

# Interim Assessment 1

## Mathematics

### Algebra I

student: \_\_\_\_\_

teacher: \_\_\_\_\_

school: \_\_\_\_\_



**DIRECTIONS**

In this assessment you will answer a total of 20 questions, including 2 constructed-response question(s). Mark all of your answers to the questions on the answer sheet provided.

You may use this test booklet to work out the questions, but remember to mark all of your answers on the answer sheet. For constructed-response questions, record your answers directly on the page in the test booklet.

**Calculator Section**

You may use a calculator to solve the questions in this section.



1. The formula for finding the area,  $A$ , of a circle with radius,  $r$ , is given below.

$$A = \pi r^2$$

Which formula shows how the radius of a circle can be determined from the area?

- A.  $r = \frac{A}{\pi}$
- B.  $r = \sqrt{\frac{A}{\pi}}$
- C.  $r = \frac{\sqrt{A}}{\pi}$
- D.  $r = \sqrt{A\pi}$

2. Which is the solution set of  $a$  for  $-3(-x + a) + 7 < 5$  when  $x = -1$ ?

- A.  $a > -\frac{1}{3}$
- B.  $a < -\frac{1}{3}$
- C.  $a > \frac{5}{3}$
- D.  $a < \frac{5}{3}$

3. The graph of a linear equation shows the points  $(3, 1)$  and  $(6, 0)$  as two of its solutions.

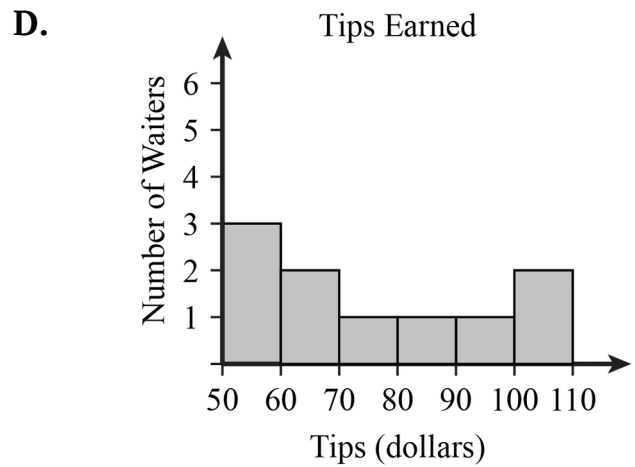
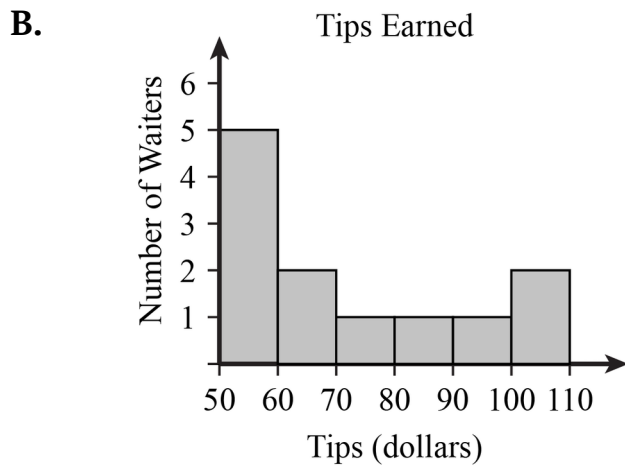
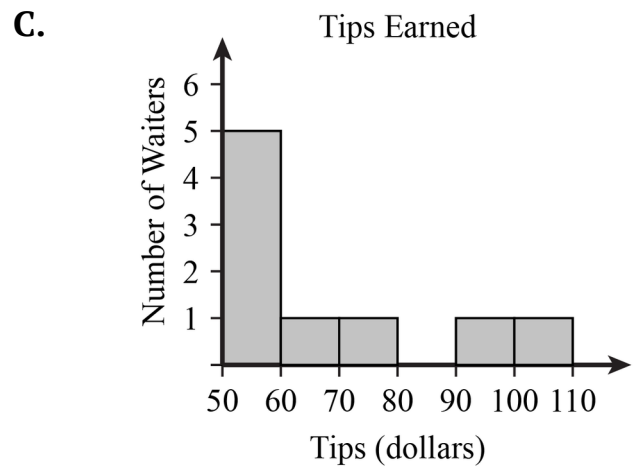
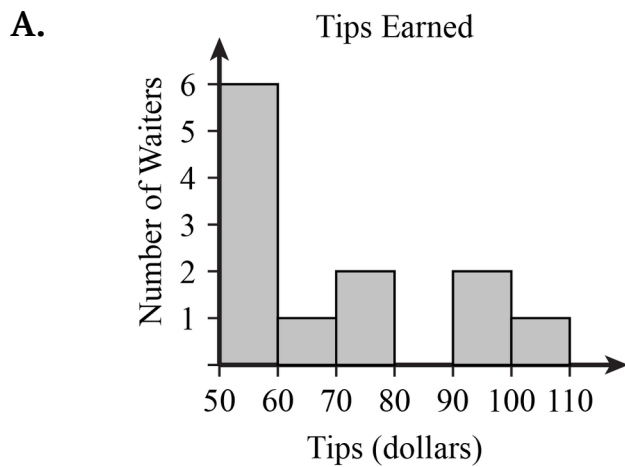
Which point is another solution to the linear equation?

- A.  $(-\frac{1}{3}, 2)$
- B.  $(9, -1)$
- C.  $(12, 2)$
- D.  $(15, -7)$

4. A group of waiters recorded how much money they each earned in tips during one shift. The amounts are recorded in the table below.

\$60.16	\$52.70	\$65.00
\$107.00	\$73.50	\$56.00
\$51.70	\$80.06	\$92.50
\$56.00	\$52.70	\$100.02

Which histogram best represents the data recorded?



5. At work, Elon takes a break  $\frac{1}{5}$  of each hour he works. He also takes a lunch break for  $\frac{1}{2}$  of an hour each day he works. Elon's break time totals  $12\frac{1}{2}$  hours at the end of 5 days.

Which equation could be used to determine the number of hours,  $h$ , Elon works during one 5-day work week?

- A.  $\frac{1}{5}h + \frac{1}{2} = 12\frac{1}{2}$
- B.  $\frac{1}{5}h + 5(\frac{1}{2}) = 12\frac{1}{2}$
- C.  $5(\frac{1}{5}h + \frac{1}{2}) = 12\frac{1}{2}$
- D.  $5(\frac{1}{5}h + \frac{1}{2}h) = 12\frac{1}{2}$
6. What is the solution to the system of equations below?

$$3x + 5y = -6$$

$$3x + y = 2$$

- A.  $(\frac{4}{3}, -2)$
- B.  $(\frac{8}{9}, -\frac{2}{3})$
- C.  $(8, -2)$
- D. There are infinite solutions.

7. Maia is comparing the costs for one month's usage of two cell phone companies. Company A charges \$40 per month plus \$8.50 per gigabyte of data used. Company B charges \$30 per month plus \$10.50 per gigabyte of data used.

How many gigabytes of data would have to be used for Company A and Company B to charge the same amount?

Respond in the space provided.

*If your test is on paper, write your answer on the answer sheet.*

8. Kiki is comparing the ages of all of the penguins at two local zoos using the data recorded below.

**Zoo A:** 0, 2, 3, 4, 6, 7, 7, 10, 11, 13, 13

**Zoo B:** 0, 0, 1, 2, 2, 3, 4, 5, 7, 8, 10, 11, 21

Based on this data, which statistics should Kiki use to compare the two data sets?

Select **all** that apply.

- A. the means for both Zoo A and Zoo B
- B. the medians for both Zoo A and Zoo B
- C. the mean for Zoo A and the median for Zoo B
- D. the standard deviations for both Zoo A and Zoo B
- E. the interquartile ranges for both Zoo A and Zoo B
- F. the standard deviation for Zoo A and interquartile range for Zoo B

9. The table below shows a social media manager's prices for social media posts. The "Cost of Each Post" reflects what the manager charges per post. Additionally, the manager charges a "Base Price" that reflects the cost of the service, regardless of the number of posts.

Types of Posts	Cost of Each Post	Base Price
Posts with Words Only	\$5	\$5
Posts with Pictures Only	\$10	\$25
Posts with Words and Pictures	\$10	\$35

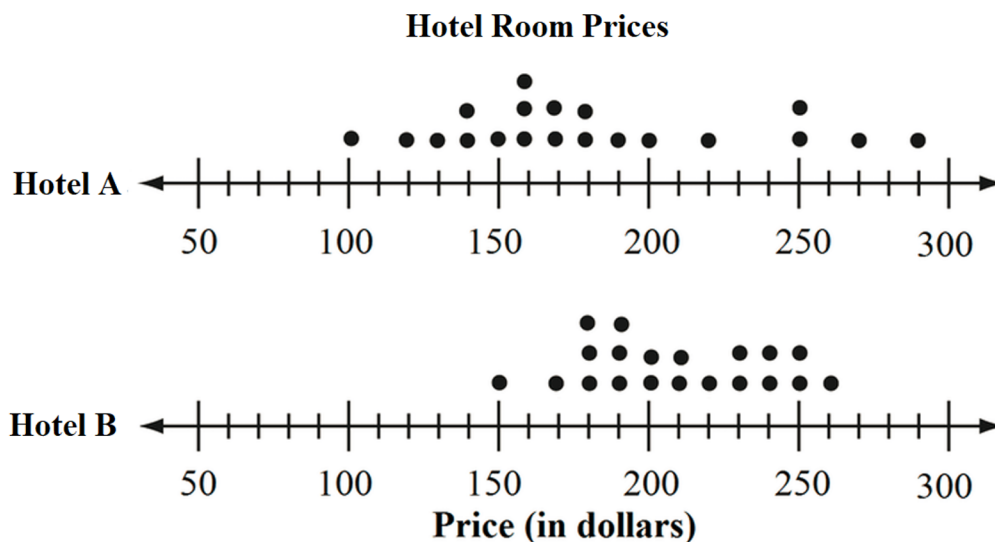
Samuel ordered 2 posts with **words only** and 2 posts with **pictures only**. After placing his order, Samuel realized he could have saved money if he, instead, ordered 2 posts with **words and pictures**. Let  $y$  represent Samuel's savings, in dollars, and let  $x$  represent the number of posts.

Which equation could be used to determine the amount of money Samuel could have saved if he ordered 2 posts with **words and pictures**, instead of his original order?

- A.  $y = 5x - 5$
- B.  $y = 5x + 65$
- C.  $y = -5x + 25$
- D.  $y = 2x$



10. Derek is comparing hotel room prices for Hotel A and Hotel B. He took random samples of 20 room prices for the two hotels and recorded their prices, rounded to the nearest ten dollars, on the dot plots below.



Which statement **best** compares the hotel room prices?

- A. Hotel room prices for both hotels tend to cost about the same amount and vary equally.
- B. Hotel room prices for Hotel A tend to be less expensive and vary less than hotel room prices for Hotel B.
- C. Hotel room prices for Hotel A tend to be less expensive and vary more than hotel room prices for Hotel B.
- D. Hotel room prices for Hotel A tend to be more expensive and vary more than hotel room prices for Hotel B.

- 11.** Cole needs to include at least 11 mg and at most 22 mg of iron in his diet each day. Cole plans to eat multiple bananas daily, and each banana has 0.3 mg of iron. Cole will get the rest of his iron from vitamins. Each whole vitamin contains 4 mg of iron.

**Part A**

If Cole eats 3 bananas each day, what is the least number of whole vitamins he must take in order to stay within his daily iron requirement? What is the greatest number of whole vitamins he can take in order to stay within his daily iron requirement? Use inequalities to solve.

Respond in the space provided.

**Part B**

Cole continues to eat 3 bananas each day. He pays \$2 for every 3 bananas he buys. His first 10 vitamins are free, but if he purchases more than 10 vitamins in 1 week, he pays an additional dollar for every 2 additional vitamins he purchases.

- Write an equation to describe the total amount of money Cole spends on bananas and vitamins each week.
- If Cole spends a total of \$20 on bananas and vitamins this week and he takes the same number of whole vitamins each day, will he be able to meet his iron requirement every day this week, based on your answer in Part A?

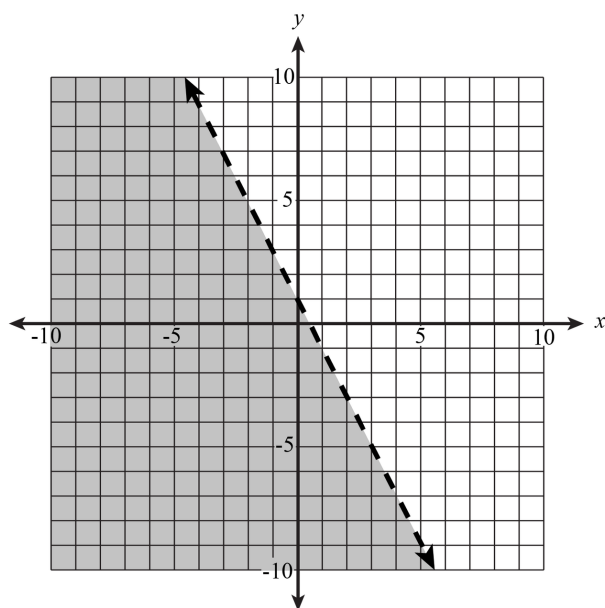
Respond in the space provided.

**Non-Calculator Section**

You may **not** use a calculator to solve the questions in this section.



12. Which inequality is represented by the graph below?



- A.  $y \leq 2x + 1$   
 B.  $y \leq -2x + 1$   
 C.  $y < 2x + 1$   
 D.  $y < -2x + 1$

13. Jacob has taken three math tests, and the total sum of his scores is 235. He will be taking a fourth math test and wants his new average math test score to be at least 80.

Which inequality correctly represents  $s$ , the scores for Jacob's fourth math test that will give him an average of at least 80?

- A.  $\frac{235 + s}{4} \leq 80$   
 B.  $\frac{235 + s}{4} \geq 80$   
 C.  $\frac{235}{4} + s \leq 80$   
 D.  $\frac{235}{4} + s \geq 80$

14. Kara is graphing the equation  $|x| + |y| = a$ , where  $a$  is a real number.

Which of the following statements are true?

Select **all** that apply.

- A. If  $a = 0$ , there are no points on the graph.
- B. If  $a > 0$ , there are no points on the graph.
- C. If  $a < 0$ , there are no points on the graph.
- D. If  $a = 0$ , there is exactly one point on the graph.
- E. If  $a > 0$ , there is exactly one point on the graph.
- F. If  $a < 0$ , there are infinitely many points on the graph.
- G. If  $a > 0$ , there are infinitely many points on the graph.

15. What is the value of  $p$  in the equation below?

$$\frac{4}{5}p + 6 = -\frac{1}{3}p - 3$$

Respond in the space provided.

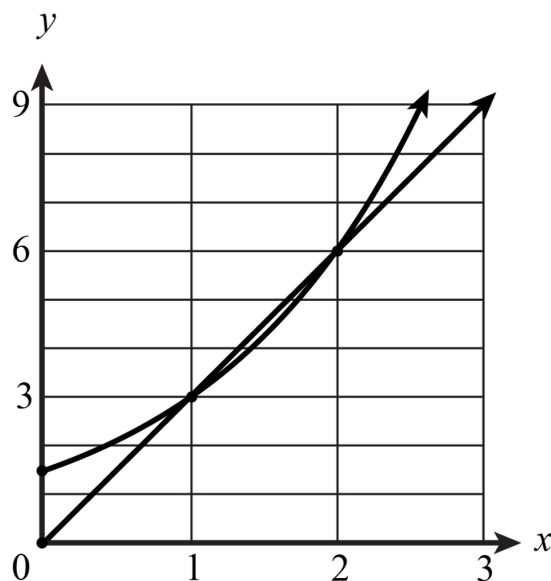
*If your test is on paper, write your answer on the answer sheet.*

- 16.** Tamlin is learning to become a carpenter. She gets paid \$12 per hour for building shelves and \$14 per hour for building cabinets. She can work a maximum of 40 hours per week, and she would like to earn at least \$250 this week.

Let  $s$  represent the number of hours she spends building shelves and  $c$  represent the number of hours she spends building cabinets. Which system of inequalities could be used to represent the given conditions?

- A.**  $s + c \leq 40$   
 $s + c \geq 250$
- B.**  $s + c \leq 40$   
 $12s + 14c \geq 250$
- C.**  $s + c \leq 250$   
 $12s + 14c \geq 40$
- D.**  $s + c \geq 250$   
 $12s + 14c \leq 40$

- 17.** Examine the graph of the equations  $y = f(x)$  and  $y = g(x)$  below.



Which of the following are solutions to the equation  $f(x) = g(x)$ ?

Select **all** that apply.

- A.**  $x = 0$
- B.**  $x = 1$
- C.**  $x = \frac{3}{2}$
- D.**  $x = 2$
- E.**  $x = 3$
- F.**  $x = 6$

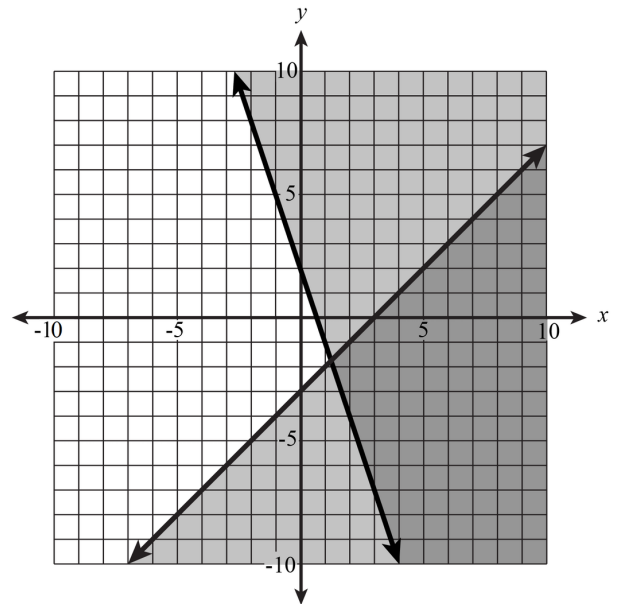
18. The formula for finding the perimeter,  $P$ , of a rectangle with length,  $l$ , and width,  $w$ , is given below.

$$P = 2l + 2w$$

Which formula shows how the width of the rectangle can be determined from the length and the perimeter?

- A.  $w = \frac{P - 2}{2l}$
- B.  $w = \frac{P}{2} + l$
- C.  $w = \frac{P - 2l}{2}$
- D.  $w = \frac{P}{2} - 2l$

19. Which system of inequalities is represented by the graph below?



- A.  $y \geq -3x + 2$   
 $y \leq x - 3$
- B.  $y \leq -3x + 2$   
 $y \geq x - 3$
- C.  $y \leq -3x + 2$   
 $y \leq x - 3$
- D.  $y > -3x + 2$   
 $y < x - 3$

**20.** Find the solution(s) for the equation below. Explain each step in your reasoning.

$$(y - 4)(5y + 6) = 0$$

Respond in the space provided.



Assessment Analysis Guide  
Interim Assessment 1  
**Mathematics**  
**Algebra I**

1

**Item Id: i119566****Item Type: Selected Response**

Standards Description:

HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Primary Standard: cc:HSA-CED.A.4

Points Possible: 1

The formula for finding the area,  $A$ , of a circle with radius,  $r$ , is given below.

$$A = \pi r^2$$

Which formula shows how the radius of a circle can be determined from the area?

A.  $r = \frac{A}{\pi}$

Student divided both sides of the equation by pi but dropped the square from the radius instead of taking the square root of both sides of the equation.

B.  $r = \sqrt{\frac{A}{\pi}}$

Correct.

C.  $r = \frac{\sqrt{A}}{\pi}$

Student divided both sides of the equation by pi and took the square root of both sides of the equation, but only took the square root of the area instead of taking the square root of the area divided by pi.

D.  $r = \sqrt{A\pi}$

Student multiplied by pi on both sides of the equation instead of dividing, thinking that would eliminate pi from radius squared. They then took the square root of both sides of the equation.

**Item Id: i132718****Item Type: Selected Response**

Standards Description:

HSA-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Primary Standard: cc:HSA-REI.B.3

Points Possible: 1

Which is the solution set of  $a$  for  $-3(-x + a) + 7 < 5$  when  $x = -1$ ?

A.  $a > -\frac{1}{3}$

Correct.

B.  $a < -\frac{1}{3}$

Student misunderstood how inequalities are affected when divided by a negative; did not change the less than symbol to greater than when dividing by  $-3$ .

C.  $a > \frac{5}{3}$

Student disregarded the negative  $x$  when substituting  $-1$  for  $x$  to get  $-3(-1 + a) + 7 < 5$ , then distributed and solved for  $a$ .

D.  $a < \frac{5}{3}$

Student disregarded the negative  $x$  when substituting  $-1$  for  $x$  to get  $-3(-1 + a) + 7 < 5$ , then distributed, solved for  $a$ , and did not change the less than symbol to greater than when dividing by  $-3$ .

