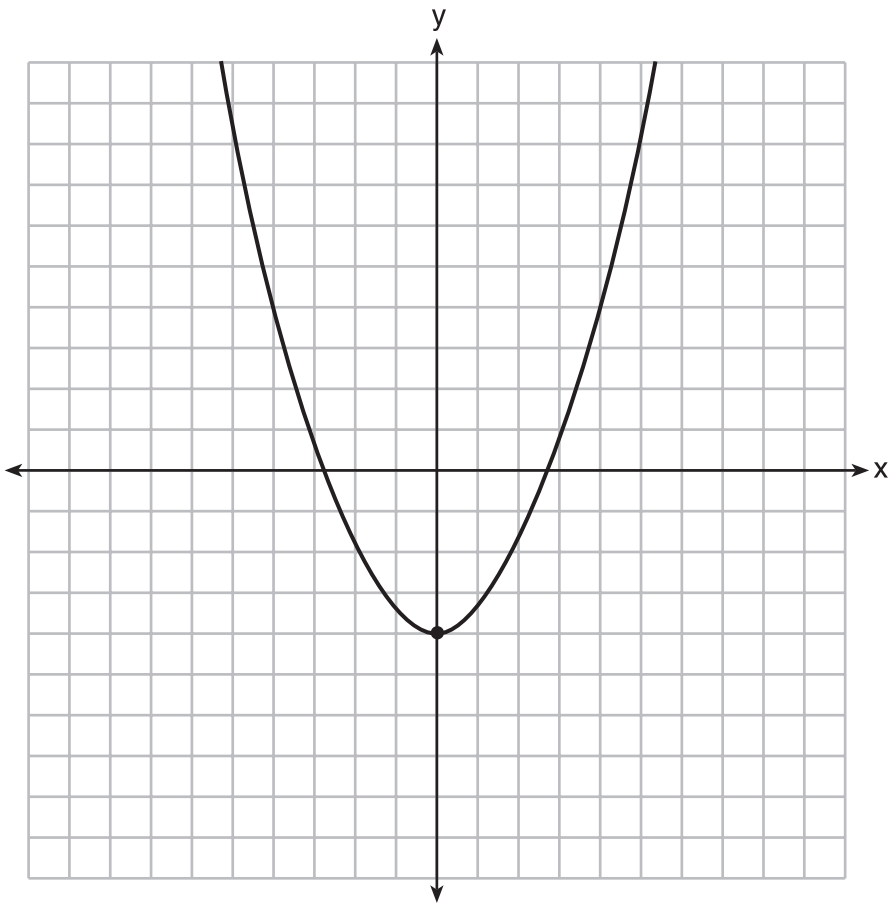
[1] -3 and $\frac{1}{2}$, but a method other than factoring is used.

or

[1] -3 and $\frac{1}{2}$, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

6 Ryker is given the graph of the function $y = \frac{1}{2}x^2 - 4$. He wants to find the zeros of the function, but is unable to read them exactly from the graph.



Find the zeros in simplest radical form.

Key: $\pm 2\sqrt{2}$

Aligned to CCLS: A.REI.4

Secondary Standard: F.IF.8a

Mathematical Practice: 7

MRC: Pa, Pl, Clk, C2b

Commentary: This item aligns to A.REI.4 and its clarification (solutions may include simplifying radicals) because it requires a student to choose an appropriate method of solving a quadratic function, and the solutions are simplified in radical form.

Rationale:

$$\frac{1}{2}x^2 - 4 = 0$$
$$2\left(\frac{1}{2}x^2 - 4\right) = (0)2$$
$$x^2 - 8 = 0$$
$$x^2 = 8$$
$$x = \pm\sqrt{8}$$
$$x = \pm 2\sqrt{2}$$

Rubric:

[2] $\pm 2\sqrt{2}$, and correct work is shown.

[1] Appropriate work is shown, but one computational or simplification error is made.

or

[1] Appropriate work is shown, but one conceptual error is made.

or

[1] Appropriate work is shown, but the answer is written in decimal form.

or

[1] $\pm 2\sqrt{2}$, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

7 Emma recently purchased a new car. She decided to keep track of how many gallons of gas she used on five of her business trips. The results are shown in the table below.

Miles Driven	Number of Gallons Used
150	7
200	10
400	19
600	29
1000	51

Write the linear regression equation for these data where miles driven is the independent variable. (Round all values to the *nearest hundredth*.)

Key: $y = 0.05x - 0.92$

Aligned to CCLS: S.ID.6a

Mathematical Practices: 5

MRC: Pa, Pl

Commentary: This question aligns to S.ID.6a and its corresponding clarification (includes the use of the regression capabilities of the calculator) because it requires the student to write a linear regression equation for the given data while using the regression capabilities of the calculator.

Rationale: The linear regression equation, $y = 0.05x - 0.92$, was found using the regression capabilities of the calculator.

Rubric:

[2] The equation $y = 0.05x - 0.92$ or an equivalent equation is written.

[1] The expression $0.05x - 0.92$ is written.

or

[1] One rounding error is made.

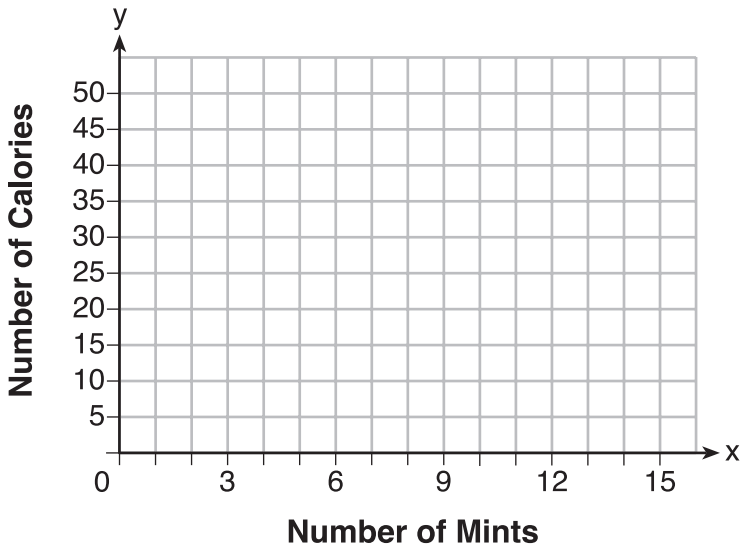
or

[1] One conceptual error is made, such as using a regression equation other than linear.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

8 Max purchased a box of green tea mints. The nutrition label on the box stated that a serving of three mints contains a total of 10 Calories.