3

**Item Id: i129114****Item Type: Selected Response**

Standards Description:

HSA-REI.D.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

Primary Standard: cc:HSA-REI.D.10

Points Possible: 1

The graph of a linear equation shows the points (3, 1) and (6, 0) as two of its solutions.

Which point is another solution to the linear equation?

A.  $(-\frac{1}{3}, 2)$ 

Student selected an x-coordinate that matches the slope and then selected a y-coordinate that matches the y-intercept.

B. (9, -1)

Correct.

C. (12, 2)

Student calculated the slope as  $\frac{1}{3}$ , instead of  $-\frac{1}{3}$ , and calculated the y-intercept as -2, instead of 2, and then found a point that fell on  $y = \frac{1}{3}x - 2$ .

D. (15, -7)

Student calculated the y-intercept as -2, instead of 2, and found a point that fell on  $y = -\frac{1}{3}x - 2$ .

4

**Item Id: i129128****Item Type: Selected Response**

Standards Description:

HSS-ID.A.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).

Primary Standard: cc:HSS-ID.A.1

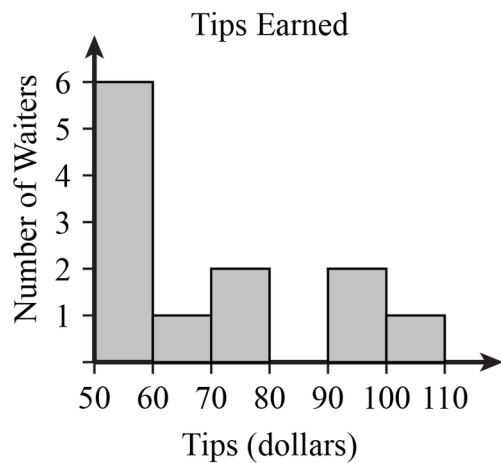
Points Possible: 1

A group of waiters recorded how much money they each earned in tips during one shift. The amounts are recorded in the table below.

\$60.16	\$52.70	\$65.00
\$107.00	\$73.50	\$56.00
\$51.70	\$80.06	\$92.50
\$56.00	\$52.70	\$100.02

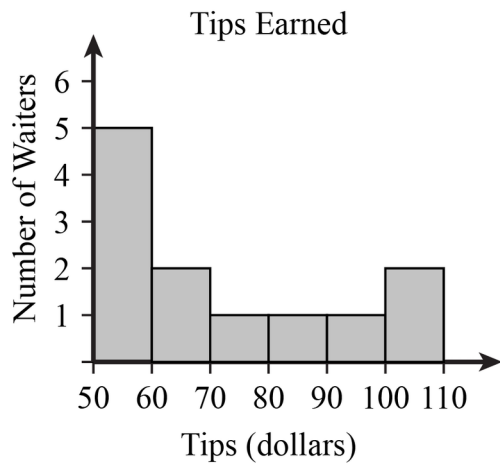
Which histogram best represents the data recorded?

A.



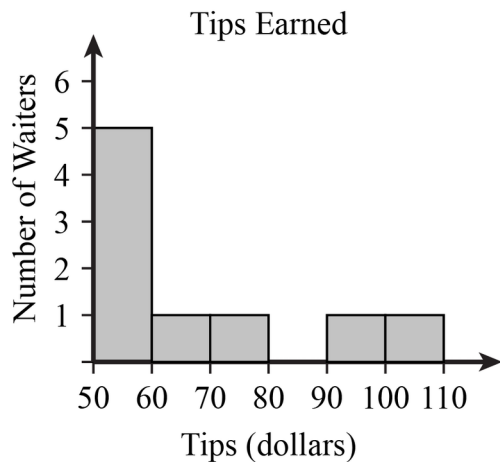
Student chose a histogram in which the values \$60.16, \$80.06, and \$100.02 are in the lower range of values; student rounded down these values without recognizing they belonged in the upper range.

B.



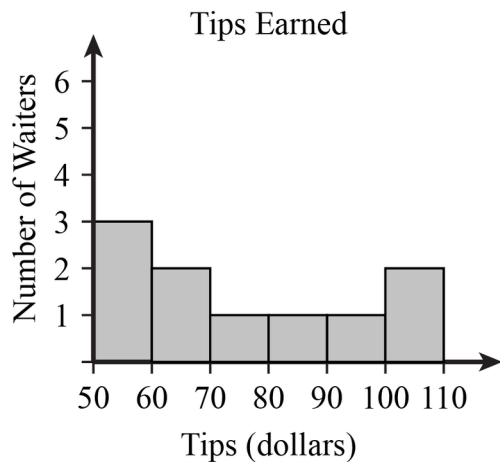
Correct.

C.



Student chose a histogram that does not graph values in which the dollar amount ends in zero (\$60.16, \$80.06, \$100.02); may have thought these values did not fall within the ranges on the x-axis, but that they belonged on the start/end point of each range and therefore could not be graphed.

D.



Student chose a histogram that graphs repeated values with a frequency of one, rather than graphing the repeated values \$52.70 and \$56.00 with a frequency of two.

**Item Id: i119561****Item Type: Selected Response**

Standards Description:

HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems.

Primary Standard: cc:HSA-CED.A.1

Points Possible: 1

At work, Elon takes a break  $\frac{1}{5}$  of each hour he works. He also takes a lunch break for  $\frac{1}{2}$  of an hour each day he works. Elon's break time totals  $12\frac{1}{2}$  hours at the end of 5 days.

Which equation could be used to determine the number of hours,  $h$ , Elon works during one 5-day work week?

A.  $\frac{1}{5}h + \frac{1}{2} = 12\frac{1}{2}$

Student selected an equation where  $h$  represents the number of hours Elon would have worked if he had taken only one half-hour lunch break during the week.

B.  $\frac{1}{5}h + 5\left(\frac{1}{2}\right) = 12\frac{1}{2}$

Correct.

C.  $5\left(\frac{1}{5}h + \frac{1}{2}\right) = 12\frac{1}{2}$

Student selected an equation where  $h$  represents the number of hours Elon worked each day instead of each week.

D.  $5\left(\frac{1}{5}h + \frac{1}{2}h\right) = 12\frac{1}{2}$

Student selected an equation where  $h$  represents the number of hours Elon worked each day instead of each week, and that indicates that Elon took a half-hour break for every hour he worked instead of taking one half-hour lunch break each day.

6

**Item Id: i128869****Item Type: Selected Response**

Standards Description:

HSA-REI.C.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

Primary Standard: cc:HSA-REI.C.6

Points Possible: 1

What is the solution to the system of equations below?

$$3x + 5y = -6$$

$$3x + y = 2$$

A.  $(\frac{4}{3}, -2)$

Correct.

B.  $(\frac{8}{9}, -\frac{2}{3})$

Student attempted to solve by elimination, "eliminating" the  $3x$  from each equation but then adding  $5y$  and  $y$  and then  $-6$  and  $2$  to find the value for  $y$  instead of subtracting.

C.  $(8, -2)$

Student correctly solved for  $y$  as  $-2$  but incorrectly substituted  $-2$  into  $x$  for the second equation to get  $8$  for the  $x$ -coordinate.

D. There are infinite solutions.

Student thought that the equations have the same slope because  $x$  has the same coefficient in the given equations, and thought that all equations with the same slope have infinite solutions.



7

**Item Id: i132721****Item Type: Math Short Answer**

Standards Description:

HSA-REI.C.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

Primary Standard: cc:HSA-REI.C.6

Points Possible: 1

Maia is comparing the costs for one month's usage of two cell phone companies. Company A charges \$40 per month plus \$8.50 per gigabyte of data used. Company B charges \$30 per month plus \$10.50 per gigabyte of data used.

How many gigabytes of data would have to be used for Company A and Company B to charge the same amount?

Respond in the space provided.

*If your test is on paper, write your answer on the answer sheet.*

**Correct Answer:**

5 gigabytes or equivalent.

8

**Item Id: i140009****Item Type: Multiple Select**

Standards Description:

HSS-ID.A.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.

Primary Standard: cc:HSS-ID.A.2

Points Possible: 1

Kiki is comparing the ages of all of the penguins at two local zoos using the data recorded below.

**Zoo A:** 0, 2, 3, 4, 6, 7, 7, 10, 11, 13, 13

**Zoo B:** 0, 0, 1, 2, 2, 3, 4, 5, 7, 8, 10, 11, 21

Based on this data, which statistics should Kiki use to compare the two data sets?

Select **all** that apply.

A. the means for both Zoo A and Zoo B

Student thought the extreme value (21) present in Zoo B's data and its skewed shape indicated mean would be preferable; did not understand that mean being sensitive to extreme values may make it a less useful tool for comparison when data is skewed.

**B. the medians for both Zoo A and Zoo B**

Correct.

C. the mean for Zoo A and the median for Zoo B

Student recognized that Zoo B is skewed such that median would be the preferred measure of center, but did not understand that the same measure of center for both data sets is necessary for a comparison.

- D. the standard deviations for both Zoo A and Zoo B      Student thought standard deviation would be preferable to interquartile range; may not understand that the shape of the distribution requires the use of interquartile range and median due to the skew and presence of an extreme value (21) in Zoo B's data.
- E. the interquartile ranges for both Zoo A and Zoo B**      Correct.
- F. the standard deviation for Zoo A and interquartile range for Zoo B      Student recognized that Zoo B is skewed such that the IQR would be the preferred measure of spread, but did not understand that the same measure of spread for both data sets is necessary for a comparison.

**Item Id: i119592****Item Type: Selected Response**

Standards Description:

HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

Primary Standard: cc:HSA-CED.A.2

Points Possible: 1

The table below shows a social media manager's prices for social media posts. The "Cost of Each Post" reflects what the manager charges per post. Additionally, the manager charges a "Base Price" that reflects the cost of the service, regardless of the number of posts.

Types of Posts	Cost of Each Post	Base Price
Posts with Words Only	\$5	\$5
Posts with Pictures Only	\$10	\$25
Posts with Words and Pictures	\$10	\$35

Samuel ordered 2 posts with **words only** and 2 posts with **pictures only**. After placing his order, Samuel realized he could have saved money if he, instead, ordered 2 posts with **words and pictures**. Let  $y$  represent Samuel's savings, in dollars, and let  $x$  represent the number of posts.

Which equation could be used to determine the amount of money Samuel could have saved if he ordered 2 posts with **words and pictures**, instead of his original order?

A.  $y = 5x - 5$

Correct.

B.  $y = 5x + 65$

Student wrote the initial equation correctly as  $y = [(5x + 5) + (10x + 25)] - (10x + 35)$  but only distributed the negative sign to  $10x$  before simplifying and failed to recognize the unreasonableness of the outputs of this equation within the context.

C.  $y = -5x + 25$

Student wrote the initial equation incorrectly, using the base price as the coefficient of  $x$  and the cost of each post as the constant to get  $y = [(5x + 5) + (25x + 10)] - (35x + 10)$ , only distributed the negative sign to  $35x$ , and then simplified.

D.  $y = 2x$

Student wrote the initial equation incorrectly, using 2 from the context as the coefficient for  $x$  and combining the cost of each post and base price in each row to be used as the constant to get  $y = [(2x + 10) + (2x + 35)] - (2x + 45)$ , and then simplified.

10

**Item Id: i129163**

**Item Type: Selected Response**

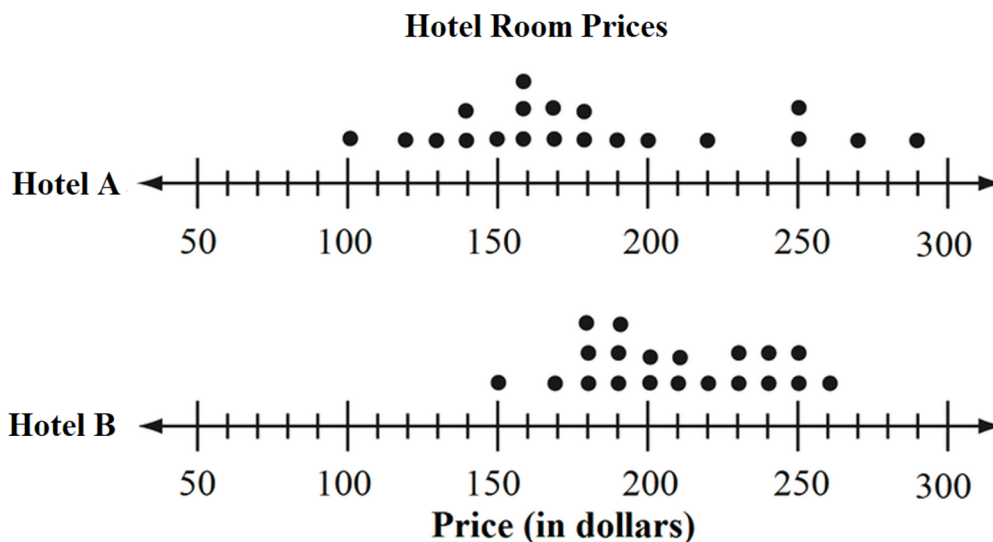
Standards Description:

HSS-ID.A.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

Primary Standard: cc:HSS-ID.A.3

Points Possible: 1

Derek is comparing hotel room prices for Hotel A and Hotel B. He took random samples of 20 room prices for the two hotels and recorded their prices, rounded to the nearest ten dollars, on the dot plots below.



Which statement **best** compares the hotel room prices?

- |   |  |
|---|--|
| <p>A. Hotel room prices for both hotels tend to cost about the same amount and vary equally.</p>                    | <p>Student did not take into account variability and only looked at where most values fall for both hotels.</p>  |
| <p>B. Hotel room prices for Hotel A tend to be less expensive and vary less than hotel room prices for Hotel B.</p> | <p>Student did not recognize that the hotel room prices of Hotel A tend to vary more than the hotel room prices of Hotel B; may have confused the concept of more variability with less variability.</p> |

**C. Hotel room prices for Hotel A tend to be less expensive and vary more than hotel room prices for Hotel B.**

Correct.

D. Hotel room prices for Hotel A tend to be more expensive and vary more than hotel room prices for Hotel B.

Student may have concluded that because Hotel A has a greater maximum value, its hotel room prices tend to be more expensive.

11

**Item Id: i119574****Item Type: Constructed Response**

Standards Description:

HSA-CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.

Standard(s) for Mathematical Practice:

MP4 Model with mathematics.

Students must create inequalities and equations that model the given constraints.  
Students must interpret solutions in the context of the constraints.

11A

Primary Standard: cc:HSA-CED.A.3

Points Possible: 2

Cole needs to include at least 11 mg and at most 22 mg of iron in his diet each day. Cole plans to eat multiple bananas daily, and each banana has 0.3 mg of iron. Cole will get the rest of his iron from vitamins. Each whole vitamin contains 4 mg of iron.

**Part A**

If Cole eats 3 bananas each day, what is the least number of whole vitamins he must take in order to stay within his daily iron requirement? What is the greatest number of whole vitamins he can take in order to stay within his daily iron requirement? Use inequalities to solve.

Respond in the space provided.

**Exemplar Student Response:**

*Equivalent answers and alternate explanations are also accepted. When prompted, answers may vary due to rounding or estimation.*

$b$  = number of bananas

$v$  = number of vitamins

$$11 \leq 0.3b + 4v$$



$$11 \leq 0.3(3) + 4v$$

$$11 \leq 0.9 + 4v$$

$$10.1 \leq 4v$$

$$2.525 \leq v$$

Cole should take at least 3 vitamins.

$$22 \geq 0.3b + 4v$$

$$22 \geq 0.3(3) + 4v$$

$$22 \geq 0.9 + 4v$$

$$21.1 \geq 4v$$

$$5.275 \geq v$$

Cole should take at most 5 vitamins.

**Evidence Statement(s):**

1. Student wrote inequalities representing the least and greatest amount of vitamins Cole should take to stay within his daily requirement.
2. Student solved inequalities in order to determine the least and greatest amount of vitamins Cole should take in order to stay within his daily requirement.

**Common Misconception(s):**

- Student set up inequalities incorrectly. They may have used 3 as the coefficient of  $b$  and attempted to solve, instead of using 0.3 as the coefficient of  $b$  and substituting 3 for  $b$ .
- Student made a mistake when solving the inequalities, or did not finish isolating  $v$  in one or both inequalities.
- Student misinterpreted the meaning of the solutions of the inequalities. They may have rounded down to 2 vitamins, instead of recognizing that  $v$  must be the closest whole number of vitamins greater than 2.525, or they may have rounded up to 6 vitamins, instead of recognizing that  $v$  must be the closest whole number of vitamins less than 5.275.

Primary Standard: cc:HSA-CED.A.3

Points Possible: 2

**Part B**

Cole continues to eat 3 bananas each day. He pays \$2 for every 3 bananas he buys. His first 10 vitamins are free, but if he purchases more than 10 vitamins in 1 week, he pays an additional dollar for every 2 additional vitamins he purchases.

- Write an equation to describe the total amount of money Cole spends on bananas and vitamins each week.
- If Cole spends a total of \$20 on bananas and vitamins this week and he takes the same number of whole vitamins each day, will he be able to meet his iron requirement every day this week, based on your answer in Part A?

Respond in the space provided.

**Exemplar Student Response:**

*Equivalent answers and alternate explanations are also accepted. When prompted, answers may vary due to rounding or estimation.*

$s$  = total Cole spends each week

$b$  = number of bananas he purchases each week

$v$  = number of vitamins he purchases each week

$$s = \frac{2b}{3} + \frac{v - 10}{2}$$

$$s = \frac{2(21)}{3} + \frac{v - 10}{2}$$

$$s = 14 + \frac{v - 10}{2}$$

If Cole spends \$20 this week:

$$20 = 14 + \frac{v - 10}{2}$$

$$6 = \frac{v - 10}{2}$$

$$12 = v - 10$$

$$22 = v$$

Cole will purchase 22 vitamins this week.

$$22 \div 7 \approx 3.14$$

Cole will be able to take 3 vitamins per day this week. Since he should take 3, 4, or 5 vitamins each day, he will be able to meet his iron requirement every day this week.

**Evidence Statement(s):**

1. Student created an equation to model the total amount of money Cole spends on bananas and vitamins each week, substituting 21 for the number of bananas he purchases this week.
2. Student substituted 20 as the total Cole spends for the week, and interpreted the solution as the number of vitamins he will buy for the week.
3. Student determined the number of vitamins Cole will be able to take each day and compared that to their answer in Part A in order to determine that Cole will be able to meet his daily iron requirement.

**Common Misconception(s):**

- Student modeled "\$2 for every 3 bananas" incorrectly when creating their equation, and/or student modeled "more than 10 vitamins in 1 week, he pays an additional dollar for every 2 additional vitamins" incorrectly when creating their equation.
- Student did not interpret 22 as the number of vitamins Cole buys for the week, and did not use 22 to determine about how many vitamins Cole could take each day.
- Student did not compare 3.14 to the number of vitamins Cole must take per day, found in their work for Part A.

12

**Item Id: i129116****Item Type: Selected Response**

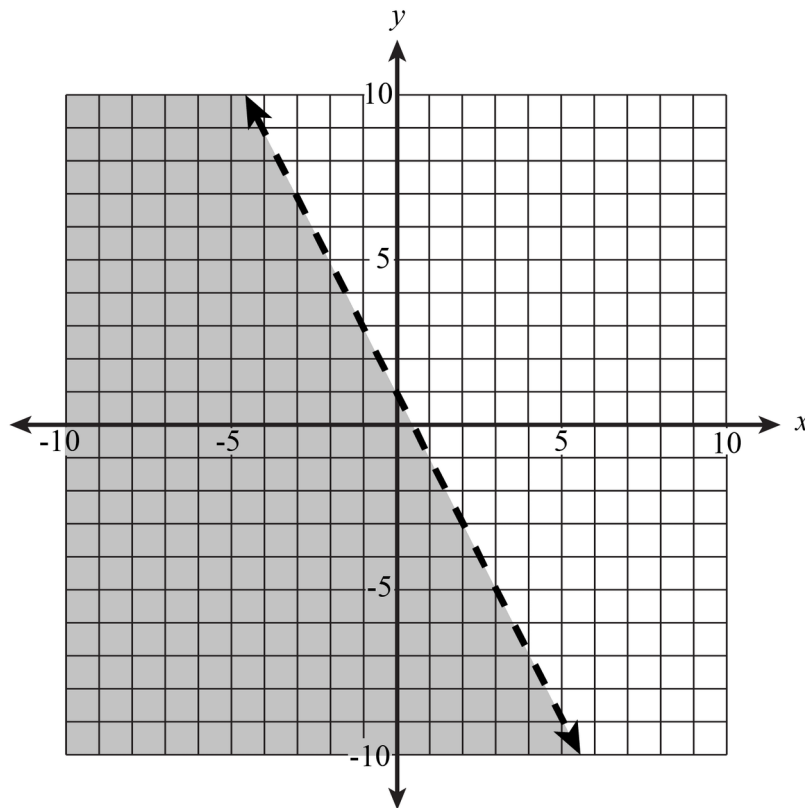
Standards Description:

HSA-REI.D.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Primary Standard: cc:HSA-REI.D.12

Points Possible: 1

Which inequality is represented by the graph below?

A.  $y \leq 2x + 1$ 

Student identified the slope as positive instead of negative and believed the solution set includes the points on the line instead of only those below the line.

**B.**  $y \leq -2x + 1$

Student thought the solution set includes the points on the line instead of only those below the line.

**C.**  $y < 2x + 1$

Student identified the slope as positive instead of negative.

**D.**  $y < -2x + 1$

Correct.

**Item Id: i131782****Item Type: Selected Response**

Standards Description:

HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems.

Primary Standard: cc:HSA-CED.A.1

Points Possible: 1

Jacob has taken three math tests, and the total sum of his scores is 235. He will be taking a fourth math test and wants his new average math test score to be at least 80.

Which inequality correctly represents  $s$ , the scores for Jacob's fourth math test that will give him an average of at least 80?

A.  $\frac{235 + s}{4} \leq 80$

Student chose an inequality that represents getting an average no greater than 80, instead of "at least 80."

B.  $\frac{235 + s}{4} \geq 80$

Correct.

C.  $\frac{235}{4} + s \leq 80$

Student chose an inequality that represents dividing 235 by the total number of tests (4) before adding the fourth test,  $s$ , and getting an average no greater than 80, instead of "at least 80."

D.  $\frac{235}{4} + s \geq 80$

Student chose an inequality that represents dividing 235 by the total number of tests (4) before adding the fourth test,  $s$ .

**Item Id: i129112****Item Type: Multiple Select**

Standards Description:

HSA-REI.D.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

Primary Standard: cc:HSA-REI.D.10

Points Possible: 1

Kara is graphing the equation  $|x| + |y| = a$ , where  $a$  is a real number.

Which of the following statements are true?

Select **all** that apply.

A. If  $a = 0$ , there are no points on the graph.

Student thought that the y-intercept indicates the number of solutions.

B. If  $a > 0$ , there are no points on the graph.

Student did not consider that  $|x|$  and  $|y|$  are each nonnegative for all real numbers  $x$  and  $y$ , and therefore, the sum must be nonnegative for all real numbers, meaning there are infinitely many solutions when  $a > 0$ .

C. If  $a < 0$ , there are no points on the graph.

Correct.

D. If  $a = 0$ , there is exactly one point on the graph.

Correct.

E. If  $a > 0$ , there is exactly one point on the graph.

Student did not consider that  $|x|$  and  $|y|$  are each nonnegative for all real numbers  $x$  and  $y$ , and therefore, the sum must be nonnegative for all real numbers, meaning there are infinitely many solutions when  $a > 0$ .



F. If  $a < 0$ , there are infinitely many points on the graph.

Student did not consider that  $|x|$  and  $|y|$  are each nonnegative for all real numbers  $x$  and  $y$ , and therefore, the sum must be nonnegative for all real numbers, meaning there are no solutions when  $a < 0$ .

**G. If  $a > 0$ , there are infinitely many points on the graph.**

Correct.

15

**Item Id: i128857****Item Type: Math Short Answer**

Standards Description:

HSA-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Primary Standard: cc:HSA-REI.B.3

Points Possible: 1

What is the value of  $p$  in the equation below?

$$\frac{4}{5}p + 6 = -\frac{1}{3}p - 3$$

Respond in the space provided.

*If your test is on paper, write your answer on the answer sheet.***Correct Answer:**

$$p = -\frac{135}{17} \text{ or equivalent.}$$

**Item Id: i128851****Item Type: Selected Response**

Standards Description:

HSA-CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.

Primary Standard: cc:HSA-CED.A.3

Points Possible: 1

Tamlin is learning to become a carpenter. She gets paid \$12 per hour for building shelves and \$14 per hour for building cabinets. She can work a maximum of 40 hours per week, and she would like to earn at least \$250 this week.

Let  $s$  represent the number of hours she spends building shelves and  $c$  represent the number of hours she spends building cabinets. Which system of inequalities could be used to represent the given conditions?

A. Student did not incorporate the hourly rates into the inequality representing the amount she will earn.

$$s + c \leq 40$$

$$s + c \geq 250$$

B. Correct.

$$s + c \leq 40$$

$$12s + 14c \geq 250$$

C. Student confused the maximum number of hours with the minimum amount Tamlin would like to earn.

$$s + c \leq 250$$

$$12s + 14c \geq 40$$

D.

$$s + c \geq 250$$

$$12s + 14c \leq 40$$

Student confused the maximum number of hours with the minimum amount Tamlin would like to earn, and switched the symbols for "at most" and "at least."

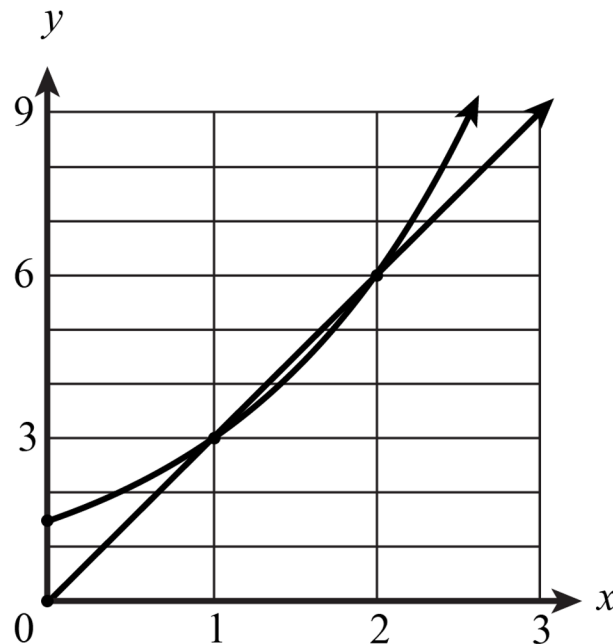
**Item Id: i129960****Item Type: Multiple Select**

Standards Description:

HSA-REI.D.11 Explain why the  $x$ -coordinates of the points where the graphs of the equations  $y = f(x)$  and  $y = g(x)$  intersect are the solutions of the equation  $f(x) = g(x)$ ; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where  $f(x)$  and/or  $g(x)$  are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

Primary Standard: cc:HSA-REI.D.11

Points Possible: 1

Examine the graph of the equations  $y = f(x)$  and  $y = g(x)$  below.Which of the following are solutions to the equation  $f(x) = g(x)$ ?Select **all** that apply.

A.  $x = 0$

Student selected the x-value for the y-intercepts or believed that the line passing through the origin indicated a solution.

B.  $x = 1$

Correct.

C.  $x = \frac{3}{2}$

Student selected the y-value for the y-intercept of the curve.

D.  $x = 2$

Correct.

E.  $x = 3$

Student identified a correct point, but selected the y-value for the first intersection and may have confused input with output.

F.  $x = 6$

Student identified a correct point, but selected the y-value for the second intersection and may have confused input with output.

18

**Item Id: i119569****Item Type: Selected Response**

Standards Description:

HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Primary Standard: cc:HSA-CED.A.4

Points Possible: 1

The formula for finding the perimeter,  $P$ , of a rectangle with length,  $l$ , and width,  $w$ , is given below.

$$P = 2l + 2w$$

Which formula shows how the width of the rectangle can be determined from the length and the perimeter?

A.  $w = \frac{P - 2}{2l}$

Student divided both sides by 2 but switched 2 and  $2l$ .

B.  $w = \frac{P}{2} + l$

Student divided both sides by 2 but added  $l$  to  $P/2$  instead of subtracting.

C.  $w = \frac{P - 2l}{2}$

Correct.

D.  $w = \frac{P}{2} - 2l$

Student only divided  $P$  and  $2w$  by 2 before subtracting  $2l$  from both sides of the equation.

**Item Id: i129117****Item Type: Selected Response**

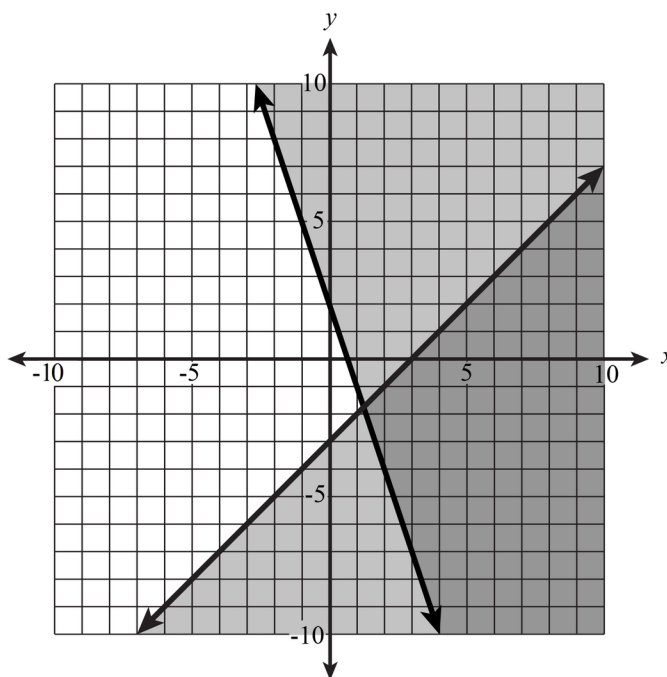
Standards Description:

HSA-REI.D.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Primary Standard: cc:HSA-REI.D.12

Points Possible: 1

Which system of inequalities is represented by the graph below?

**A.**

Correct.

$$y \geq -3x + 2$$

$$y \leq x - 3$$



B.

$$y \leq -3x + 2$$

$$y \geq x - 3$$

Student correctly identified the solution set as including the points on the given lines but mistakenly identified the solution set as including the intersection of the area below the negatively-sloped line and the area above the positively-sloped line.

C.

$$y \leq -3x + 2$$

$$y \leq x - 3$$

Student correctly identified the solution set as including the points on the given lines but mistakenly identified the solution set as including the intersection of the area below the negatively-sloped line and the area below the positively-sloped line.

D.

$$y > -3x + 2$$

$$y < x - 3$$

Student thought the solution set does not include the points on the given lines.

20

**Item Id: i128881****Item Type: Constructed Response**

Standards Description:

HSA-REI.A.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

Standard(s) for Mathematical Practice:

MP6 Attend to precision.

Students must precisely communicate the reasoning for each step involved in their solution(s).

Primary Standard: cc:HSA-REI.A.1

Points Possible: 2

Find the solution(s) for the equation below. Explain each step in your reasoning.

$$(y - 4)(5y + 6) = 0$$

Respond in the space provided.

**Exemplar Student Response:**

*Equivalent answers and alternate explanations are also accepted. When prompted, answers may vary due to rounding or estimation.*

$$y = 4 \text{ or } y = -\frac{6}{5}$$

If either of the expressions in parentheses is equal to zero, then the equation is true. Setting each expression equal to zero and solving for  $y$  finds the possible solutions.

$$y - 4 = 0$$

Add 4 to each side, so both sides still equal each other.

$$y = 4$$

OR

$$5y + 6 = 0$$

Subtract 6 from each side, so both sides still equal each other.

$$5y = -6$$

Divide both sides by 5, so both sides still equal each other.

$$y = -\frac{6}{5}$$

**Evidence Statement(s):**

1. Student provided an explanation that demonstrates an understanding of equality at each step as well as an understanding of the Zero Product Property, namely that if either  $(y - 4)$  or  $(5y + 6)$  equal 0, the equation will equal 0.
2. Student found the two possible solutions.

**Common Misconception(s):**

- Student demonstrated an ability to manipulate the equation in a way that preserves equality but does not find the correct solutions.
- Student found the solutions for the equation but did not provide reasoning that demonstrates an understanding of why each step preserves equality.
- Student only found one possible value for  $y$ .

# Interim Assessment 2

## Mathematics

### Algebra I

student: \_\_\_\_\_

teacher: \_\_\_\_\_

school: \_\_\_\_\_



**DIRECTIONS**

In this assessment you will answer a total of 14 questions, including 2 constructed-response question(s). Mark all of your answers to the questions on the answer sheet provided.

You may use this test booklet to work out the questions, but remember to mark all of your answers on the answer sheet. For constructed-response questions, record your answers directly on the page in the test booklet.

***Calculator Section***

*You may use a calculator to solve the questions in this section.*



1. If  $f(x) = \frac{x^2}{2} - 13$ , what is the value of  $f(6)$ ?

Respond in the space provided.

*If your test is on paper, write your answer on the answer sheet.*

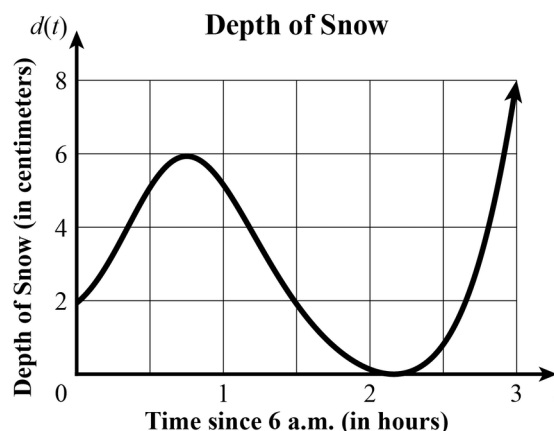
2. Morgan wants to sell his bike and does research online to determine what his selling price should be. He finds 25 bikes of the same bike model listed, along with their ages, in years, and listed prices, in dollars. He finds the equation of the regression line, shown below, where  $p$  represents the predicted price and  $y$  represents the age of the bike, in years.

$$p = 800 - 50y$$

Which of the following is the best interpretation of the rate of change of the equation of the regression line in the context of the problem?

- A. The price of the bike was originally \$800.
- B. The price of the bike has decreased to \$750.
- C. As the age of the bike increases by one year, the price of the bike decreases by \$50.
- D. As the age of the bike increases by one year, the price of the bike increases by \$50.

3. The average depth of snow, in centimeters, on Alison's driveway one morning can be modeled by a function,  $d(t)$ , where  $t$  is the number of hours since 6 a.m. Below is a graph of the function  $d(t)$ .



Which statement must be true?

- A. The snow on Alison's driveway was deepest before 7 a.m.
- B. There was already about 2 centimeters of snow on Alison's driveway at 6 a.m.
- C. The depth of snow on Alison's driveway increased the most between 6 a.m. and 7 a.m.
- D. A total of about 8 centimeters of snow fell on Alison's driveway between 6 a.m. and 9 a.m.

4. Use the information below about  $c$  and  $d$  to answer the following questions.

$$c = \{ (2, 7), (3, 8), (4, 10), (3, 11) \}$$

$$d = \{ (2, 9), (3, 7), (4, 9), (5, 8), (6, 10) \}$$

**Part A**

- Give the domain and range for  $c$ .
- Is  $c$  a function? Explain how you know.

Respond in the space provided.

**Part B**

- Give the domain and range for  $d$ .
- Is  $d$  a function? Explain how you know.

Respond in the space provided.



5. Use the table below to answer the question.

$g$	0	1	2	3
$h$	100	95	85	87

If  $h$  is a function of  $g$ , what value belongs in the blank to make the statement below true?

$$h(\underline{\quad}) = 95$$

Respond in the space provided.

*If your test is on paper, write your answer on the answer sheet.*

**Non-Calculator Section**

You may **not** use a calculator to solve the questions in this section.



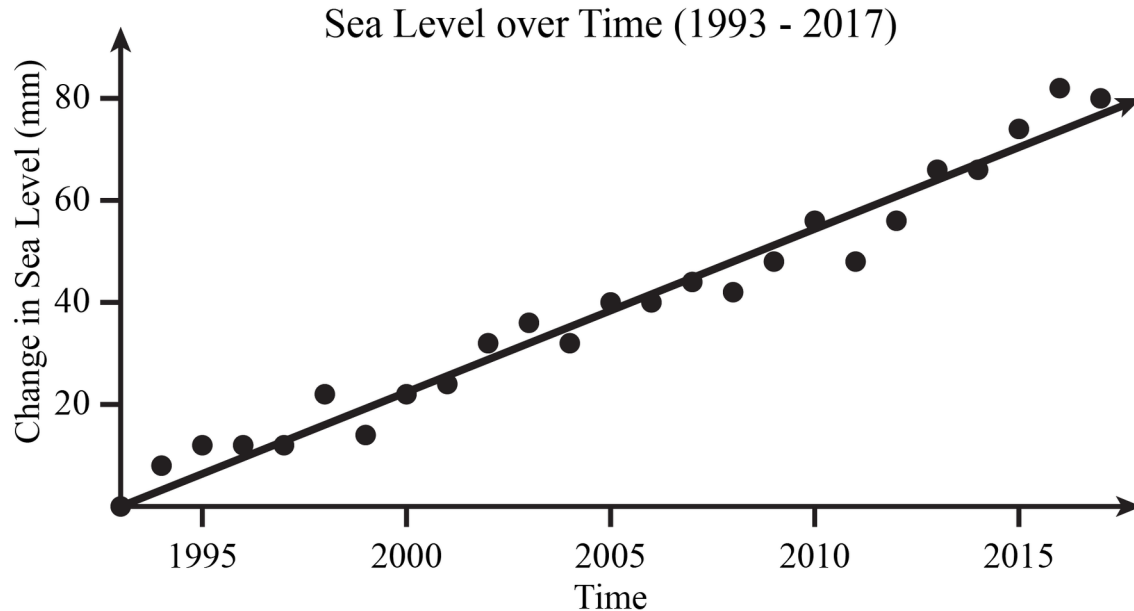
6. The function  $T(y)$  gives the end-of-year tablet sales, in thousands, at an electronics store  $y$  years after 2010 for  $-1 \leq y \leq 8$ . The table below represents the values of the function  $T(y)$ .

$y$	-1	0	1	2	3	4	5	6	7	8
$T(y)$	17	19	25	42	78	93	108	116	130	125

Which statement is true?

- A. No tablets were sold in 2009.
- B. The number of tablets sold increased each year.
- C. More people used a tablet sold by the store in 2017 than they did in 2018.
- D. The maximum number of tablet sales the store made occurred 7 years after 2010.

7. The scatter plot below represents the change in global sea level from 1993 to 2017.



The equation of the regression line is written below, where  $y$  represents the predicted change in sea level and  $t$  represents the years since 1993.

$$y = 0 + 3.2t$$

### Part A

Identify the  $y$ -intercept of the regression line and explain what it represents in the context of the data.

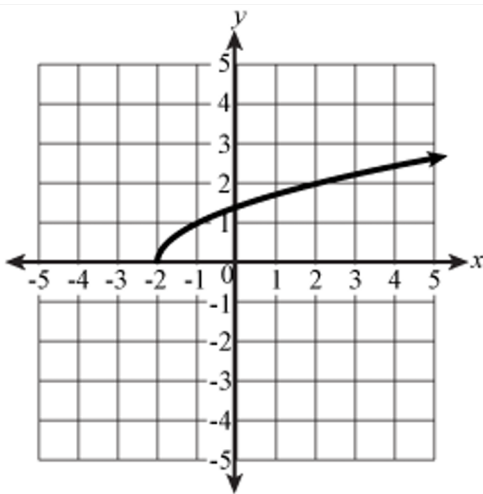
Respond in the space provided.

**Part B**

Identify the slope of the regression line and explain what it represents in the context of the data.

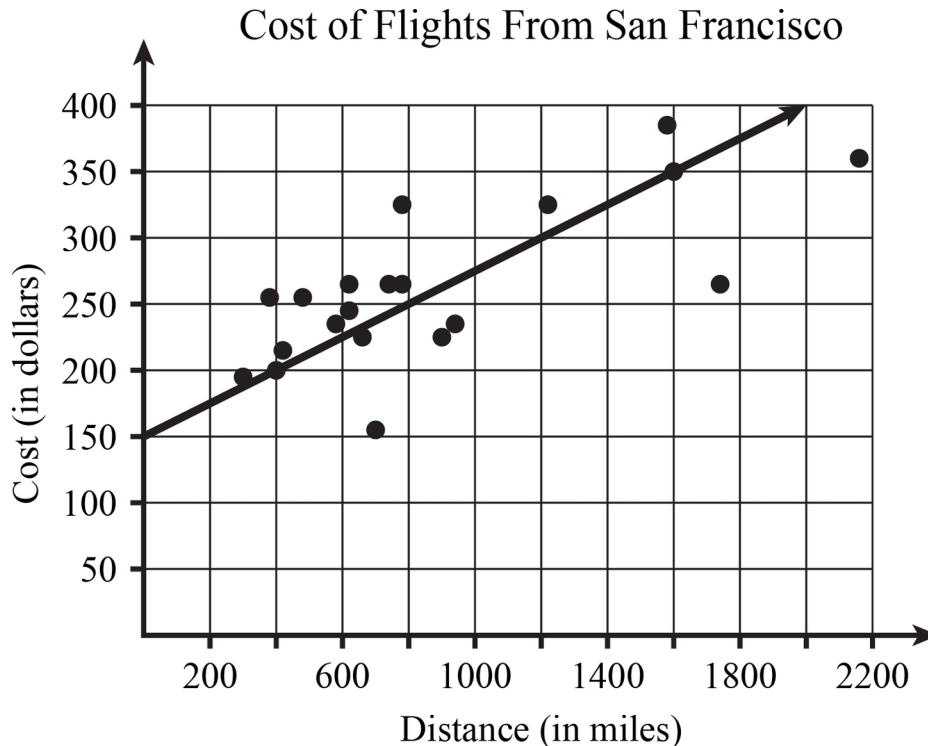
Respond in the space provided.