On the axes below, graph the function, C, where $C(x)$ represents the number of Calories in x mints.



Write an equation that represents $C(x)$.

A full box of mints contains 180 Calories. Use the equation to determine the total number of mints in the box.

Key: See graph in rationale.

$C(x) = \frac{10}{3}x$

54 mints

Aligned to CCLS: A.CED.3

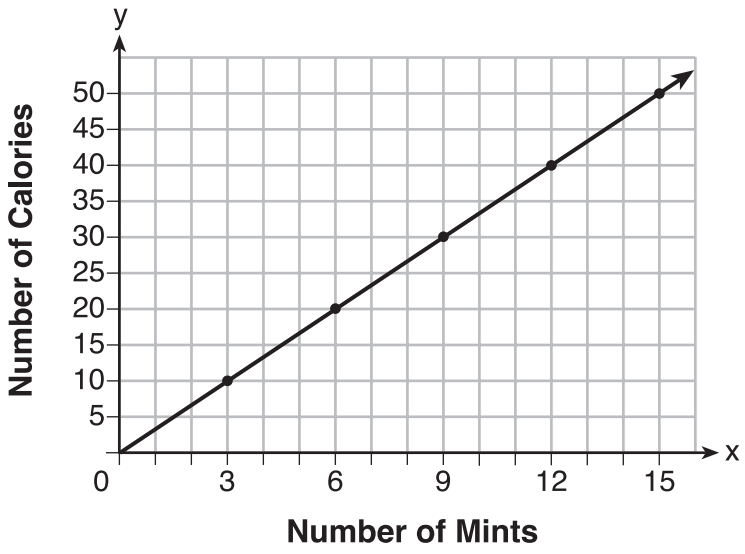
Secondary Standard: A.CED.1, F.IF.2

Mathematical Practice: 4

MRC: Pa, Pk

Commentary: This question aligns with A.CED.3 because students must write an equation, then use the equation to determine a viable solution.

Rationale:



The slope of the given line is $\frac{10}{3}$, therefore the equation representing $C(x)$ is

$C(x) = \frac{10}{3}x$

$180 = \frac{10}{3}x$

$540 = 10x$

$54 = x$

There are 54 mints in the box.

Rubric:

[4] A correct graph is drawn, $C(x) = \frac{10}{3}x$, $y = \frac{10}{3}x$ or an equivalent equation is written, and correct work using the equation is shown to find 54.

[3] Appropriate work is shown, but one computational or graphing error is made.

or

[3] A correct graph is drawn and $C(x) = \frac{10}{3}x$, but no further correct work is shown.

or

[3] A correct graph is drawn and appropriate work is shown to find 54, but the expression $\frac{10}{3}x$ is written.

or

[3] $C(x) = \frac{10}{3}x$ and correct work is shown to find 54, but no graph or an incorrect graph is drawn.

[2] Appropriate work is shown, but two or more computational or graphing errors are made.

or

[2] Appropriate work is shown, but one conceptual error is made.

or

[2] $C(x) = \frac{10}{3}x$, but no further correct work is shown.

[1] Appropriate work is shown, but one conceptual error and one computational or graphing error are made.

or

[1] A correct graph is drawn, but no further correct work is shown.

or

[1] 54, but no further correct work is shown.

or

[1] The expression $\frac{10}{3}x$ is written, but no further correct work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

9 David has two jobs. He earns $8 per hour babysitting his neighbor's children and he earns $11 per hour working at the coffee shop.

Write an inequality to represent the number of hours, *x*, babysitting and the number of hours, *y*, working at the coffee shop that David will need to work to earn a minimum of $200.

David worked 15 hours at the coffee shop. Use the inequality to find the number of full hours he must babysit to reach his goal of $200.

Key: $8x + 11y \geq 200$
5 hours

Aligned to CCLS: A.CED.3

Secondary Standard: A.REI.3

Mathematical Practices: 4

MRC: Pa, Pl

Commentary: This question aligns to A.CED.3 because the student must write an inequality and interpret solutions as viable or nonviable options.

Rationale: $8x + 11y \geq 200$

$8x + 11(15) \geq 200$
$8x + 165 \geq 200$
$8x \geq 35$
$x \geq 4.375$
5 hours

Rubric:

[4] $8x + 11y \geq 200$ or equivalent, 5 and correct work is shown.

[3] Appropriate work is shown, but one computational or rounding error is made.

or

[3] An incorrect inequality is written, but solved appropriately for the number of full hours of babysitting.

[2] Appropriate work is shown, but two or more computational or rounding errors are made.

or

[2] Appropriate work is shown, but one conceptual error is made.

or

[2] $8x + 11y \geq 200$ and 5 are stated, but no work is shown.