8. Which relationship can best be described as a causal relationship?
- A. the distance traveled and the time spent traveling
  - B. a student's grades in middle school and in high school
  - C. the number of people living in a home and the size of their TV
  - D. the time spent playing video games and time spent playing outside
9. Which function is represented by the graph shown below?



- A.  $f(x) = \sqrt{x+2}$
- B.  $f(x) = \sqrt{x-2}$
- C.  $f(x) = \sqrt{-x+2}$
- D.  $f(x) = \sqrt{-x-2}$

10. The scatter plot below represents the costs of one-way flights from San Francisco based on the distances, in miles, of the flights.



If  $c$  represents cost, in dollars, and  $d$  represents distance, in miles, which of the following functions best represents the regression line for the data in the scatter plot above?

- A.  $d = 190 + 8c$
- B.  $d = 150 + \frac{1}{8}c$
- C.  $c = 0 + 0.125d$
- D.  $c = 150 + 0.125d$

11. The data from a statistical study of the relationship between two quantities shows that the relationship is linear.

Which value of a correlation coefficient represents the strongest linear relationship between the two quantities?

- A.  $-0.9874$
- B.  $-0.1123$
- C.  $0.1473$
- D.  $0.9214$

12. If  $x$  represents the domain and  $y$  represents the range, which equations represent a function?

Select **all** that apply.

- A.  $y = x^2$
- B.  $|y| = x$
- C.  $y = 5^x$
- D.  $y = \pm\sqrt{x}$
- E.  $y = \frac{3}{5}x$

13. Function  $f$  is represented by the equation  $f(x) = |12 - 3x| - 7$ .

What is the ordered pair that represents the vertex of the graph of function  $f$ ?

Respond in the space provided.

*If your test is on paper, write your answer on the answer sheet.*

14. The results of a statistical study of the relationship between two quantities show there is a linear correlation between the two quantities.

Which statements are true?

Select **all** that apply.

- A. The relationship must be causal.
- B. The relationship cannot be causal.
- C. The relationship may or may not be causal.
- D. The correlation coefficient must be positive.
- E. The correlation coefficient must be negative.
- F. The correlation coefficient could be positive or negative.

Assessment Analysis Guide  
Interim Assessment 2  
**Mathematics**  
**Algebra I**



1

**Item Id: i117323****Item Type: Math Short Answer**

Standards Description:

HSF-IF.A.2

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

Primary Standard: cc:HSF-IF.A.2

Points Possible: 1

If  $f(x) = \frac{x^2}{2} - 13$ , what is the value of  $f(6)$ ?

Respond in the space provided.

*If your test is on paper, write your answer on the answer sheet.***Correct Answer:**

5

**Item Id: i129997****Item Type: Selected Response**

Standards Description:

HSS-ID.C.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

Primary Standard: cc:HSS-ID.C.7

Points Possible: 1

Morgan wants to sell his bike and does research online to determine what his selling price should be. He finds 25 bikes of the same bike model listed, along with their ages, in years, and listed prices, in dollars. He finds the equation of the regression line, shown below, where  $p$  represents the predicted price and  $y$  represents the age of the bike, in years.

$$p = 800 - 50y$$

Which of the following is the best interpretation of the rate of change of the equation of the regression line in the context of the problem?

- A. The price of the bike was originally \$800. Student interpreted the constant term, rather than the rate of change, in the context of the problem.
- B. The price of the bike has decreased to \$750. Student found the price of the bike after one year of age; student understood how to calculate using the rate of change, but did not interpret it in the context of the problem.
- C. As the age of the bike increases by one year, the price of the bike decreases by \$50.** Correct.
- D. As the age of the bike increases by one year, the price of the bike increases by \$50. Student interpreted an increase in price, rather than a decrease in price, with age.

3

Item Id: i139479

Item Type: Selected Response

Standards Description:

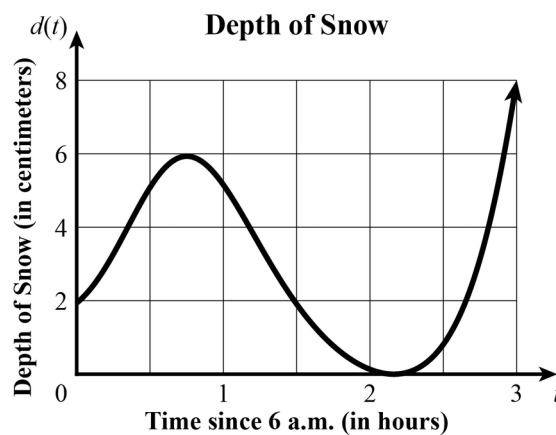
HSF-IF.B.4

For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.

Primary Standard: cc:HSF-IF.B.4

Points Possible: 1

The average depth of snow, in centimeters, on Alison's driveway one morning can be modeled by a function,  $d(t)$ , where  $t$  is the number of hours since 6 a.m. Below is a graph of the function  $d(t)$ .



Which statement must be true?

- A. The snow on Alison's driveway was deepest before 7 a.m. Student interpreted a relative maximum in snow depth as the absolute maximum in snow depth.
- B. There was already about 2 centimeters of snow on Alison's driveway at 6 a.m. Correct.

C. The depth of snow on Alison's driveway increased the most between 6 a.m. and 7 a.m.

Student recognized that the snow depth decreased after 7 a.m. and thought this meant that the amount of snow on the driveway increased the most in the first hour; did not recognize that more snow accumulated on the driveway between the second and third hour.

D. A total of about 8 centimeters of snow fell on Alison's driveway between 6 a.m. and 9 a.m.

Student interpreted the maximum depth on this interval as the total accumulation.

4

**Item Id: i119526****Item Type: Constructed Response**

Standards Description:

HSF-IF.A.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If  $f$  is a function and  $x$  is an element of its domain, then  $f(x)$  denotes the output of  $f$  corresponding to the input  $x$ . The graph of  $f$  is the graph of the equation  $y = f(x)$ .

Standard(s) for Mathematical Practice:

MP3 Construct viable arguments and critique the reasoning of others.

Student must provide evidence to support their claim about whether or not each relationship is a function.

MP6 Attend to precision.

Students must apply a clear and accurate definition of a function as they determine whether or not each relationship consists of a domain, or input values, that corresponds to exactly one element of the range, or output values.

4A

Primary Standard: cc:HSF-IF.A.1

Points Possible: 1

Use the information below about  $c$  and  $d$  to answer the following questions.

$$c = \{ (2, 7), (3, 8), (4, 10), (3, 11) \}$$

$$d = \{ (2, 9), (3, 7), (4, 9), (5, 8), (6, 10) \}$$

**Part A**

- Give the domain and range for  $c$ .
- Is  $c$  a function? Explain how you know.

Respond in the space provided.

**Exemplar Student Response:**

*Equivalent answers and alternate explanations are also accepted. When prompted, answers may vary due to rounding or estimation.*

$c$  has a domain of  $\{2, 3, 4\}$  and a range of  $\{7, 8, 10, 11\}$ .

$c$  is not a function because the input value of 3 corresponds to two output values, 8 and 11. This means that each element of the domain does not correspond to exactly one element of the range.

**Evidence Statement(s):**

1. Student named all the input values of  $c$  as the domain and all the output values of  $c$  as the range.
2. Student identified that  $c$  is not a function because each element of the domain does not correspond to exactly one element of the range.

**Common Misconception(s):**

- Student confused the definitions of domain and range; student named all input values of  $c$  as the range and named all output values of  $c$  as the domain.
- Student included the input value of 3 twice in the domain.
- Student thought that  $c$  is a function, perhaps because they thought that some elements of the domain could correspond to more than one element of the range.
- Student thought that  $c$  is a function, perhaps because they did not recognize that an element of the domain, 3, corresponded to two elements of the range, 8 and 11.

4B

Primary Standard: cc:HSF-IF.A.1

Points Possible: 1

**Part B**

- Give the domain and range for  $d$ .
- Is  $d$  a function? Explain how you know.

Respond in the space provided.

**Exemplar Student Response:**

*Equivalent answers and alternate explanations are also accepted. When prompted, answers may vary due to rounding or estimation.*

$d$  has a domain of  $\{2, 3, 4, 5, 6\}$  and a range of  $\{7, 8, 9, 10\}$ .

$d$  is a function because each element of the domain corresponds to exactly one element of the range.

**Evidence Statement(s):**

1. Student named all the input values of  $d$  as the domain and all the output values of  $d$  as the range.
2. Student identified that  $d$  is a function because each element of the domain corresponds to exactly one element of the range.

**Common Misconception(s):**

- Student confused the definitions of domain and range; student named all input values of  $d$  as the range and named all output values of  $d$  as the domain.
- Student included the output value of 9 twice in the range.
- Student thought that  $d$  is not a function, perhaps because the output value of 9 appears twice.
- Student thought that  $d$  is not a function, perhaps because they thought that each element of the range must correspond to exactly one element of the domain.

5

**Item Id: i117320****Item Type: Math Short Answer**

Standards Description:

HSF-IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

Primary Standard: cc:HSF-IF.A.2

Points Possible: 1

Use the table below to answer the question.

$g$	0	1	2	3
$h$	100	95	85	87

If  $h$  is a function of  $g$ , what value belongs in the blank to make the statement below true?

$$h(\underline{\quad}) = 95$$

Respond in the space provided.

*If your test is on paper, write your answer on the answer sheet.***Correct Answer:**

1



6

**Item Id: i139493****Item Type: Selected Response**

Standards Description:

HSF-IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.

Primary Standard: cc:HSF-IF.B.4

Points Possible: 1

The function  $T(y)$  gives the end-of-year tablet sales, in thousands, at an electronics store  $y$  years after 2010 for  $-1 \leq y \leq 8$ . The table below represents the values of the function  $T(y)$ .

$y$	-1	0	1	2	3	4	5	6	7	8
$T(y)$	17	19	25	42	78	93	108	116	130	125

Which statement is true?

A. No tablets were sold in 2009.

Student thought that  $y$  representing the years since 2010 indicated that 2010 was the first year anyone purchased a tablet from the store; did not recognize that  $y = -1$  would indicate 17 thousand tablets were sold in 2009.

B. The number of tablets sold increased each year.

Student recognized a general trend of increasing tablet sales, but did not see that tablet sales decreased in 2018.

C. More people used a tablet sold by the store in 2017 than they did in 2018.

Student interpreted the value of  $T(y)$  as the number of people, in thousands, who used a tablet in a given year, rather than the number of tablets sold.

**D. The maximum number of tablet sales the store made occurred 7 years after 2010.**

Correct.

7

**Item Id: i130000****Item Type: Constructed Response**

Standards Description:

HSS-ID.C.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

Standard(s) for Mathematical Practice:

MP2 Reason abstractly and quantitatively.

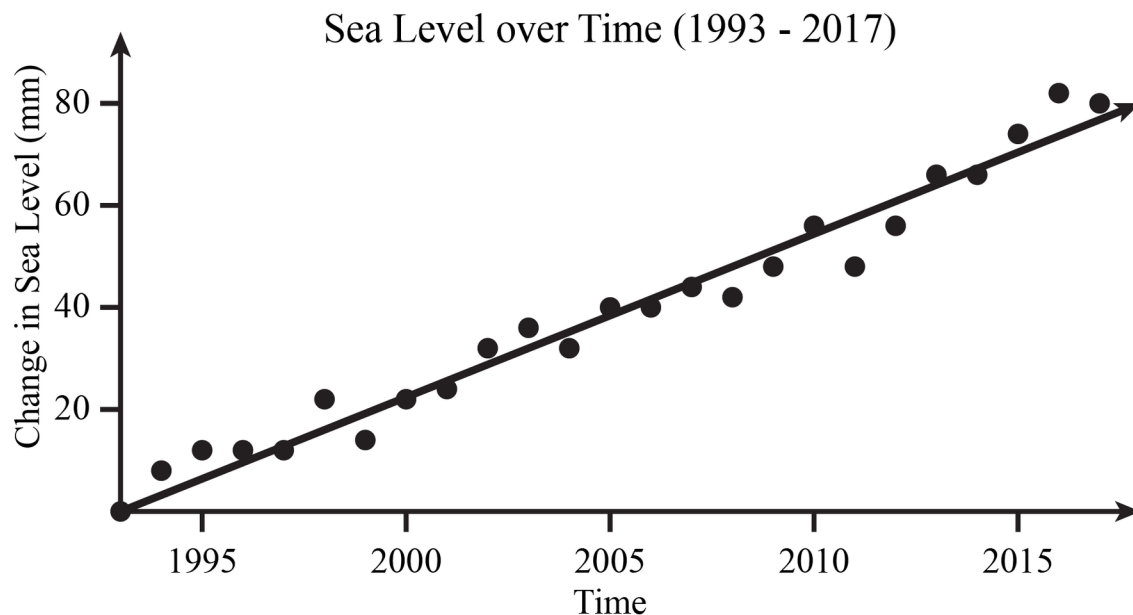
Students must identify and make sense of quantities and their relationships in the context of the data.

7A

Primary Standard: cc:HSS-ID.C.7

Points Possible: 2

The scatter plot below represents the change in global sea level from 1993 to 2017.



The equation of the regression line is written below, where  $y$  represents the predicted change in sea level and  $t$  represents the years since 1993.

$$y = 0 + 3.2t$$

**Part A**

Identify the  $y$ -intercept of the regression line and explain what it represents in the context of the data.

Respond in the space provided.

**Exemplar Student Response:**

*Equivalent answers and alternate explanations are also accepted. When prompted, answers may vary due to rounding or estimation.*

The  $y$ -intercept, 0, represents that all the data points for other years represented on the scatter plot are based on the sea level in 1993; the sea level in 1993 is the comparison point for the rest of the data.

**Evidence Statement(s):**

1. Student correctly identified the  $y$ -intercept.
2. Student explained the meaning of 0 in the situation; student explained that it represents that data for all other years in the scatter plot is based on the sea level in 1993.

**Common Misconception(s):**

- Student thought the  $y$ -intercept, 0, represents that the sea level in 1993 was 0.
- Student thought the  $y$ -intercept, 0, represents that there was 0 change in sea level in 1993.
- Student misidentified the  $y$ -intercept; may have thought the slope, 3.2, was the  $y$ -intercept.
- Student explained what the slope, 3.2, represents in the context of the data.

<b>7B</b>
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Primary Standard: cc:HSS-ID.C.7

Points Possible: 2

**Part B**

Identify the slope of the regression line and explain what it represents in the context of the data.

Respond in the space provided.

**Exemplar Student Response:**

*Equivalent answers and alternate explanations are also accepted. When prompted, answers may vary due to rounding or estimation.*

The slope, 3.2, represents the average change in sea level, in millimeters, per year since 1993.

**Evidence Statement(s):**

1. Student correctly identified the slope.
2. Student explained that the slope represents the annual change in sea level since 1993.

**Common Misconception(s):**

- Student did not recognize that the slope represents the annual change in sea level since 1993; may have identified that the change in sea level is 3.2 millimeters per year but did not include that this change has occurred since 1993.
- Student thought that the slope represented a decrease of 3.2 millimeters per year; did not recognize that the graph has a positive slope and therefore represents an increase in sea level.
- Student misidentified the slope; may have thought the  $y$ -intercept, 0, was the slope.
- Student explained what the  $y$ -intercept, 0, represents in the context of the data.

8

**Item Id: i133760****Item Type: Selected Response**

Standards Description:

HSS-ID.C.9 Distinguish between correlation and causation.

Primary Standard: cc:HSS-ID.C.9

Points Possible: 1

Which relationship can best be described as a causal relationship?

**A. the distance traveled and the time spent traveling**

Correct.

B. a student's grades in middle school and in high school

Student chose a relationship that is correlated but not necessarily causal; perhaps because the correlation is likely positive and they thought that positive correlations are causal.

C. the number of people living in a home and the size of their TV

Student thought that a relationship cannot be both correlated and causal, and so they chose the situation that is most likely not correlated.

D. the time spent playing video games and time spent playing outside

Student chose a relationship that is correlated but not necessarily causal; perhaps because the correlation is likely negative and they thought that negative correlations are causal.

**Item Id: i129957****Item Type: Selected Response**

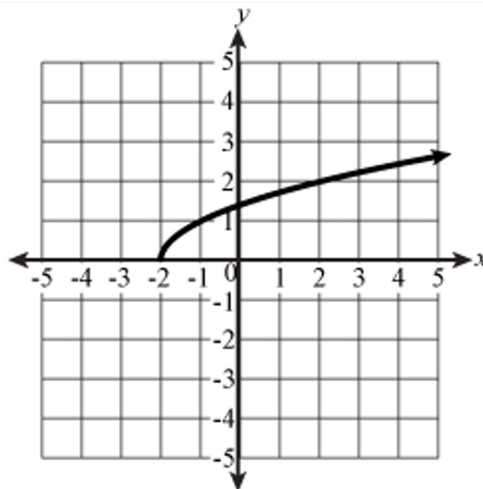
Standards Description:

HSF-IF.C.7.b Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

Primary Standard: cc:HSF-IF.C.7.b

Points Possible: 1

Which function is represented by the graph shown below?



A.  $f(x) = \sqrt{x + 2}$

Correct.

B.  $f(x) = \sqrt{x - 2}$

Student correctly chose a function with a positive rate of change but that includes the point (2, 0) instead of the point (-2, 0); perhaps thought that the constant term had to be -2 to represent the x-intercept (-2, 0).

C.  $f(x) = \sqrt{-x + 2}$

Student chose a function with a negative rate of change that includes the point (2, 0) instead of a function with a positive rate of change that includes the point (-2, 0); perhaps thought the square root symbol changed the -x to +x and +2 to -2.

$$D. f(x) = \sqrt{-x - 2}$$

Student correctly chose a function that includes the point  $(-2, 0)$  but with a negative rate of change instead of a function with a positive rate of change; perhaps thought the square root symbol changed the  $-x$  to  $+x$  and that the constant term had to be  $-2$  to represent the  $x$ -intercept  $(-2, 0)$ .

10

Item Id: i130008

Item Type: Selected Response

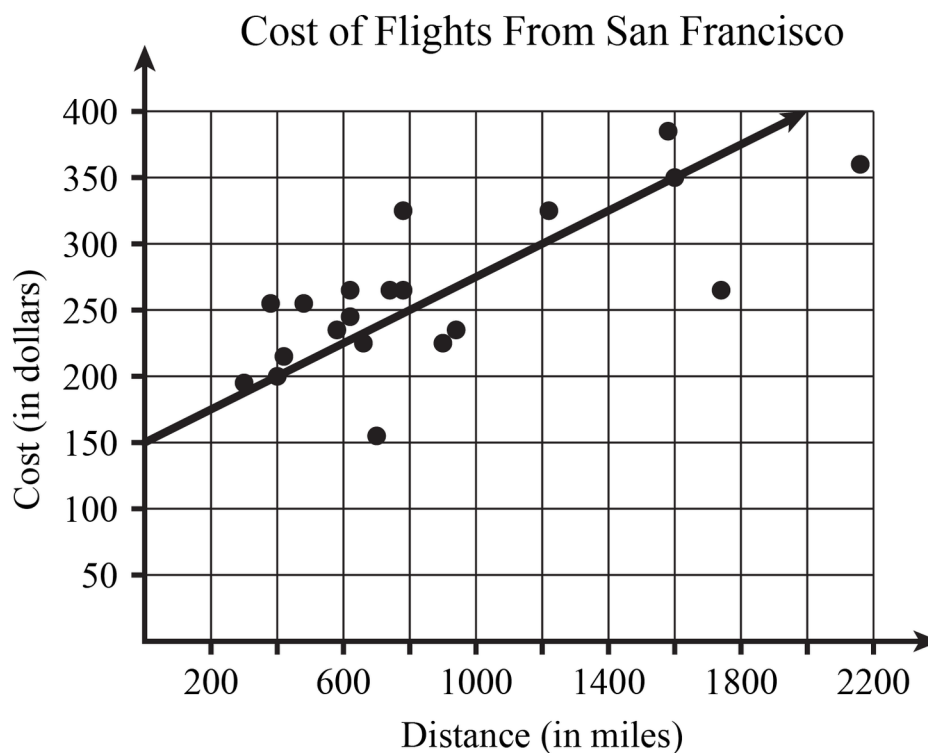
Standards Description:

HSS-ID.B.6.c Fit a linear function for a scatter plot that suggests a linear association.

Primary Standard: cc:HSS-ID.B.6.c

Points Possible: 1

The scatter plot below represents the costs of one-way flights from San Francisco based on the distances, in miles, of the flights.



If  $c$  represents cost, in dollars, and  $d$  represents distance, in miles, which of the following functions best represents the regression line for the data in the scatter plot above?



A.  $d = 190 + 8c$

Student picked a function that uses a y-intercept of 190 since that is approximately the y-coordinate of the first data point on the line (going from left to right) and a slope of 8; may have correctly calculated the slope to be 1/8 but misinterpreted that to mean a rate of change of 8 dollars per mile.

B.  $d = 150 + \frac{1}{8}c$

Student picked a function that uses an accurate y-intercept and slope but reverses the variables.

C.  $c = 0 + 0.125d$

Student picked a linear function that used an accurate slope, but that used an incorrect y-intercept; student may have thought that since the function is linear, the y-intercept must be zero.

D.  $c = 150 + 0.125d$

Correct.

11

**Item Id: i133746****Item Type: Selected Response**

Standards Description:

HSS-ID.C.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.

Primary Standard: cc:HSS-ID.C.8

Points Possible: 1

The data from a statistical study of the relationship between two quantities shows that the relationship is linear.

Which value of a correlation coefficient represents the strongest linear relationship between the two quantities?

A.  $-0.9874$ 

Correct.

B.  $-0.1123$ 

Student thought that the value that is closest to 0 represents the strongest relationship.

C.  $0.1473$ 

Student thought that the value that is positive and closest to 0 represents the strongest relationship.

D.  $0.9214$ 

Student thought that a strong relationship has to be positive and chose the greatest positive value.

**Item Id: i117336****Item Type: Multiple Select**

Standards Description:

HSF-IF.A.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If  $f$  is a function and  $x$  is an element of its domain, then  $f(x)$  denotes the output of  $f$  corresponding to the input  $x$ . The graph of  $f$  is the graph of the equation  $y = f(x)$ .

Primary Standard: cc:HSF-IF.A.1

Points Possible: 1

If  $x$  represents the domain and  $y$  represents the range, which equations represent a function?

Select **all** that apply.

A.  $y = x^2$

Correct.

B.  $|y| = x$

Student did not understand that for some inputs there are two corresponding outputs.

C.  $y = 5^x$

Correct.

D.  $y = \pm\sqrt{x}$

Student did not understand that for some inputs there are two corresponding outputs.

E.  $y = \frac{3}{5}x$

Correct.

**Item Id: i129952****Item Type: Math Short Answer**

Standards Description:

HSF-IF.C.7.b Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

Primary Standard: cc:HSF-IF.C.7.b

Points Possible: 1

Function  $f$  is represented by the equation  $f(x) = |12 - 3x| - 7$ .

What is the ordered pair that represents the vertex of the graph of function  $f$ ?

Respond in the space provided.

*If your test is on paper, write your answer on the answer sheet.*

**Correct Answer:** $(4, -7)$

**Item Id: i133769****Item Type: Multiple Select**

Standards Description:

HSS-ID.C.9 Distinguish between correlation and causation.

Primary Standard: cc:HSS-ID.C.9

Secondary Standard(s): cc:HSS-ID.C.8

Points Possible: 1

The results of a statistical study of the relationship between two quantities show there is a linear correlation between the two quantities.

Which statements are true?

Select **all** that apply.

A. The relationship must be causal.

Student thought that if there is a correlation there must also be causation.

B. The relationship cannot be causal.

Student thought that if there is a correlation there cannot also be causation.

**C. The relationship may or may not be causal.**

Correct.

D. The correlation coefficient must be positive.

Student thought only  $0 < r < 1$  translated to a correlation.

E. The correlation coefficient must be negative.

Student thought only  $-1 < r < 0$  translated to a correlation.**F. The correlation coefficient could be positive or negative.**

Correct.

# Interim Assessment 3

## Mathematics

### Algebra I

student: \_\_\_\_\_

teacher: \_\_\_\_\_

school: \_\_\_\_\_



**DIRECTIONS**

In this assessment you will answer a total of 26 questions, including 2 constructed-response question(s). Mark all of your answers to the questions on the answer sheet provided.

You may use this test booklet to work out the questions, but remember to mark all of your answers on the answer sheet. For constructed-response questions, record your answers directly on the page in the test booklet.

**Calculator Section**

You may use a calculator to solve the questions in this section.



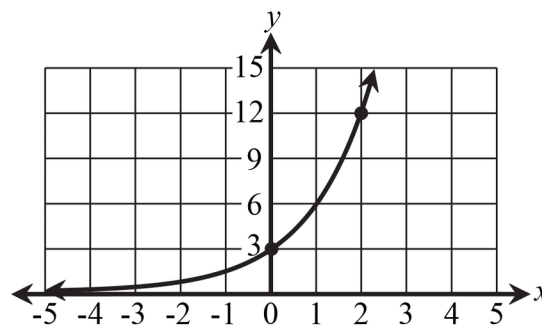
1. Use the table shown below to answer the following question.

$x$	$y$
-1	0.8
0	1.2
1	1.8
2	2.7

Which equation represents the relationship between the variables  $x$  and  $y$ ?

- A.  $y = 1.5x^2$   
 B.  $y = 0.8(0.4)^x$   
 C.  $y = 1.2(1.5)^x$   
 D.  $y = 1.5x + 1.2$

2. Use the graph shown below to answer the following question.



Which function represents the graph?

- A.  $f(x) = 2(3)^x$   
 B.  $f(x) = 3(2)^x$   
 C.  $f(x) = 3(4)^x$   
 D.  $f(x) = 4(3)^x$



3. Use the table below to answer the following question.

$x$	$h(x)$
-25	6
-13	0
-3	-5
0	-7
9	-14
11	-30

What is the average rate of change of  $h(x)$  over the interval  $-13 < x < 11$ ?

Respond in the space provided.

*If your test is on paper, write your answer on the answer sheet.*

4. Kira gathers data on the average annual cost to rent a one-bedroom apartment in Boston for each year since 2014. She finds the equation of the regression line for the data, and she writes the equation below so that  $c$  represents the predicted annual cost and  $y$  represents years since 2014.

$$c = 28,932 + 867.96y$$

Which of the following is the best interpretation of the term that represents the vertical intercept of the regression line in the context of the problem?

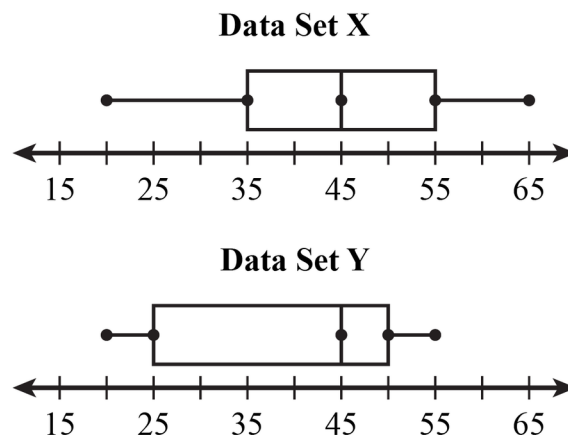
- A. The average annual cost of a one-bedroom apartment in Boston is \$28,932.
- B. The average annual cost of a one-bedroom apartment in Boston in 2014 was \$867.96.
- C. The average annual cost of a one-bedroom apartment in Boston in 2014 was \$28,932.
- D. The average annual cost of a one-bedroom apartment in Boston has increased \$867.96 every year since 2014.

5. There are 140 birds at the start of a repopulation project, and the population of birds increases by 4% each year.

Which of the following represents the population,  $p$ , at the end of 6 years?

- A.  $p = 140(0.04)^6$   
 B.  $p = 140(1 + 0.04)^6$   
 C.  $p = 140 + 6(1 + 0.04)$   
 D.  $p = 6(140 + 0.04)$

6. Use the box plots below.



Which statements must be true?

Select **all** that apply.

- A. The medians of Data Set X and Data Set Y are equal.  
 B. The mean of Data Set X is greater than the mean of Data Set Y.  
 C. The median of Data Set Y is greater than the median of Data Set X.  
 D. It cannot be determined whether Data Set X or Data Set Y has a greater mean.  
 E. The interquartile range of Data Set Y is greater than the interquartile range of Data Set X.  
 F. The interquartile range of Data Set X is greater than the interquartile range of Data Set Y.

7. Elena notices that when she spends less time on social media the night before a quiz, she gets a higher score. Before one quiz, she spent 107 minutes on social media and earned 37 points on a quiz. Before another quiz, she spent 73 minutes on social media and earned 41 points on a quiz.

Write a function to model a linear relationship between Elena's social media usage, in minutes, and her quiz scores, assuming that the total number of points on each quiz remains a constant.

Respond in the space provided.

8. Consider the functions defined by

$$f(x) = 2x - 2 \text{ and } g(x) = -\left(x - \frac{3}{2}\right)^2 + \frac{5}{3}.$$

Which of the following are approximate solutions to the equation  $f(x) = g(x)$ ?

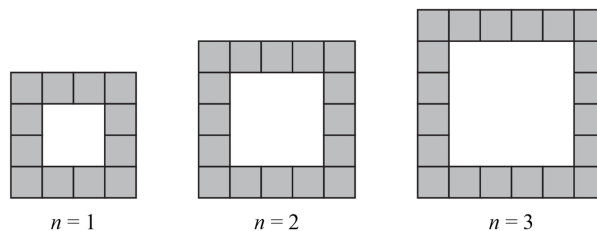
Select **all** that apply.

- A.  $x = -3.582$
  - B.  $x = -0.791$
  - C.  $x = 0.209$
  - D.  $x = 1.500$
  - E.  $x = 1.582$
  - F.  $x = 1.791$
  - G.  $x = 2.791$
9. Use the function  $f(x) = 2^x$  to answer the following question.

Over which interval is the average rate of change the greatest for  $f(x)$ ?

- A.  $-5 < x < -2$
- B.  $-1 < x < 0$
- C.  $0 < x < 5$
- D.  $3 < x < 5$

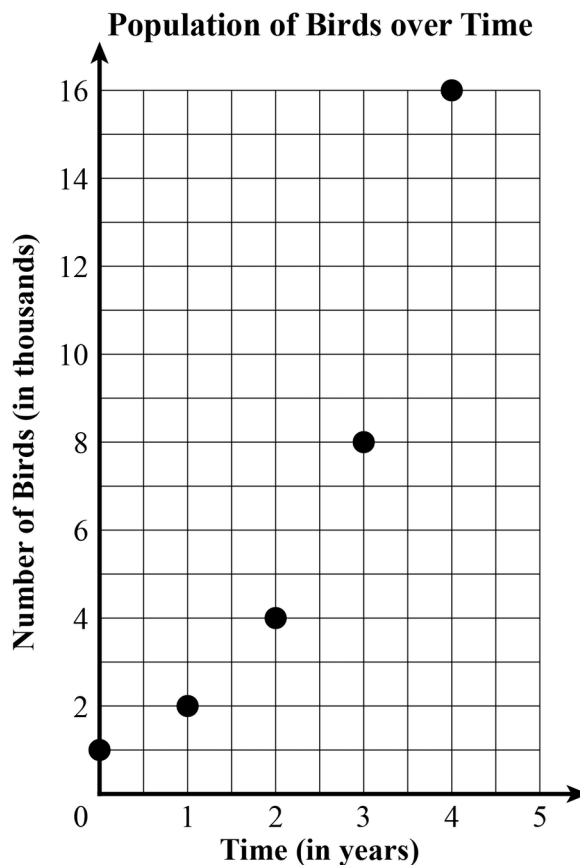
10. The diagrams below represent the first three terms of a sequence.



Assuming the pattern continues, which formula determines  $a_n$ , the number of shaded squares in the  $n$ th term?

- A.  $a_n = 4n$
- B.  $a_n = n + 4$
- C.  $a_n = 8n + 4$
- D.  $a_n = 4n + 8$

11. The graph below shows the yearly population of a particular breed of birds since the year 2016.



**Part A**

Write an equation that represents the relationship between the number of birds and time, in years, that is shown in the graph. Define all variables used in your equation.

Respond in the space provided.

**Part B**

If the relationship between the number of birds and time, in years, continues, how many birds will there be in year 9? Show or explain how you found your answer.

Respond in the space provided.

**Non-Calculator Section**

You may **not** use a calculator to solve the questions in this section.



12. The results of a linear regression analysis on the relationship between  $x$  and  $y$  are shown below.

$$y = a + bx$$

$$a = 0.952$$

$$b = -0.857$$

$$r^2 = 0.116$$

$$r = -0.341$$

Which statement best describes the relationship between  $x$  and  $y$ ?

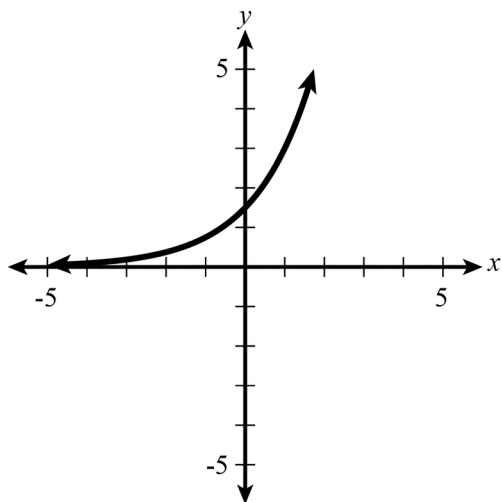
- A. There is a weak positive correlation.
- B. There is a weak negative correlation.
- C. There is a strong positive correlation.
- D. There is a strong negative correlation.

13. Use the function shown below to answer the following question.

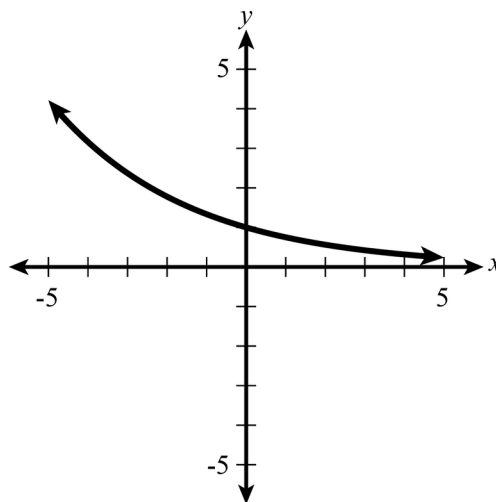
$$y = 1.5(0.5)^x$$

Which graph best represents the function?

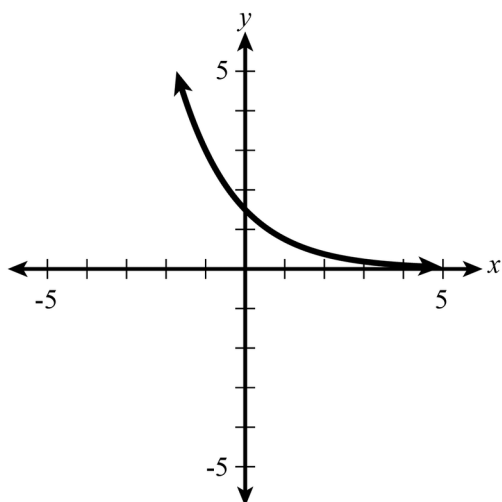
A.



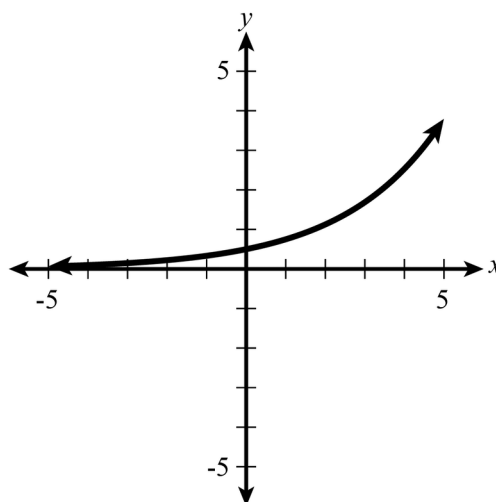
C.



B.

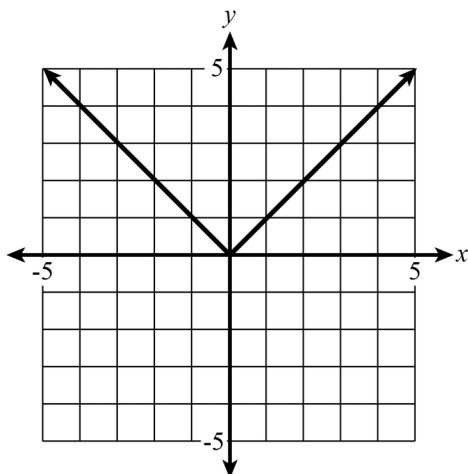


D.



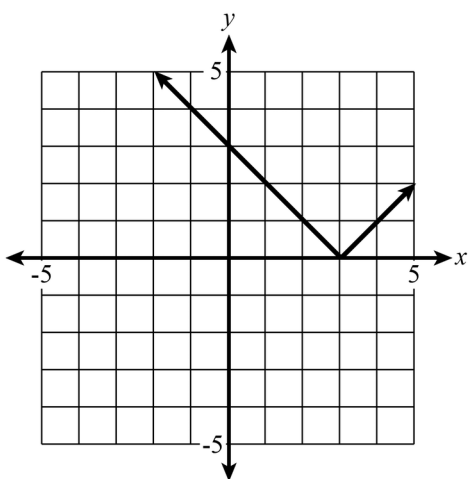


14. Below is the graph of the function  $f(x) = |x|$ .

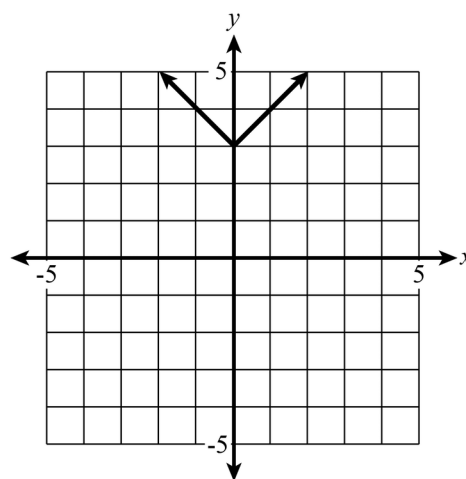


Which graph represents  $f(x - 3)$ ?

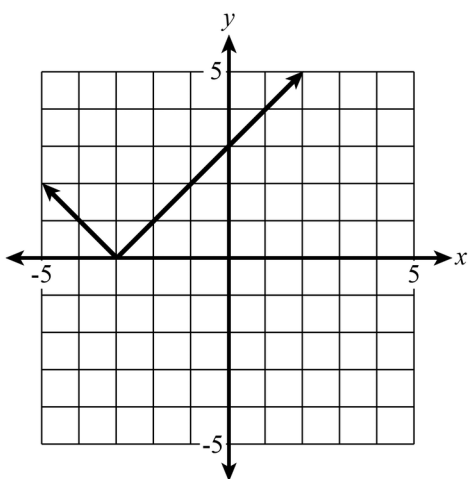
A.



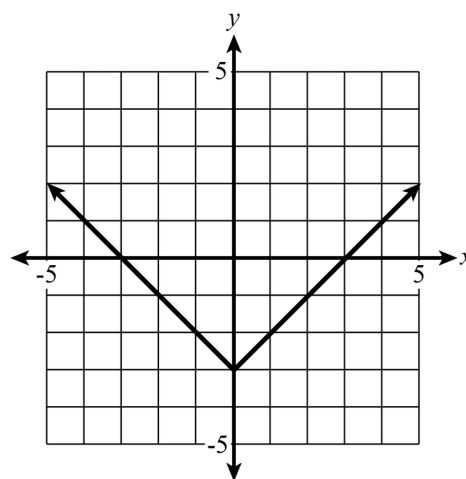
C.



B.



D.



15. A ball is dropped from a height of 10 feet. The height of the ball after it bounces is a function of the number of times it has bounced and can be modeled by the function  $h(b) = 10(0.7)^b$ . The ball stops bouncing after  $n$  bounces.

Which statement is true about the domain of  $h(b)$ ?