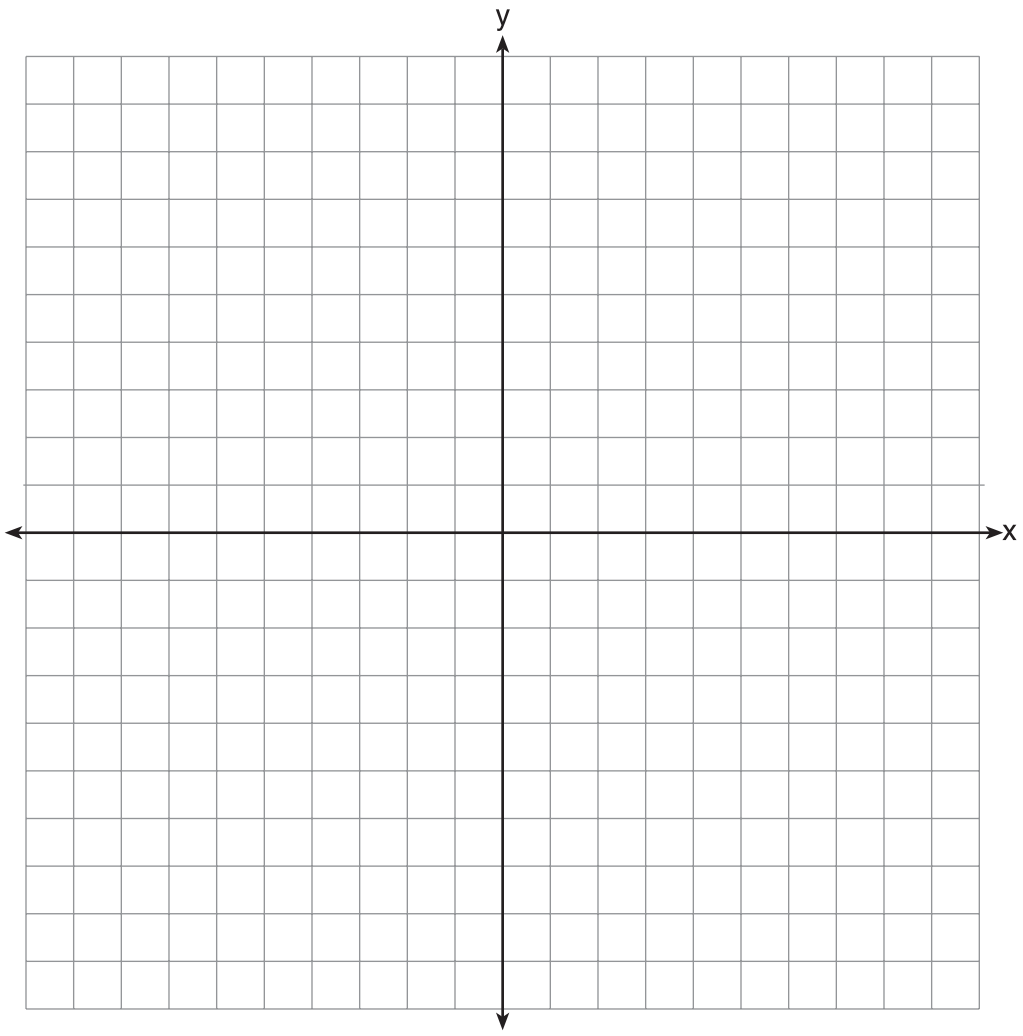
[1] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.

or

[1] $8x + 11y \geq 200$ is written, but no further correct work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

10 On the set of axes below, graph the function $y = |x + 1|$.



State the range of the function.

State the domain over which the function is increasing.

Key: See graph in the rationale.
Range: $y \geq 0, [0,\infty), \{y \mid y \geq 0,$ where y is a real number$\}$, or all real numbers ≥ 0
Domain: $x > -1, (-1,\infty), \{x \mid x > -1,$ where x is a real number$\}$, or all real numbers > -1

Aligned to CCLS: F.IF.7b

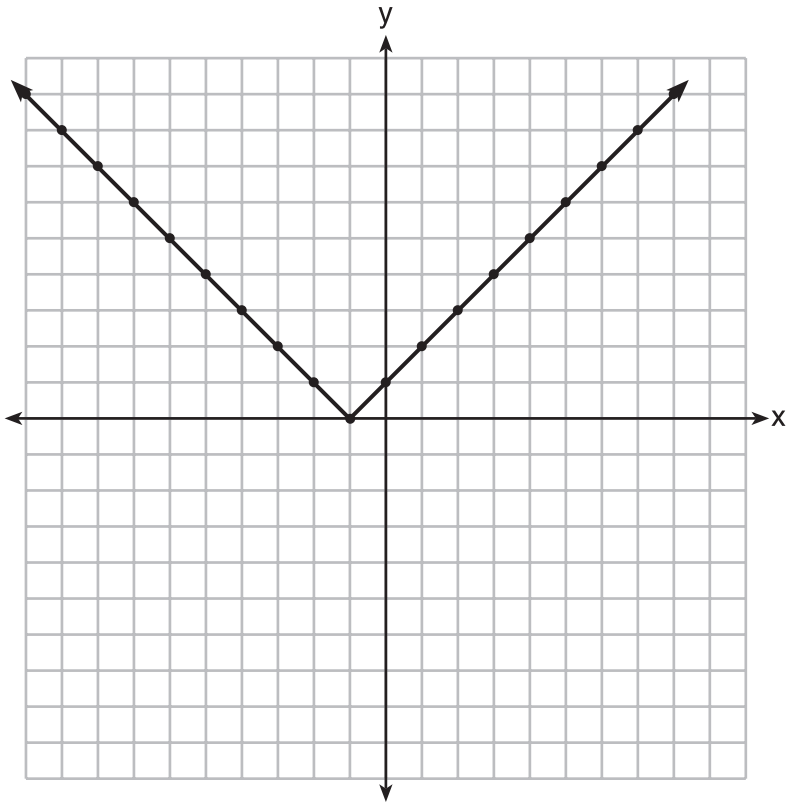
Secondary Standard: F.IF.4 and F.IF.5

Mathematical Practice: 2

MRC: Pj, Pl

Commentary: This question aligns to F.IF.7b because students must draw the graph of an absolute value function.

Rationale:



The graph should be drawn to include the decreasing and increasing portions of the graph. Since a domain is *not* stated, arrows *must* be included on the graph of the function.

The range of the function is $y \geq 0, [0,\infty), \{y \mid y \geq 0,$ where y is a rational number$\}$, or all real numbers ≥ 0.

The function is increasing for $x > -1, (-1,\infty), \{x \mid x > -1,$ where x is a real number$\}$, or all real numbers > -1.