- A.  $\{b: b \text{ is any integer}\}$
  - B.  $\{b: b \text{ is any real number}\}$
  - C.  $\{b: b \text{ is any integer between 1 and } n, \text{ inclusive}\}$
  - D.  $\{b: b \text{ is any real number between 1 and } n, \text{ inclusive}\}$
16. Which of the following describes the relationship between the expressions in the equation below?

$$8x + 6 = (4x + 3)^2$$

- A.  $b = b^2$
- B.  $b^2 = b^2$
- C.  $b = 2b^2$
- D.  $2b = b^2$

17. The depth in feet,  $D$ , of a scuba diver can be modeled by the function

$$D(x) = -x^2 + 12x + 4, \text{ where } x \text{ is the number of seconds spent diving.}$$

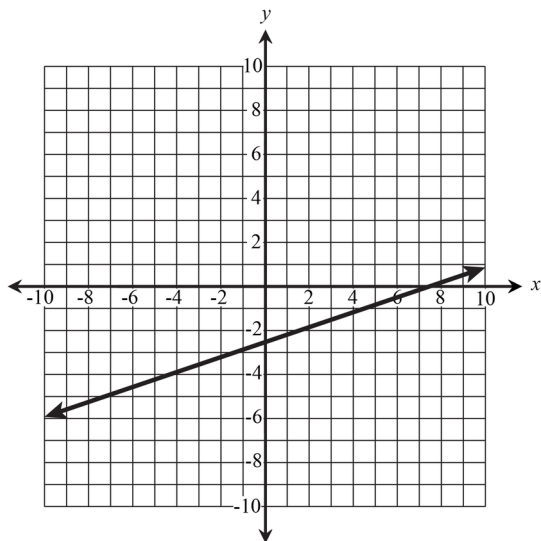
What is the number of seconds spent diving when the scuba diver reaches their maximum depth?

Respond in the space provided.

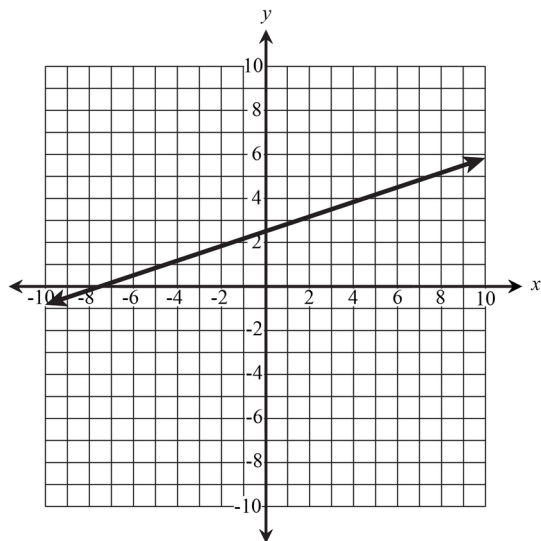
*If your test is on paper, write your answer on the answer sheet.*

18. Which graph represents the equation  $2x - 6y = 15$ ?

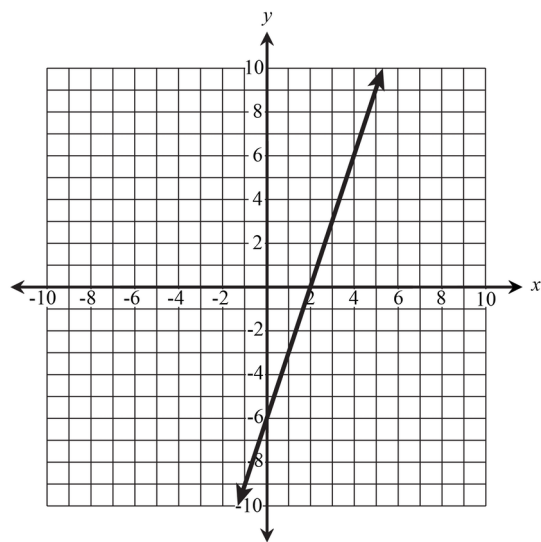
A.



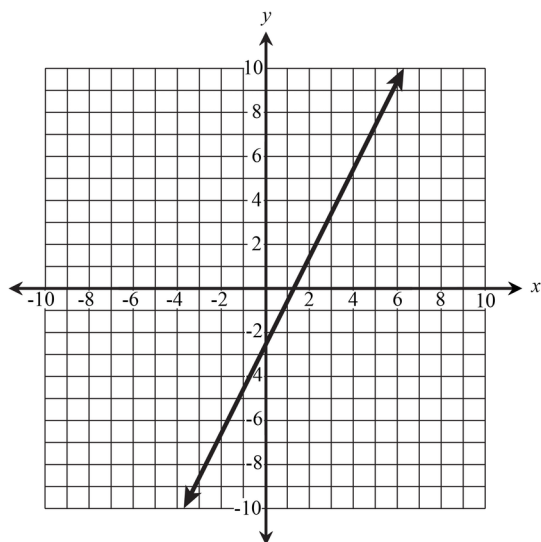
C.



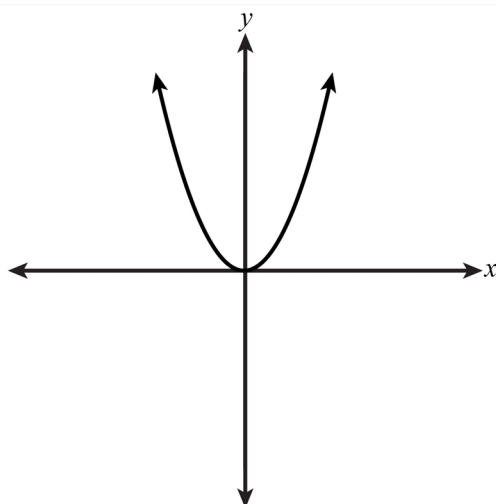
B.



D.

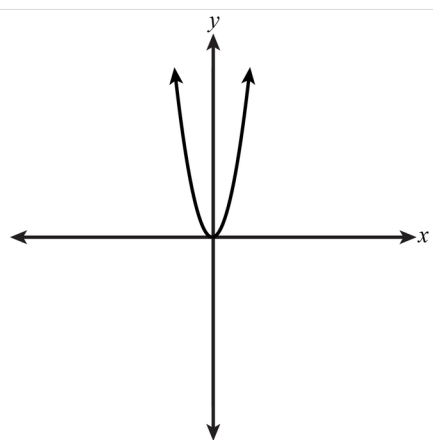


19. The diagram below shows the graph of  $f(x) = ax^2$ .

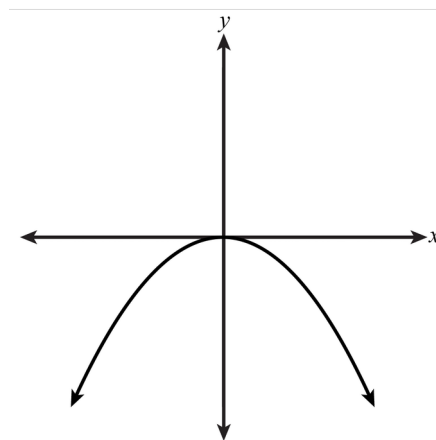


Which diagram represents the graph of  $kf(x)$ , given that  $k < -1$ ?

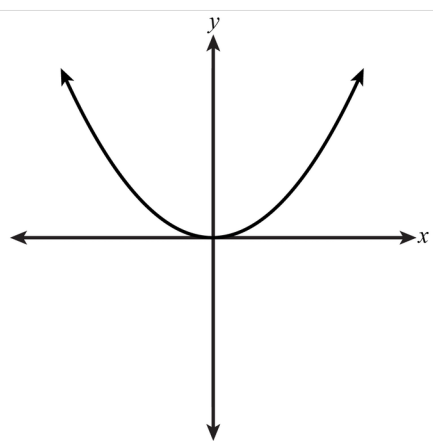
A.



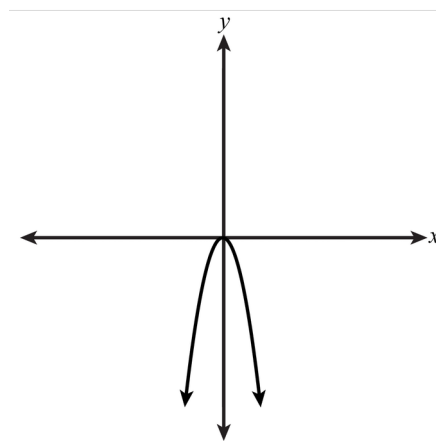
C.



B.



D.



20. Which equation represents exponential growth?

A.  $y = \left(\frac{1}{3}\right)^t$

B.  $y = \left(\frac{1}{3}\right)^{-t}$

C.  $y = \frac{1}{1 + 3^{-t}}$

D.  $y = 3^{-t}$

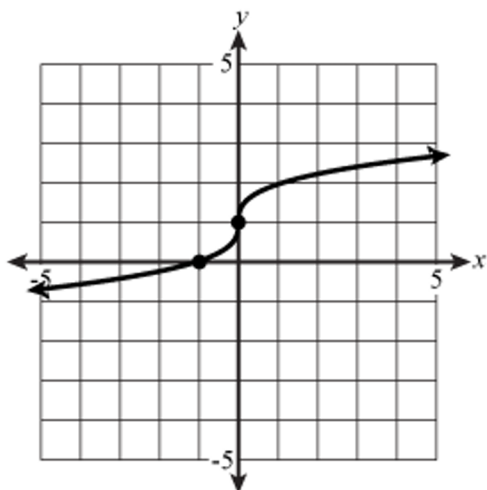
21. The cost to make  $j$  pairs of jeans can be represented as  $C(j)$ .

Which statement below is a true statement about function  $C$ ?

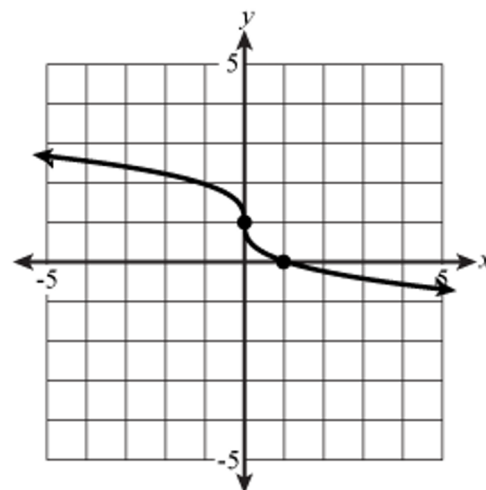
- A. If  $C(20) = 100$ , then making 20 pairs of jeans costs \$100.
- B. If  $C(20) = 100$ , then making 20 pairs of jeans costs \$5.
- C. If  $C(20) = 100$ , then making 100 pairs of jeans costs \$20.
- D. If  $C(20) = 100$ , then making 100 pairs of jeans costs \$2,000.

22. Which graph represents the function  $f(x) = \sqrt[3]{x} - 1$ ?

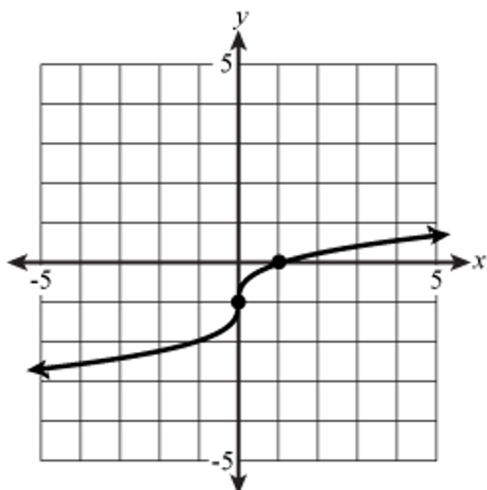
A.



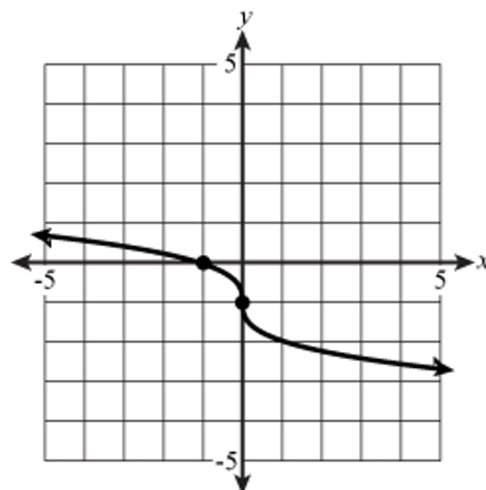
C.



B.



D.



23. Function  $q$  is represented by the equation  $q(x) = x^2 + 4x - 5$ .

Which statements are true about the graph that represents function  $q$ ?

Select **all** that apply.

- A. The point  $(-2, -9)$  represents the minimum of function  $q$ .
- B. The point  $(-2, -9)$  represents the maximum of function  $q$ .
- C. The point  $(-2, -9)$  represents a zero of function  $q$ .
- D. The point  $(1, 0)$  represents a zero of function  $q$ .
- E. The point  $(-5, 0)$  represents a zero of function  $q$ .
- F. The point  $(0, -5)$  represents a zero of function  $q$ .

24. Benjamin has a rectangular backyard that measures 100 feet by 80 feet. He wants to build a square garden in his backyard that has an area of at least 4 square feet. The area, in square feet, of the garden he wants to build can be modeled by the function  $g(x) = x^2$ .

What is the domain of the function  $g(x)$ ?

- A.  $\{x: 2 \leq x \leq 80\}$
- B.  $\{x: 2 \leq x \leq 100\}$
- C.  $\{x: x \text{ is all real numbers}\}$
- D.  $\{x: x \text{ is all positive numbers}\}$

25. Consider a graph (not pictured) of a quadratic function  $g(x)$ .

Which statement would be true of the graph of the function  $g(x + 2)$ ?

- A. The graph of  $g(x + 2)$  is the result of a shift in the positive  $y$  direction by 2 from the graph of  $g(x)$ .
  - B. The graph of  $g(x + 2)$  is the result of a shift in the negative  $y$  direction by 2 from the graph of  $g(x)$ .
  - C. The graph of  $g(x + 2)$  is the result of a shift in the positive  $x$  direction by 2 from the graph of  $g(x)$ .
  - D. The graph of  $g(x + 2)$  is the result of a shift in the negative  $x$  direction by 2 from the graph of  $g(x)$ .
26. The productivity,  $P$ , of a worker in a factory can be modeled by the function  $P(x) = -2x^2 + 24x$ , where  $x$  is the number of hours worked.

How many hours have been worked when productivity is at 0?

- A. 6
- B. 12
- C. 24
- D. 72



Assessment Analysis Guide  
Interim Assessment 3  
**Mathematics**  
**Algebra I**

1

**Item Id: i132102****Item Type: Selected Response**

Standards Description:

HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

Primary Standard: cc:HSA-CED.A.2

Points Possible: 1

Use the table shown below to answer the following question.

$x$	$y$
-1	0.8
0	1.2
1	1.8
2	2.7

Which equation represents the relationship between the variables  $x$  and  $y$ ?

A.  $y = 1.5x^2$

Student determined the common ratio of 1.5 but thought the relationship was quadratic and chose an equation that shows the common ratio times the  $x^2$ .

B.  $y = 0.8(0.4)^x$

Student identified the relationship is exponential but thought that the first  $y$ -value in the table is the initial value and that the difference between the first and second  $y$ -values is the common ratio.

C.  $y = 1.2(1.5)^x$

Correct.

D.  $y = 1.5x + 1.2$

Student determined the common ratio and initial value but thought that the relationship was linear.

Item Id: i155489

Item Type: Selected Response

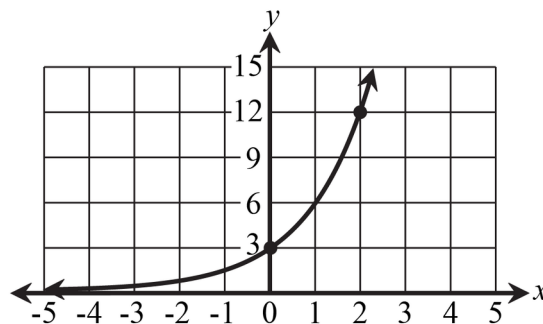
Standards Description:

HSF-LE.A.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

Primary Standard: cc:HSF-LE.A.2

Points Possible: 1

Use the graph shown below to answer the following question.



Which function represents the graph?

A.  $f(x) = 2(3)^x$

Student confused the initial value and the common ratio.

B.  $f(x) = 3(2)^x$

Correct.

C.  $f(x) = 3(4)^x$

Student determined the initial value but thought the common ratio was 4 because the y-values for the two points increase by a factor of 4.

D.  $f(x) = 4(3)^x$

Student thought the common ratio was 4 because the y-values for the two points increase by a factor of 4 and confused that common ratio with the initial value.

3

**Item Id: i134858****Item Type: Math Short Answer**

Standards Description:

HSF-IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

Primary Standard: cc:HSF-IF.B.6

Points Possible: 1

Use the table below to answer the following question.

$x$	$h(x)$
-25	6
-13	0
-3	-5
0	-7
9	-14
11	-30

What is the average rate of change of  $h(x)$  over the interval  $-13 < x < 11$ ?

Respond in the space provided.

*If your test is on paper, write your answer on the answer sheet.***Correct Answer:**

-1.25

**Item Id: i140016****Item Type: Selected Response**

Standards Description:

HSS-ID.C.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

Primary Standard: cc:HSS-ID.C.7

Points Possible: 1

Kira gathers data on the average annual cost to rent a one-bedroom apartment in Boston for each year since 2014. She finds the equation of the regression line for the data, and she writes the equation below so that  $c$  represents the predicted annual cost and  $y$  represents years since 2014.

$$c = 28,932 + 867.96y$$

Which of the following is the best interpretation of the term that represents the vertical intercept of the regression line in the context of the problem?

A. The average annual cost of a one-bedroom apartment in Boston is \$28,932.

Student did not recognize that the vertical intercept represented the average annual cost of a one-bedroom in 2014 and that the average rent has increased every year.

B. The average annual cost of a one-bedroom apartment in Boston in 2014 was \$867.96.

Student thought the rate of change would represent the vertical intercept of the regression line.

**C. The average annual cost of a one-bedroom apartment in Boston in 2014 was \$28,932.**

Correct.

D. The average annual cost of a one-bedroom apartment in Boston has increased \$867.96 every year since 2014.

Student interpreted the rate of change, rather than the vertical intercept, in context of the problem.

**Item Id: i119560****Item Type: Selected Response**

Standards Description:

HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems.

Primary Standard: cc:HSA-CED.A.1

Points Possible: 1

There are 140 birds at the start of a repopulation project, and the population of birds increases by 4% each year.

Which of the following represents the population,  $p$ , at the end of 6 years?

A.  $p = 140(0.04)^6$

Student used the percent yearly increase (0.04) as the growth factor instead of  $1 + 0.04$ .

B.  $p = 140(1 + 0.04)^6$

Correct.

C.  $p = 140 + 6(1 + 0.04)$

Student added the original amount (140) instead of multiplying, and student multiplied the growth factor by the number of years (6) instead of raising the growth factor to the power of 6.

D.  $p = 6(140 + 0.04)$

Student multiplied the number of years (6) by the sum of the original amount (140) and the percent yearly increase (0.04) instead of adding the percent yearly increase to 1 and raising the growth factor to the power of 6.

6

**Item Id: i129161****Item Type: Multiple Select**

Standards Description:

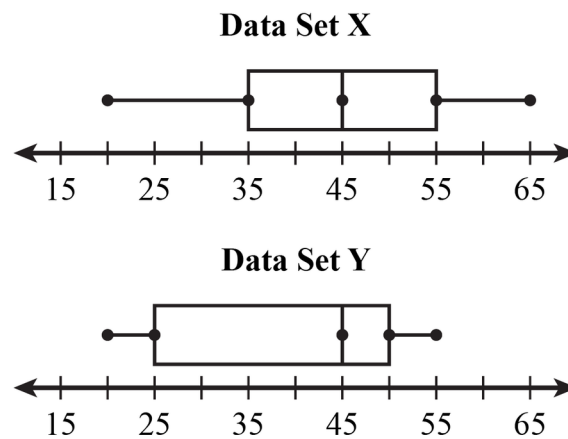
HSS-ID.A.2

Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.

Primary Standard: cc:HSS-ID.A.2

Points Possible: 1

Use the box plots below.



Which statements must be true?

Select **all** that apply.

**A. The medians of Data Set X and Data Set Y are equal.**

Correct.

B. The mean of Data Set X is greater than the mean of Data Set Y.

Student did not recognize that a box plot cannot be used to find the mean of a data set; may have confused the spread with the mean.

C. The median of Data Set Y is greater than the median of Data Set X.

Student thought that a greater interquartile range means a greater median.

**D. It cannot be determined whether Data Set X or Data Set Y has a greater mean.** Correct.

**E. The interquartile range of Data Set Y is greater than the interquartile range of Data Set X.** Correct.

F. The interquartile range of Data Set X is greater than the interquartile range of Data Set Y. Student confused the range with the interquartile range.



**Item Id: i119570****Item Type: Constructed Response**

Standards Description:

HSF-LE.A.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

Standard(s) for Mathematical Practice:

MP4 Model with mathematics.

In this item, students must demonstrate an understanding of how the quantities relate to one another by representing the verbal descriptions of a real-world context as a linear equation.

Primary Standard: cc:HSF-LE.A.2

Points Possible: 2

Elena notices that when she spends less time on social media the night before a quiz, she gets a higher score. Before one quiz, she spent 107 minutes on social media and earned 37 points on a quiz. Before another quiz, she spent 73 minutes on social media and earned 41 points on a quiz.

Write a function to model a linear relationship between Elena's social media usage, in minutes, and her quiz scores, assuming that the total number of points on each quiz remains a constant.

Respond in the space provided.