Rubric:

[4] A correct graph is drawn and range, $y \geq 0$ and domain, $x > -1$ or equivalent intervals are stated.

[3] Appropriate work is shown, but one graphing error is made.

or

[3] A correct graph is drawn, but either the range or domain is missing or is incorrect.

[2] Appropriate work is shown, but two or more graphing errors are made.

or

[2] Appropriate work is shown, but one conceptual error is made.

or

[2] A correct graph is drawn, but no further correct work is shown.

or

[2] Range, $y \geq 0$ and domain, $x > -1$ are stated, but no graph is drawn.

[1] Appropriate work is shown, but one conceptual error and one graphing error are made.

or

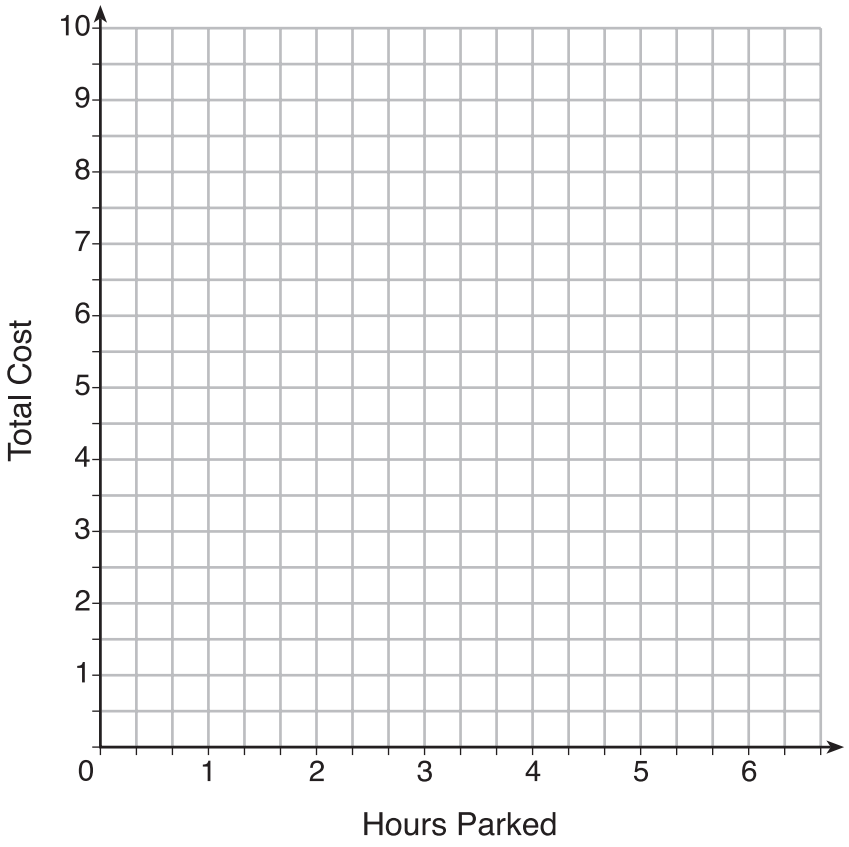
[1] Range, $y \geq 0$ or domain, $x > -1$ is stated, but no graph is drawn.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

11 The table below lists the total cost for parking for a period of time on a street in Albany, N.Y. The total cost is for any length of time up to and including the hours parked. For example, parking for up to and including 1 hour would cost $1.25; parking for 3.5 hours would cost $5.75.

Hours Parked	Total Cost
1	1.25
2	2.50
3	4.00
4	5.75
5	7.75
6	10.00

Graph the step function that represents the cost for the number of hours parked.



Explain how the cost per hour to park changes over the six-hour period.

Key: See graph in rationale below.
A correct explanation is given such as, the cost for each additional hour increases after the first 2 hours.

Aligned to CCLS: F.IF.7b

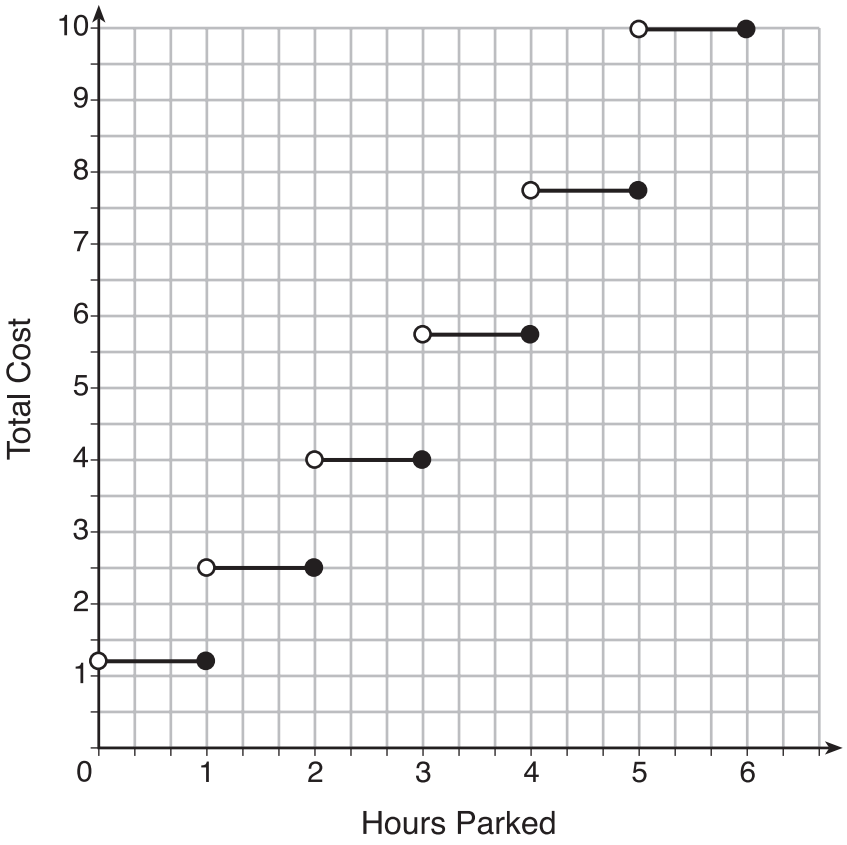
Secondary Standard: F.IF.4

Mathematical Practices: 4

MRC: Clj, C2b, C3b

Commentary: This question aligns to F.IF.7b because it requires a student to graph a step function. Students may interpret the cost per hour of the function from the table or the graph.

Rationale:



The cost for each additional hour increases after the first 2 hours. This can be determined by viewing the increasing gaps between the steps or by calculating the cost for each additional hour after two hours.

Rubric:

[4] A correct graph is drawn and a correct explanation is stated.

[3] One graphing error is made.

or

[3] A correct graph is drawn, but the explanation is missing or incorrect.

[2] Two or more graphing errors are made.

or

[2] One conceptual error is made.

[1] One conceptual error and one graphing error are made.

or

[1] A correct explanation is stated, but no graph is drawn.

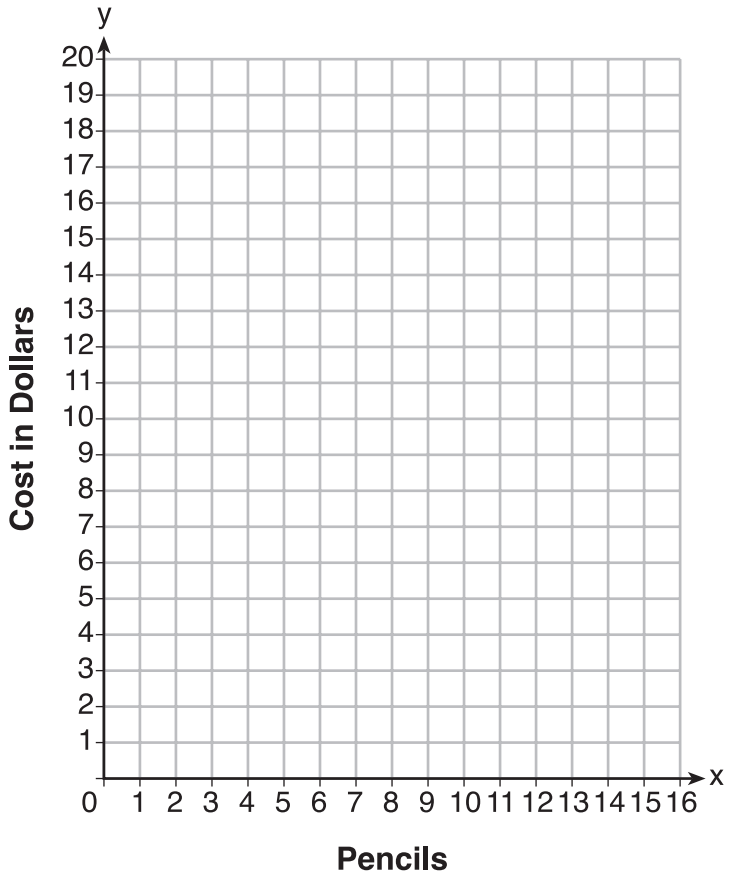
[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

12 At an office supply store, if a customer purchases fewer than 10 pencils, the cost of each pencil is \$1.75. If a customer purchases 10 or more pencils, the cost of each pencil is \$1.25.

Let c be a function for which $c(x)$ is the cost of purchasing x pencils, where x is a whole number.

$$c(x) = \begin{cases} 1.75x, \text{ if } 0 \le x \le 9 \\ 1.25x, \text{ if } x \ge 10 \end{cases}$$

Create a graph of c on the axes below.



A customer brings 8 pencils to the cashier. The cashier suggests that the total cost to purchase 10 pencils would be less expensive. State whether the cashier is correct or incorrect. Justify your answer.

Key: See the graph in the rationale below.
The cashier is correct with an appropriate explanation or work shown to justify the answer.

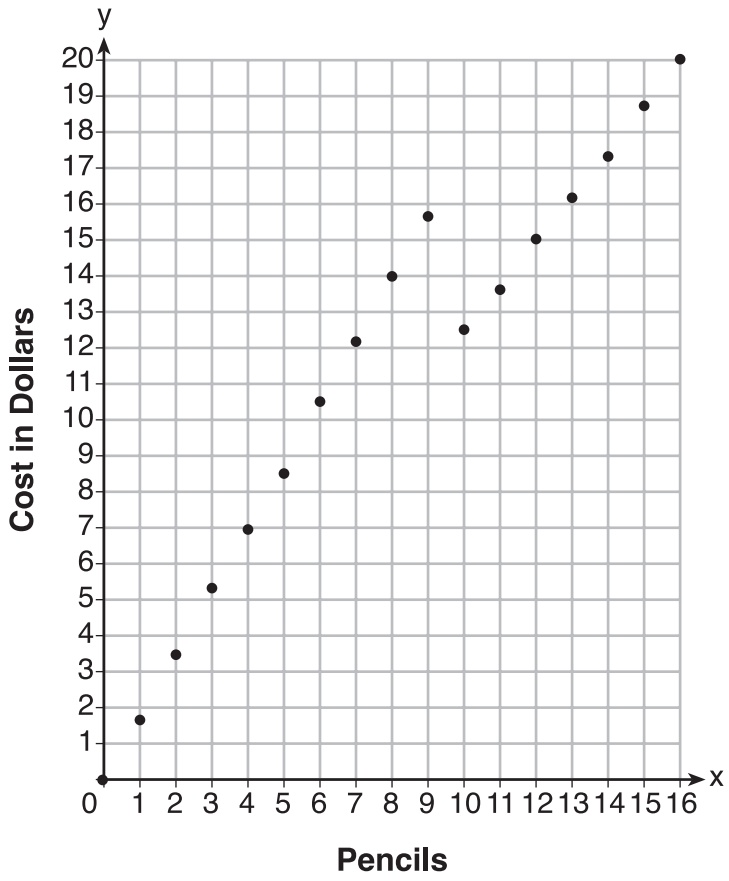
Aligned to CCLS: F.IF.7b

Mathematical Practices: 1 and 4

MRC: Pa, Pj

Commentary: This question aligns to F.IF.7b because a student has to graph a piecewise-defined function.