**Exemplar Student Response:**

*Equivalent answers and alternate explanations are also accepted. When prompted, answers may vary due to rounding or estimation.*

Slope:

$$m = \frac{41 - 37}{73 - 107}$$

$$m = \frac{4}{-34} = -\frac{2}{17}$$

Point-Slope Form:

$$y - 37 = -\frac{2}{17}(x - 107)$$

$$y = -\frac{2}{17}x + \frac{214}{17} + 37$$

$$y = -\frac{2}{17}x + \frac{843}{17} \text{ or } f(x) \approx -0.118x + 49.588$$

**Evidence Statement(s):**

1. Student correctly identified time on social media as the  $x$ -variable and quiz score as the  $y$ -variable.
2. Student correctly calculated the slope.
3. Student used one of the points given in the question and the slope to create an algebraic model.

**Common Misconception(s):**

- Student incorrectly identified the variables.
- Student incorrectly calculated the slope (perhaps by finding change in  $x$  over change in  $y$ ).
- Student thought that one of the given points was the  $y$ -intercept and used the  $y$ -value of either given point as the  $y$ -intercept of the model.
- Student used the point-slope form incorrectly (by adding  $x_1$  and  $y_1$  or by switching their positions).

**Item Id: i129899****Item Type: Multiple Select**

Standards Description:

HSA-REI.D.11 Explain why the  $x$ -coordinates of the points where the graphs of the equations  $y = f(x)$  and  $y = g(x)$  intersect are the solutions of the equation  $f(x) = g(x)$ ; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where  $f(x)$  and/or  $g(x)$  are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

Primary Standard: cc:HSA-REI.D.11

Points Possible: 1

Consider the functions defined by  $f(x) = 2x - 2$  and  $g(x) = -(x - \frac{3}{2})^2 + \frac{5}{3}$ .

Which of the following are approximate solutions to the equation  $f(x) = g(x)$ ?

Select **all** that apply.

A.  $x = -3.582$

Student mistook the  $y$ -value where the two functions are equal as the solution to the equation  $f(x) = g(x)$  and did not realize that the solution would be the  $x$ -value or input that generates the  $y$ -value.

B.  $x = -0.791$

Correct.

C.  $x = 0.209$

Student thought that a solution would be the  $x$ -intercept of the parabola; probably believed this point of interest was a solution due to experience finding  $x$ -intercepts of parabolas and did not recognize the solution in this situation would be the intersection of the graphs of  $f(x)$  and  $g(x)$ .

D.  $x = 1.500$

Student selected the x-coordinate of the vertex of the parabola as the solution; probably mistook this point of interest as a solution due to experience finding the vertex of a parabola and did not recognize the solution in this situation would be the intersection of the graphs of  $f(x)$  and  $g(x)$ .

E.  $x = 1.582$

Student mistook the y-value where the two functions are equal as the solution to the equation  $f(x) = g(x)$  and did not realize that the solution would be the x-value or input that generates the y-value.

F.  $x = 1.791$

Correct.

G.  $x = 2.791$

Student thought that a solution would be the x-intercept of the parabola; probably believed this point of interest was a solution due to experience finding x-intercepts of parabolas and did not recognize the solution in this situation would be the intersection of the graphs of  $f(x)$  and  $g(x)$ .

**Item Id: i139519****Item Type: Selected Response**

Standards Description:

HSF-IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

Primary Standard: cc:HSF-IF.B.6

Points Possible: 1

Use the function  $f(x) = 2^x$  to answer the following question.Over which interval is the average rate of change the greatest for  $f(x)$ ?A.  $-5 < x < -2$ 

Student calculated the average rate of change for each interval by finding the change in x per the change in y instead of the change in y per the change in x.

B.  $-1 < x < 0$ 

Student confused the smallest interval with the greatest rate of change; may have recognized that the rate of change would increase between  $x = -1$  and  $x = 0$  and thought that since the change in x was smallest in this answer choice, the change in y per the change in x would be greatest.

C.  $0 < x < 5$ 

Student confused the largest interval with the greatest rate of change; did not find the change in y per the change in x.

D.  $3 < x < 5$ 

Correct.

10

**Item Id: i140011****Item Type: Selected Response**

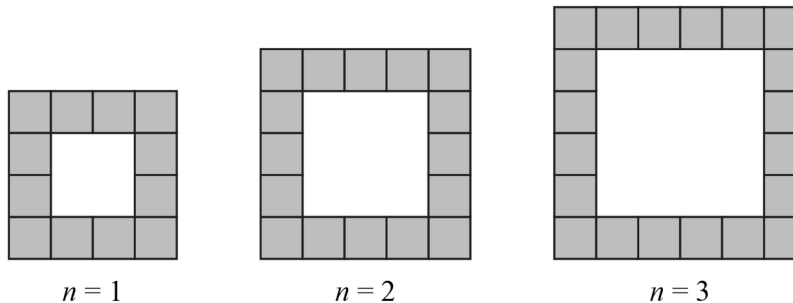
Standards Description:

HSF-LE.A.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

Primary Standard: cc:HSF-LE.A.2

Points Possible: 1

The diagrams below represent the first three terms of a sequence.

Assuming the pattern continues, which formula determines  $a_n$ , the number of shaded squares in the  $n$ th term?

A.  $a_n = 4n$

Student correctly identified the common difference, but neglected the initial quantity.

B.  $a_n = n + 4$

Student correctly identified the common difference, but thought that it gets added to the  $n$ th term; did not consider that  $n$  represents the term in the sequence and not the number of shaded squares.

C.  $a_n = 8n + 4$

Student switched the common difference and the initial quantity.

D.  $a_n = 4n + 8$

Correct.

11
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**Item Id: i139435****Item Type: Constructed Response**

Standards Description:

- HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems.

Standard(s) for Mathematical Practice:

MP2 Reason abstractly and quantitatively.

Students must make sense of the quantities and their relationships in the context of the situation. Additionally, students must decontextualize the given situation to represent it symbolically as an equation.

MP4 Model with mathematics.

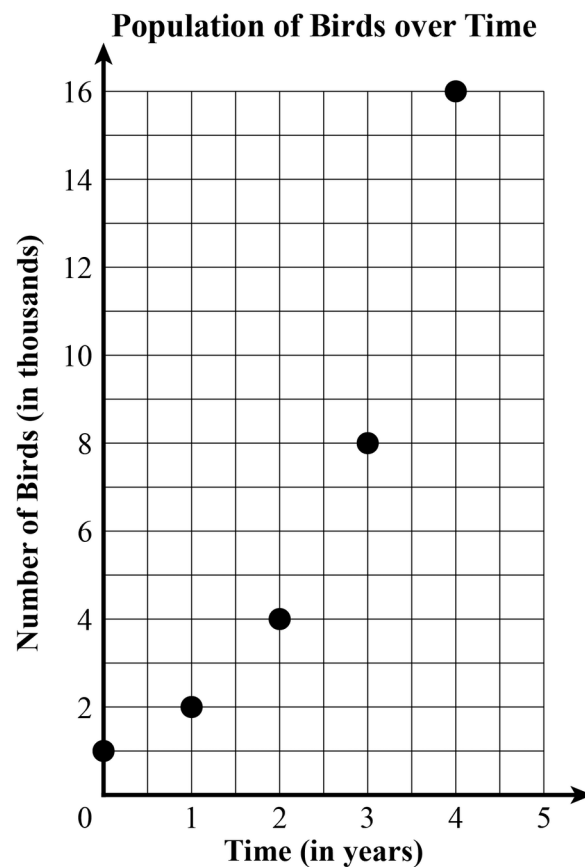
Students must create and solve an equation that models the situation.

11A
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Primary Standard: cc:HSA-CED.A.2

Points Possible: 3

The graph below shows the yearly population of a particular breed of birds since the year 2016.

**Part A**

Write an equation that represents the relationship between the number of birds and time, in years, that is shown in the graph. Define all variables used in your equation.

Respond in the space provided.

**Exemplar Student Response:**

*Equivalent answers and alternate explanations are also accepted. When prompted, answers may vary due to rounding or estimation.*

$$B = 1,000(2^t)$$

$B$  is the number of birds.

$t$  is the number of years since the year 2016.

$B = 2^t$  is also acceptable if  $B$  is defined as number of birds in thousands.

**Evidence Statement(s):**



1. Student understood that the relationship shown in the graph is exponential.
2. Student created an exponential equation in the form of  $y = a(b^x)$ , where  $a$  is the initial value of the graph and  $b$  is the growth factor.
3. Student defined the dependent variable as the number of birds and defined the independent variable as the number of years since the year 2016.

**Common Misconception(s):**

- Student did not understand that the relationship shown in the graph is exponential and created a linear equation, perhaps  $B = 1,000(2t)$  or  $B = 2t$ .
- Student did not understand that the relationship shown in the graph is exponential and created a quadratic equation, perhaps  $B = 1,000(t^2)$  or  $B = t^2$ .
- Student confused the independent variable (number of years) and dependent variable (number of birds).

**11B**

Primary Standard: cc:HSA-CED.A.1

Points Possible: 1

**Part B**

If the relationship between the number of birds and time, in years, continues, how many birds will there be in year 9? Show or explain how you found your answer.

Respond in the space provided.

**Exemplar Student Response:**

*Equivalent answers and alternate explanations are also accepted. When prompted, answers may vary due to rounding or estimation.*

$$t = 9$$

$$B = 1,000(2^9)$$

$$B = 1,000(512)$$

$$B = 512,000$$

There will be 512,000 birds in year 9.

**Evidence Statement(s):**

1. Student determined how many birds there will be in year 9.

**Common Misconception(s):**

- Student determined how many birds there will be in year 9 as if the relationship was linear.
- Student determined how many birds there will be in year 9 as if the relationship was quadratic.
- Student simplified  $2^9$  by calculating  $2 \times 9$ .

12

**Item Id: i133725****Item Type: Selected Response**

Standards Description:

HSS-ID.C.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.

Primary Standard: cc:HSS-ID.C.8

Points Possible: 1

The results of a linear regression analysis on the relationship between  $x$  and  $y$  are shown below.

$$y = a + bx$$

$$a = 0.952$$

$$b = -0.857$$

$$r^2 = 0.116$$

$$r = -0.341$$

Which statement best describes the relationship between  $x$  and  $y$ ?

A. There is a weak positive correlation.

Student confused a weak negative correlation with a weak positive correlation; perhaps they thought the value of  $r^2$  was the correlation coefficient while understanding that a positive value near zero translates to a weak positive correlation.

**B. There is a weak negative correlation.**

Correct.

C. There is a strong positive correlation.

Student confused a weak negative correlation with a strong positive correlation; perhaps they thought the value of  $a$  was the correlation coefficient while understanding that a positive value near 1 translates to a strong positive correlation.

D. There is a strong negative correlation.

Student confused a weak negative correlation with a strong negative correlation; perhaps they thought the value of  $b$  was the correlation coefficient while understanding that a negative value near  $-1$  translates to a strong negative correlation.

**Item Id: i132107****Item Type: Selected Response**

Standards Description:

HSF-IF.C.7.e Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

Primary Standard: cc:HSF-IF.C.7.e

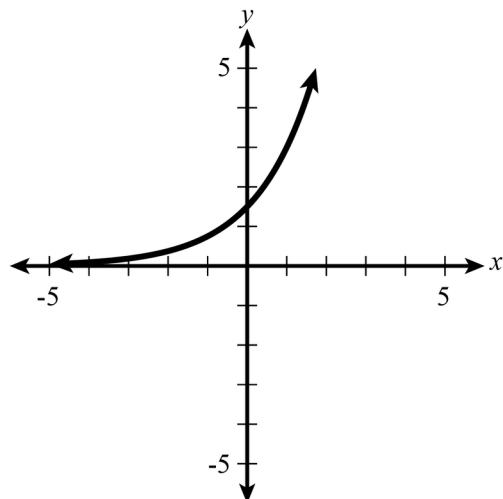
Points Possible: 1

Use the function shown below to answer the following question.

$$y = 1.5(0.5)^x$$

Which graph best represents the function?

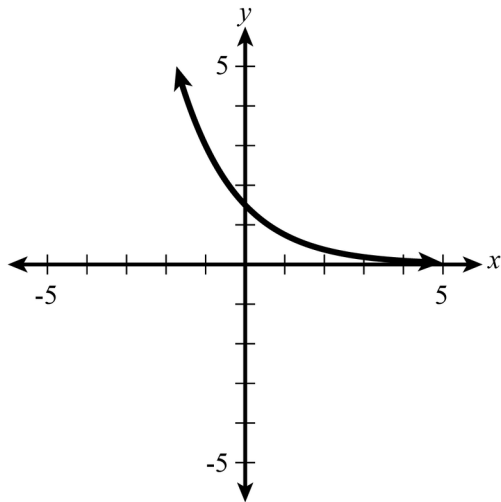
A.



Student used the correct initial value but confused the effects of a common ratio of 0.5 (half) with a common ratio of 2 (double).

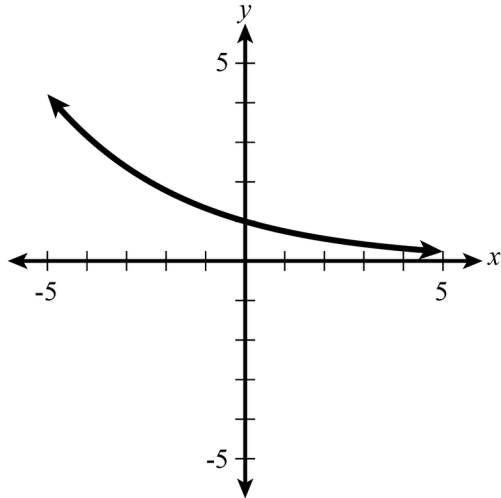
B.

Correct.



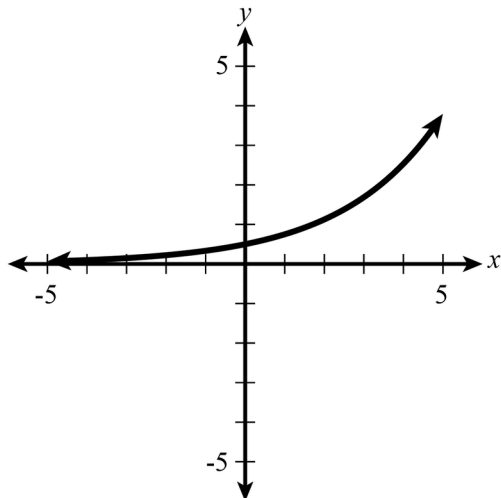
C.

Student multiplied the initial value and common ratio to get  $0.75^x$ .



D.

Student confused the initial value and the common ratio.



**Item Id: i134972****Item Type: Selected Response**

Standards Description:

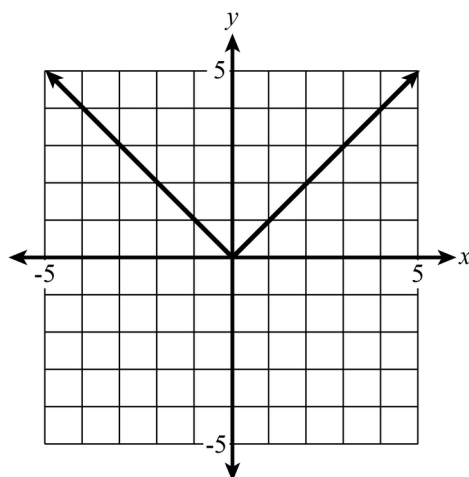
HSF-BF.B.3

Identify the effect on the graph of replacing  $f(x)$  by  $f(x) + k$ ,  $k f(x)$ ,  $f(kx)$ , and  $f(x + k)$  for specific values of  $k$  (both positive and negative); find the value of  $k$  given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology.

Primary Standard: cc:HSF-BF.B.3

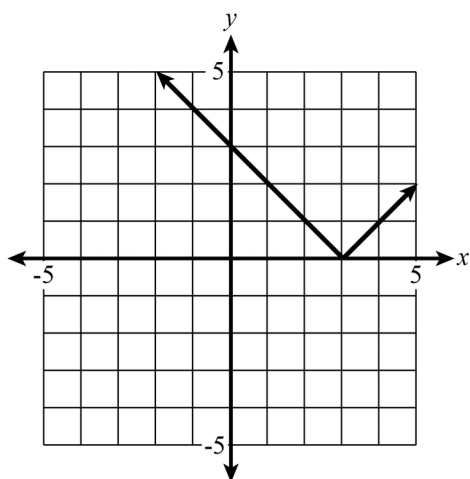
Points Possible: 1

Below is the graph of the function  $f(x) = |x|$ .



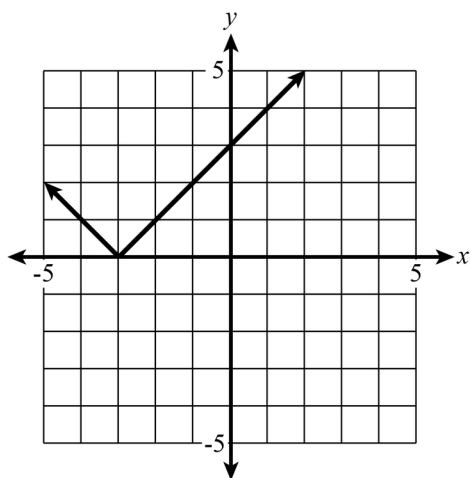
Which graph represents  $f(x - 3)$ ?

A.



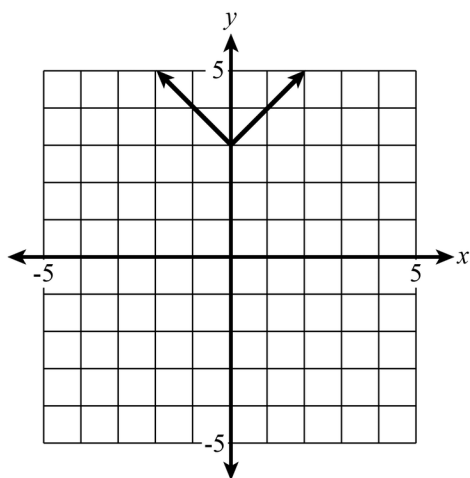
Correct.

B.



Student confused the graph of  $|x + 3|$  with the graph of  $|x - 3|$ ; may have thought that substituting  $(x - 3)$  for  $x$  would result in a horizontal shift in the negative direction.

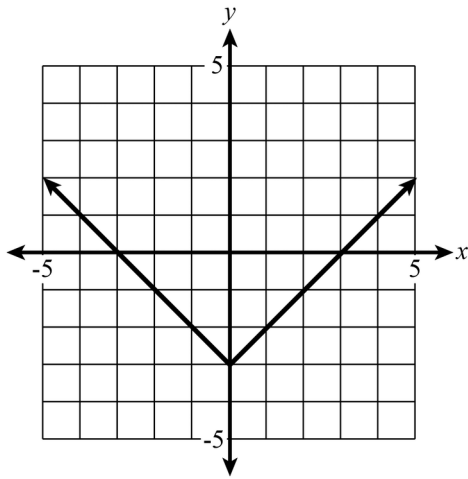
C.



Student confused the graph of  $|x| + 3$  with the graph of  $|x - 3|$ ; recognized that substituting  $(x - 3)$  for  $x$  would result in a shift in a positive direction, but thought it would be a positive vertical shift instead of a horizontal one.



D.



Student confused the graph of  $|x| - 3$  with the graph of  $|x - 3|$ ; may have thought that substituting  $(x - 3)$  for  $x$  would result in a vertical shift in the negative direction.

15

**Item Id: i139518****Item Type: Selected Response**

Standards Description:

HSF-IF.B.5            Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

Primary Standard: cc:HSF-IF.B.5

Points Possible: 1

A ball is dropped from a height of 10 feet. The height of the ball after it bounces is a function of the number of times it has bounced and can be modeled by the function  $h(b) = 10(0.7)^b$ . The ball stops bouncing after  $n$  bounces.

Which statement is true about the domain of  $h(b)$ ?A.  $\{b: b \text{ is any integer}\}$ 

Student recognized the context required an integer input, but did not understand how the nature of the variable would restrict the domain to integers between 1 and  $n$ .

B.  $\{b: b \text{ is any real number}\}$ 

Student determined the domain by looking at the function only and without considering the domain in terms of the context.

C.  $\{b: b \text{ is any integer between } 1 \text{ and } n, \text{ inclusive}\}$ 

Correct.

D.  $\{b: b \text{ is any real number between } 1 \text{ and } n, \text{ inclusive}\}$ 

Student recognized how the context would restrict the domain to be between 1 bounce and the final bounce, but did not recognize that the context required an integer input.

**Item Id: i129003****Item Type: Selected Response**

Standards Description:

HSA-SSE.A.1.b Interpret complicated expressions by viewing one or more of their parts as a single entity.