Rationale:



The data points are not connected because the points represent discrete data and the values for the data can be included on the axes.

Data points *can* be connected or drawn as a straight line if plotting each individual data point would represent a line.

Since 8 pencils cost $14 and 10 pencils cost $12.50, the cashier is correct. The student can calculate the cost of pencils or use the graph to identify that 10 pencils are cheaper than 8 pencils.

Rubric:

[4] A correct graph is drawn and the cashier is correct or an equivalent answer is stated and a correct justification is written.

[3] Appropriate work is shown, but one graphing or computational error is made.

or

[3] A correct graph is drawn but either the cashier's statement or the justification is missing or incorrect.

[2] Appropriate work is shown, but two or more graphing or computational errors are made.

or

[2] Appropriate work is shown, but one conceptual error is made.

or

[2] A correct graph is drawn, but no further correct work is shown.

[1] Appropriate work is shown, but one conceptual error and one graphing or computational error are made.

or

[1] No graph is drawn. The cashier is correct is not stated, but an appropriate justification is given.

[0] No graph is drawn. The cashier is correct is stated and an incorrect, irrelevant, incoherent, or no justification is written.

or

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

13 About a year ago, Joey watched an online video of a band and noticed that it had been viewed only 843 times. One month later, Joey noticed that the band's video had 1708 views. Joey made the table below to keep track of the cumulative number of views the video was getting online.

Months Since First Viewing	Total Views
0	843
1	1708
2	forgot to record
3	7124
4	14,684
5	29,787
6	62,381

a) Write a regression equation that best models these data. Round all values to the *nearest hundredth*. Justify your choice of regression equation.

b) As shown in the table, Joey forgot to record the number of views after the second month. Use the equation from part *a* to estimate the number of full views of the online video that Joey forgot to record.

Key: $y = (836.47)(2.05)^x$ and a correct justification is given
3515

Aligned to CCLS: S.ID.6a

Secondary Standard: N.Q.3

Mathematical Practices: 4

MRC: Pa, Pc, C1i, Al, A4

Commentary: This question aligns to S.ID.6a and its corresponding clarification (includes the use of the regression capabilities of the calculator) because students will use the regression capabilities of their calculator to determine the exponential regression equation, and solve a problem using the equation created within the context of the data.

Rationale: The exponential regression equation, $y = (836.47)(2.05)^x$, was found using the regression capabilities of the calculator.

The student chose the exponential regression because the data appear to increase at an exponential rate. A scatter plot of the data supports an exponential model.

For the second month:

$y = (836.47)(2.05)^2$

$y = 3515$

Rubric:

[4] $y = 836.47(2.05)^x$, a correct justification, and 3515 are written.

[3] Appropriate work is shown, but one computational or rounding error is made.

or

[3] $y = 836.47(2.05)^x$, but either the number of views or the justification is missing or incorrect.

or

[3] The expression $836.47(2.05)^x$, a correct justification and 3515 are written.

[2] Appropriate work is shown, but two or more computational or rounding errors are made.

or

[2] Appropriate work is shown, but one conceptual error is made.

or

[2] $y = 836.47(2.05)^x$ is written, but no further correct work is shown.

or

[2] The expression $836.47(2.05)^x$ is written, but either the number of views or the justification is missing or incorrect.

[1] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.

or

[1] The expression $836.47(2.05)^x$ is written, but no further correct work is shown.

or

[1] 3515, but no further correct work is shown.

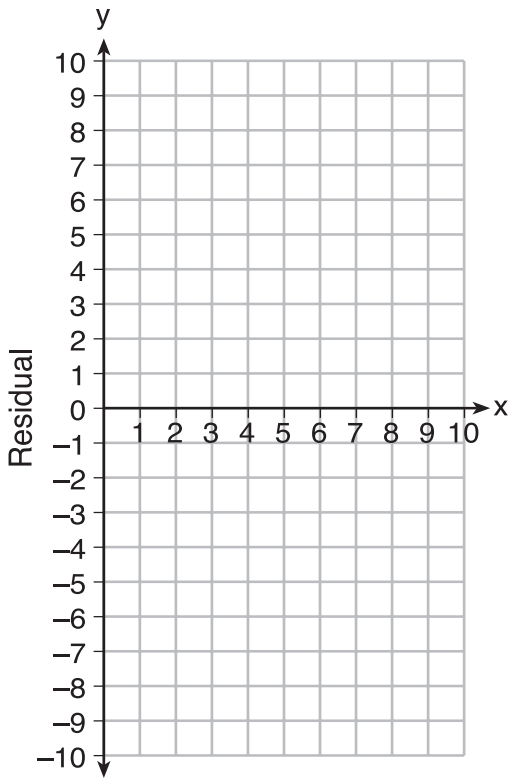
[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

14 Use the data below to write the regression equation ($y = ax + b$) for the raw test score based on the hours tutored. Round all values to the *nearest hundredth*.

Tutor Hours, x	**Raw Test Score**	**Residual** (Actual – Predicted)
1	30	1.3
2	37	1.9
3	35	–6.4
4	47	–0.7
5	56	2.0
6	67	6.6
7	62	–4.7

Equation: _____

Create a residual plot on the axes below, using the residual scores in the table above.



Based on the residual plot, state whether the equation is a good fit for the data. Justify your answer.

Key: $y = 6.32x + 22.43$
See the graph in the rationale.
The equation is a good fit for the data with a correct justification.

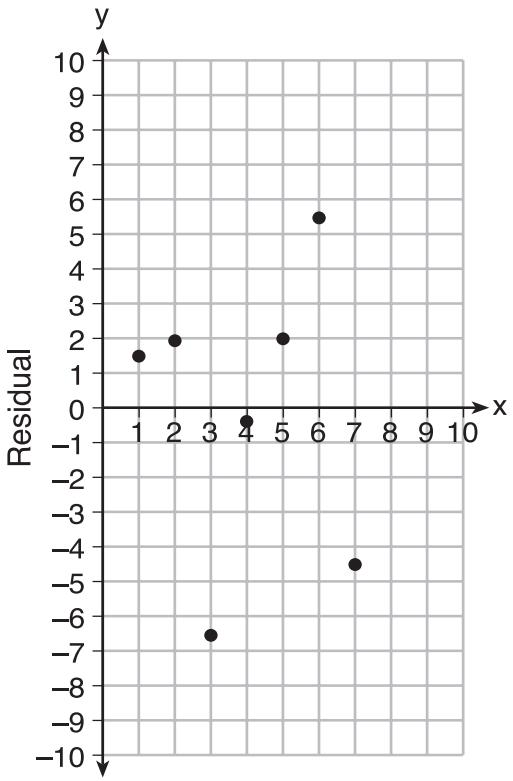
Aligned to CCLS: S.ID.6b

Mathematical Practices: 4 and 5

MRC: C1b, C2f, C3b

Commentary: This question aligns to S.ID.6b because the residuals were plotted and analyzed to assess the fit of the function. Students may have to calculate the residual using a calculator to create a residual plot.

Rationale: The regression equation $y = 6.32x + 22.43$ was found using the regression capabilities of the calculator.



Based on the residual plot, the equation is a good fit for the data because the residual values are scattered without a pattern and are fairly evenly distributed above and below the *x*-axis.

Rubric:

[4] $y = 6.32x + 22.43$, a correct residual graph is drawn, and a correct justification is written.

[3] Appropriate work is shown, but one rounding or graphing error is made.

or

[3] $y = 6.32x + 22.43$ and a correct residual graph is drawn, but the justification is missing or is incorrect.

or

[3] $y = 6.32x + 22.43$ and a correct justification is written, but the residual graph is missing or is incorrect.

or

[3] The expression $6.32x + 22.43$ is written. A correct residual graph is drawn and a correct justification is written.

or

[2] Appropriate work is shown, but two or more rounding or graphing errors are made.

or

[2] Appropriate work is shown, but one conceptual error is made.

or

[2] $y = 6.32x + 22.43$, but no further correct work is shown.

or

[2] The expression $6.32x + 22.43$ is written and a correct residual graph is shown. The justification is missing or is incorrect.

or

[2] The expression $6.32x + 22.43$ is written and a correct justification is written. The residual graph is missing or is incorrect.

[1] Appropriate work is shown, but one conceptual error and one rounding or graphing error are made.

or

[1] A correct residual graph is drawn, but no further correct work is shown.

or

[1] The expression $6.32x + 22.43$ is written, but no further correct work is shown.

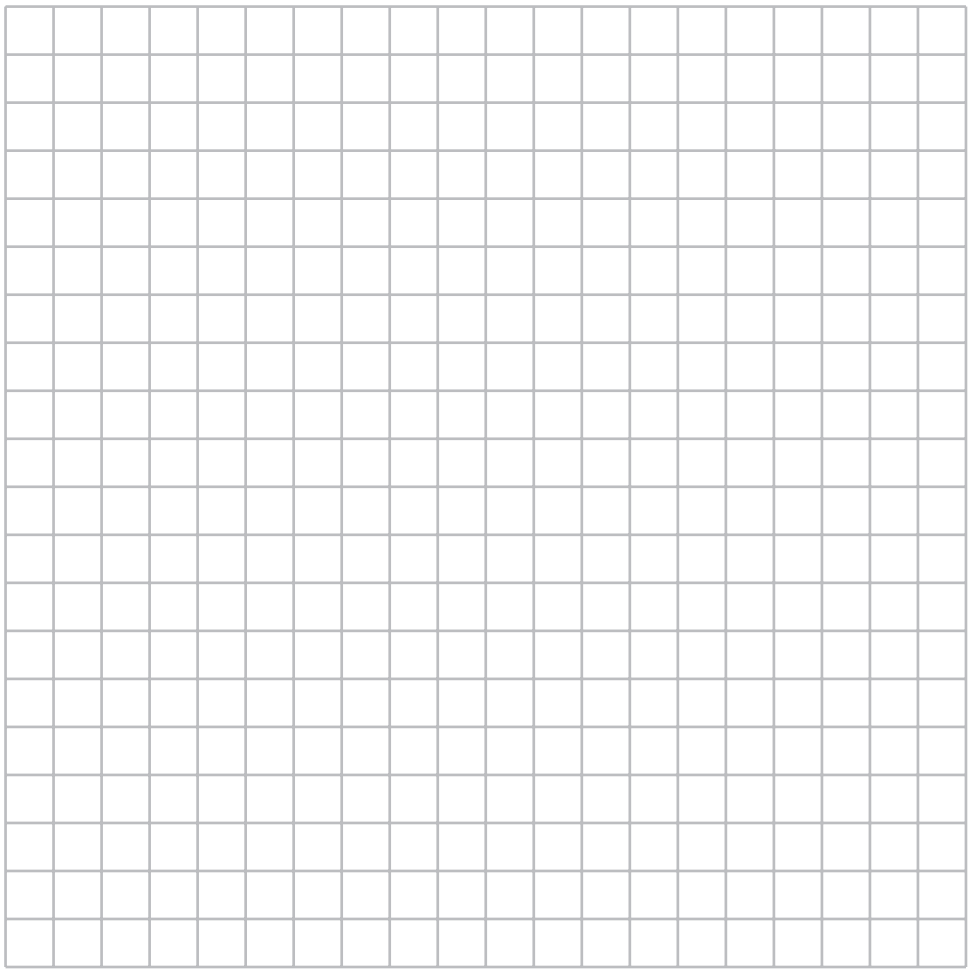
[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

15 A local business was looking to hire a landscaper to work on their property. They narrowed their choices to two companies. Flourish Landscaping Company charges a flat rate of $120 per hour. Green Thumb Landscapers charges $70 per hour plus a $1600 equipment fee.

Write a system of equations representing how much each company charges.

Determine and state the number of hours that must be worked for the cost of each company to be the same. [The use of the grid below is optional.]

If it is estimated to take at least 35 hours to complete the job, which company will be less expensive? Justify your answer.



Key: $y = 120x$ and $y = 70x + 1600$
32 hours
Green Thumb Landscapers and a correct justification.

Aligned to CCLS: A.REI.6

Mathematical Practices: 4

MRC: Pa, Pj, C1k, A5

Commentary: The item aligns to A.REI.6 because it requires a student to write and solve a system of linear equations in two variables.

Rationale: Flourish Landscaping Company

$$y = 120x$$

Green Thumb Landscapers

$$y = 70x + 1600$$

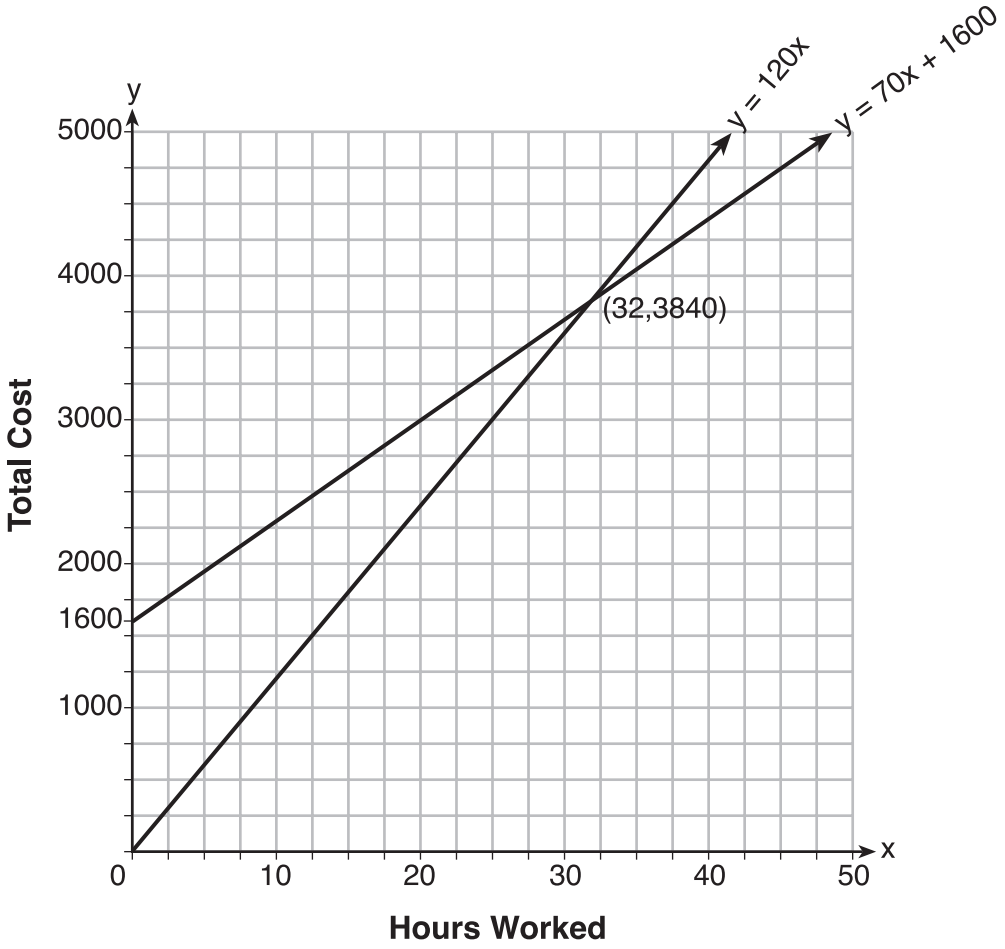
$$120x = 70x + 1600$$
$$-70x \quad -70x$$

$$\frac{50x}{50} = \frac{1600}{50}$$
$$x = 32 \text{ hours}$$

$$y = 120(35) = \$4200$$
$$y = 70(35) + 1600 = \$4050$$

Green Thumb Landscapers would be less expensive.

Additionally, as shown on the next page, a grid can be used to estimate the intersection of the two lines, while the exact point can be calculated. The graph also shows that Green Thumb Landscapers would be less expensive if the job takes at least 35 hours to complete.


y
5000
4000
3000
2000
1600
1000
Total Cost
y = 120x
y = 70x + 1600
(32,3840)
0
10
20
30
40
50
x
Hours Worked

Rubric:

[6] $y = 120x$ and $y = 70x + 1600$ or equivalent, 32, and Green Thumb Landscapers with a correct justification written.

[5] Appropriate work is shown, but one computational or graphing error is made.

or

[5] Appropriate work and justification are shown, but Green Thumb Landscapers is not stated.

or

[5] Appropriate work is shown, but the justification is missing or incorrect.

[4] Appropriate work is shown, but two computational or graphing errors are made.

or

[4] Appropriate work and justification are shown, but the number of hours is not stated or stated incorrectly.

or

[4] Appropriate work is shown, but Green Thumb Landscapers and justification are not stated.

[3] Appropriate work is shown, but three or more computational or graphing errors are made.

or

[3] Appropriate work and justification are shown, but one conceptual error is made.

[2] Appropriate work is shown, but one conceptual error and one computational or graphing error are made.

or

[2] Green Thumb Landscapers and an appropriate justification are stated, but no further correct work is shown.

or

[2] A correct system of equations is stated, but no further correct work is shown.

[1] Appropriate work is shown, but one conceptual error and two or more computational or graphing errors are made.

or

[1] A correct graph is drawn, but no further correct work is shown.

or

[1] 32, but no work is shown.

[0] Green Thumb Landscapers is stated, but no further correct work is shown.

or

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.