Primary Standard: cc:HSA-SSE.A.1.b

Points Possible: 1

Which of the following describes the relationship between the expressions in the equation below?

$$8x + 6 = (4x + 3)^2$$

A.  $b = b^2$

Student selected an equation that describes the structure of  $4x + 3 = (4x + 3)^2$ , instead of describing the structure of  $2(4x + 3) = (4x + 3)^2$ ; perhaps manipulated  $b = b^2$  in an attempt to uncover an equivalent structure, took the square root of both sides, and thought that the square root of  $8x + 6$  (the left side of the original equation) is  $4x + 3$  (the base of the quadratic term on the right side of the original equation).

B.  $b^2 = b^2$

Student selected an equation that describes the structure of  $(4x + 3)^2 = (4x + 3)^2$ , instead of describing the structure of  $2(4x + 3) = (4x + 3)^2$ ; perhaps thought squaring a term is the same as doubling a term.

C.  $b = 2b^2$

Student selected an equation that describes the structure of  $4x + 3 = 2(4x + 3)^2$ , instead of describing the structure of  $2(4x + 3) = (4x + 3)^2$ ; perhaps manipulated  $b = 2b^2$  in an attempt to create an equivalent structure, divided both sides by 2, and thought, since  $8x + 6$  divided by 2 is  $4x + 3$ , the equations are the same.

**D.**  $2b = b^2$

Correct.

17

**Item Id: i129488****Item Type: Math Short Answer**

Standards Description:

HSF-IF.C.8.a Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

Primary Standard: cc:HSF-IF.C.8.a

Points Possible: 1

The depth in feet,  $D$ , of a scuba diver can be modeled by the function  $D(x) = -x^2 + 12x + 4$ , where  $x$  is the number of seconds spent diving.

What is the number of seconds spent diving when the scuba diver reaches their maximum depth?

Respond in the space provided.

*If your test is on paper, write your answer on the answer sheet.*

**Correct Answer:**

6 seconds

18

**Item Id: i119590****Item Type: Selected Response**

Standards Description:

HSF-IF.C.7.a Graph linear and quadratic functions and show intercepts, maxima, and minima.

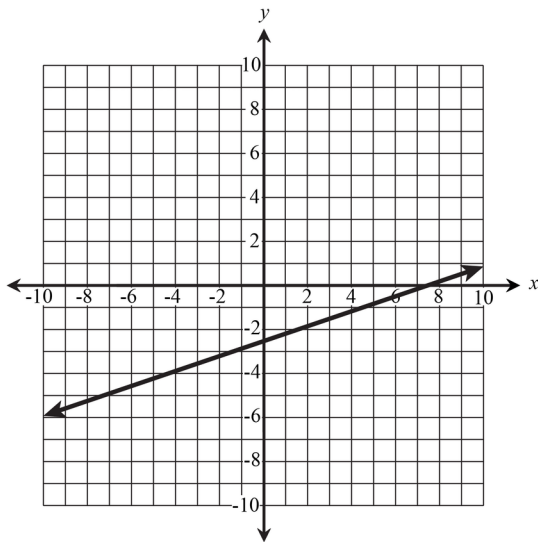
Primary Standard: cc:HSF-IF.C.7.a

Points Possible: 1

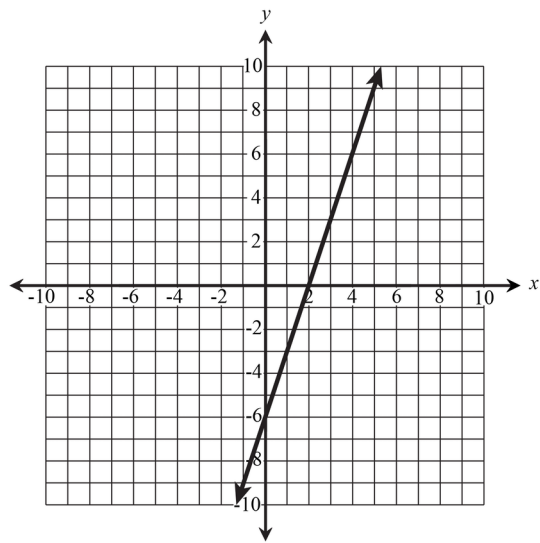
Which graph represents the equation  $2x - 6y = 15$ ?

A.

Correct.

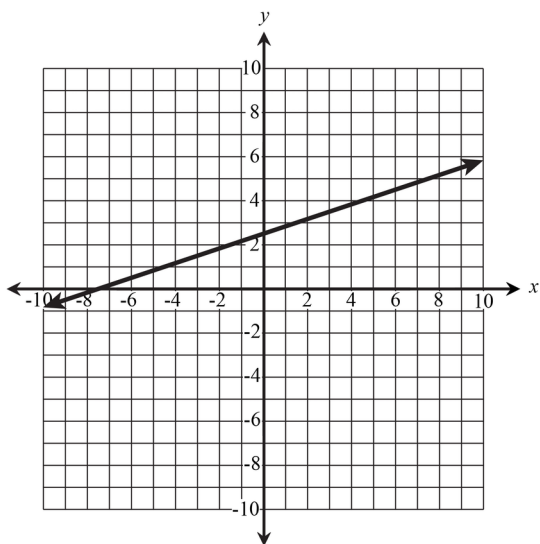


B.



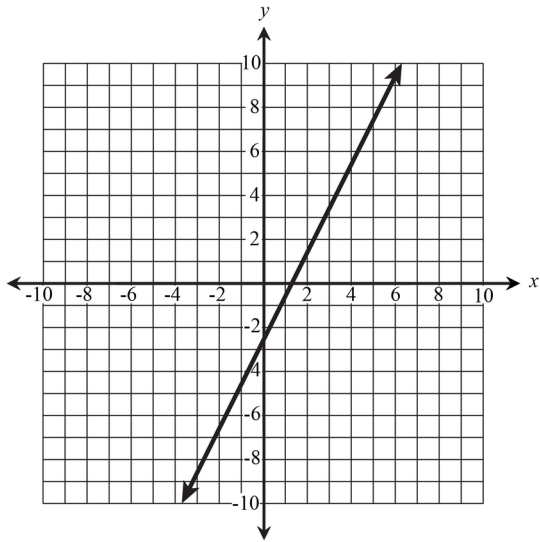
Student thought the coefficient of  $2x$  represented the  $x$ -intercept  $(2, 0)$  and the coefficient of  $-6y$  represented the  $y$ -intercept  $(0, -6)$ .

C.



Student attempted to transform the given equation to the slope-intercept form but ignored any negative values and got  $y = 1/3x + 2.5$ .

D.



Student thought the coefficient of  $2x$  represented the slope and divided 15 by the coefficient of  $-6y$  to get a y-intercept of  $(0, -2.5)$ .



**Item Id: i130073****Item Type: Selected Response**

Standards Description:

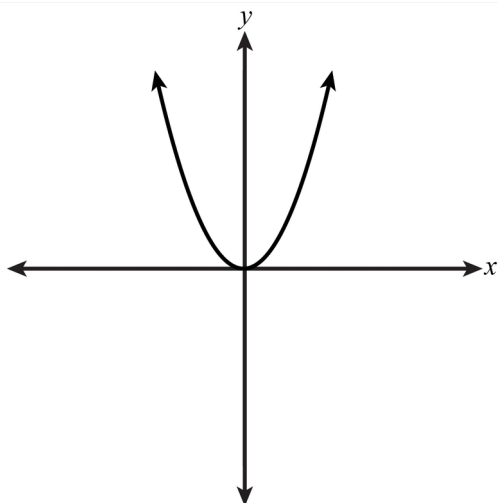
HSF-BF.B.3

Identify the effect on the graph of replacing  $f(x)$  by  $f(x) + k$ ,  $k f(x)$ ,  $f(kx)$ , and  $f(x + k)$  for specific values of  $k$  (both positive and negative); find the value of  $k$  given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology.

Primary Standard: cc:HSF-BF.B.3

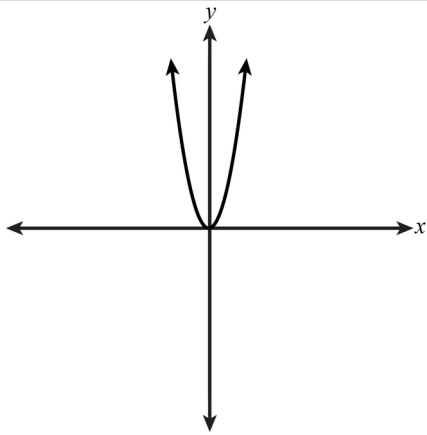
Points Possible: 1

The diagram below shows the graph of  $f(x) = ax^2$ .



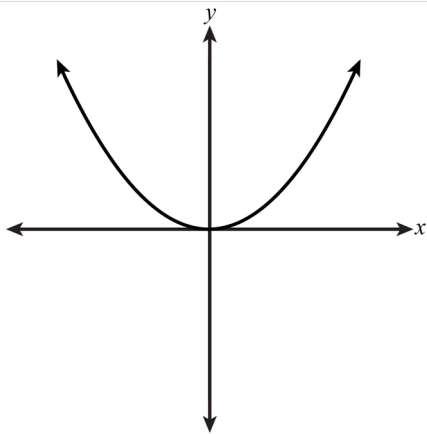
Which diagram represents the graph of  $kf(x)$ , given that  $k < -1$ ?

A.



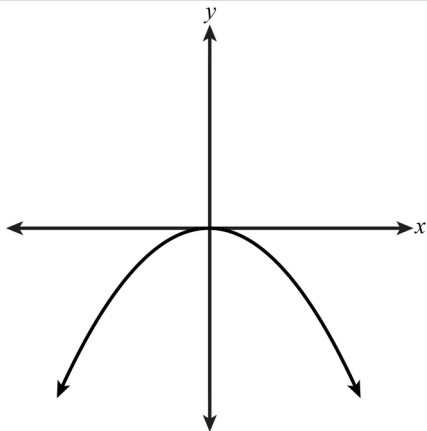
Student chose an option that has a narrower graph, but did not recognize the effect that the negative sign would have on the orientation of the graph.

B.



Student thought that  $k$  having an absolute value greater than 1 would result in a wider graph and did not take into account the negative sign.

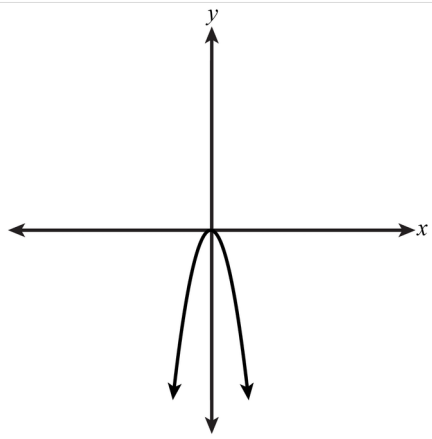
C.



Student chose an option that opens downward but thought that  $k$  having an absolute value greater than 1 would result in a wider graph.

D.

Correct.



20

**Item Id: i129521****Item Type: Selected Response**

Standards Description:

HSF-IF.C.8.b

Use the properties of exponents to interpret expressions for exponential functions.

Primary Standard: cc:HSF-IF.C.8.b

Points Possible: 1

Which equation represents exponential growth?

A.  $y = \left(\frac{1}{3}\right)^t$

Student confused an equation that represents exponential decay with one that represents exponential growth; perhaps thought that all positive exponents would represent growth.

B.  $y = \left(\frac{1}{3}\right)^{-t}$

Correct.

C.  $y = \frac{1}{1 + 3^{-t}}$

Student confused an equation that does not represent exponential growth or decay with one that represents exponential growth; perhaps saw a negative exponent in the denominator and misapplied the properties of exponents to get an expression of  $3^t$ , which would represent exponential growth.

D.  $y = 3^{-t}$

Student confused an equation that represents exponential decay with one that represents exponential growth; perhaps thought that all exponential functions with a base greater than 1 would represent growth.

**Item Id: i117322****Item Type: Selected Response**

Standards Description:

HSF-IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

Primary Standard: cc:HSF-IF.A.2

Points Possible: 1

The cost to make  $j$  pairs of jeans can be represented as  $C(j)$ .

Which statement below is a true statement about function  $C$ ?

- A. If  $C(20) = 100$ , then making 20 pairs of jeans costs \$100.** Correct.
- B. If  $C(20) = 100$ , then making 20 pairs of jeans costs \$5. Student thought that 100 had to be divided by 20 to find the cost to make 20 pairs of jeans; did not realize that \$5 represents the cost for making each pair of jeans.
- C. If  $C(20) = 100$ , then making 100 pairs of jeans costs \$20. Student confused the meaning of the 20 and the 100 in the function notation.
- D. If  $C(20) = 100$ , then making 100 pairs of jeans costs \$2,000. Student thought that the 20 represents the cost of making each pair of jeans and therefore multiplied 20 by 100 to find the cost for making 100 pairs of jeans.

Item Id: i129958

Item Type: Selected Response

Standards Description:

HSF-IF.C.7.b

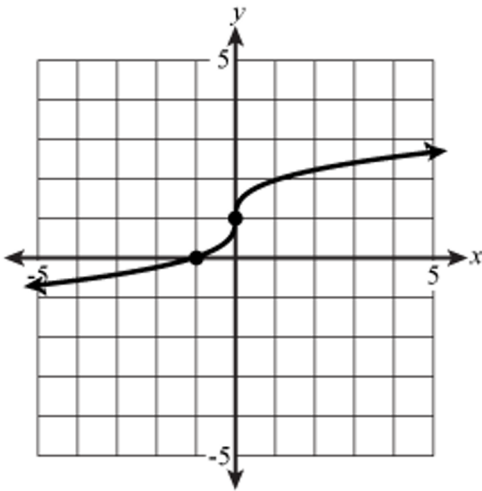
Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

Primary Standard: cc:HSF-IF.C.7.b

Points Possible: 1

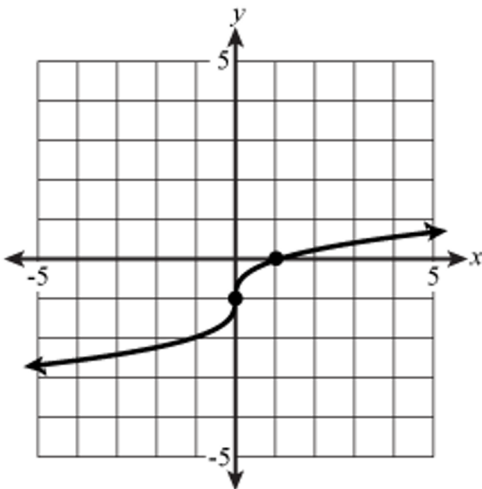
Which graph represents the function  $f(x) = \sqrt[3]{x} - 1$ ?

A.



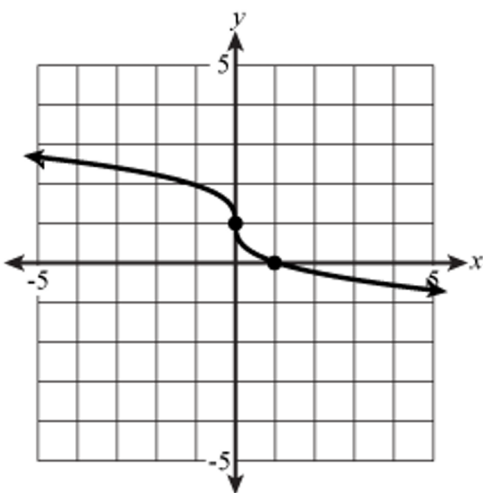
Student understood the graph would have a positive rate of change but chose a graph that includes the points  $(-1, 0)$  and  $(0, 1)$  instead of the points  $(1, 0)$  and  $(0, -1)$ ; perhaps thought the constant term  $(-1)$  would shift the graph up instead of down.

B.



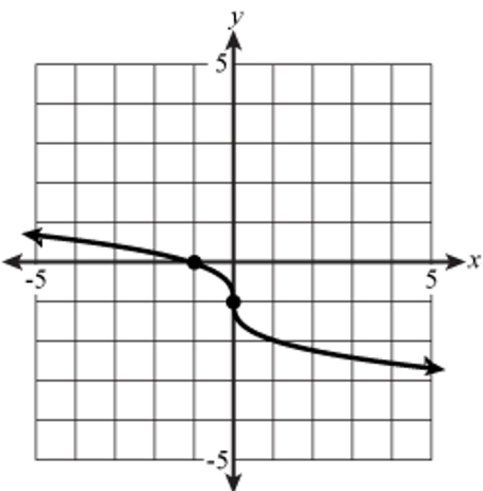
Correct.

C.



Student chose a graph with a negative rate of change that includes the points  $(1, 0)$  and  $(0, 1)$  instead of a graph with a positive rate of change that includes the points  $(1, 0)$  and  $(0, -1)$ ; perhaps thought the constant term  $(-1)$  would shift the graph up instead of down and make the rate of change negative.

D.



Student chose a graph with a negative rate of change that includes the points  $(-1, 0)$  and  $(0, -1)$  instead of a graph with a positive rate of change that includes the points  $(1, 0)$  and  $(0, -1)$ ; perhaps thought the constant term  $(-1)$  not only shifted the graph down but also made the rate of change negative.

**Item Id: i129951****Item Type: Multiple Select**

Standards Description:

HSF-IF.C.7.a Graph linear and quadratic functions and show intercepts, maxima, and minima.

Primary Standard: cc:HSF-IF.C.7.a

Points Possible: 1

Function  $q$  is represented by the equation  $q(x) = x^2 + 4x - 5$ .Which statements are true about the graph that represents function  $q$ ?Select **all** that apply.

- A. The point  $(-2, -9)$  represents the minimum of function  $q$ .** Correct.
- B. The point  $(-2, -9)$  represents the maximum of function  $q$ .** Student confused a quadratic that has a minimum with one that has a maximum.
- C. The point  $(-2, -9)$  represents a zero of function  $q$ .** Student thought that the minimum of the function represents a zero.
- D. The point  $(1, 0)$  represents a zero of function  $q$ .** Correct.
- E. The point  $(-5, 0)$  represents a zero of function  $q$ .** Correct.
- F. The point  $(0, -5)$  represents a zero of function  $q$ .** Student thought that the y-intercept represents a zero of the function.



**Item Id: i155508****Item Type: Selected Response**

Standards Description:

HSF-IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

Primary Standard: cc:HSF-IF.B.5

Points Possible: 1

Benjamin has a rectangular backyard that measures 100 feet by 80 feet. He wants to build a square garden in his backyard that has an area of at least 4 square feet. The area, in square feet, of the garden he wants to build can be modeled by the function  $g(x) = x^2$ .

What is the domain of the function  $g(x)$ ?A.  $\{x: 2 \leq x \leq 80\}$ 

Correct.

B.  $\{x: 2 \leq x \leq 100\}$ 

Student did not recognize that the domain would be restricted by the smaller dimension of the backyard.

C.  $\{x: x \text{ is all real numbers}\}$ Student did not recognize the constraints the context puts on the domain of the function  $g(x) = x^2$ .D.  $\{x: x \text{ is all positive numbers}\}$ 

Student did not recognize that the domain of the function includes numbers greater than or equal to 2 and less than or equal to 80, OR thought that since the domain included only positive numbers, "all positive numbers" described the domain.

25

Item Id: i129921

Item Type: Selected Response

Standards Description:

HSF-BF.B.3 Identify the effect on the graph of replacing  $f(x)$  by  $f(x) + k$ ,  $k f(x)$ ,  $f(kx)$ , and  $f(x + k)$  for specific values of  $k$  (both positive and negative); find the value of  $k$  given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology.

Primary Standard: cc:HSF-BF.B.3

Points Possible: 1

Consider a graph (not pictured) of a quadratic function  $g(x)$ .

Which statement would be true of the graph of the function  $g(x + 2)$ ?

- |  |  |
|--|--|
| A. The graph of $g(x + 2)$ is the result of a shift in the positive $y$ direction by 2 from the graph of $g(x)$ .  | Student thought that adding 2 to $x$ would shift the $y$ -coordinates of the graph positively along the $y$ -axis. |
| B. The graph of $g(x + 2)$ is the result of a shift in the negative $y$ direction by 2 from the graph of $g(x)$ .  | Student thought that adding 2 to $x$ would shift the $y$ -coordinates of the graph negatively along the $y$ -axis. |
| C. The graph of $g(x + 2)$ is the result of a shift in the positive $x$ direction by 2 from the graph of $g(x)$ .  | Student thought that adding 2 to $x$ would shift the $x$ -coordinates of the graph positively along the $x$ -axis. |
| <b>D. The graph of <math>g(x + 2)</math> is the result of a shift in the negative <math>x</math> direction by 2 from the graph of <math>g(x)</math>.</b> | Correct.   |

26

**Item Id: i129486****Item Type: Selected Response**

Standards Description:

HSF-IF.C.8.a Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

Primary Standard: cc:HSF-IF.C.8.a

Points Possible: 1

The productivity,  $P$ , of a worker in a factory can be modeled by the function  $P(x) = -2x^2 + 24x$ , where  $x$  is the number of hours worked.

How many hours have been worked when productivity is at 0?

- A. 6 Student chose the number of hours when productivity would be at its maximum.
- B. 12 Correct.
- C. 24 Student thought that 24, the coefficient of  $x$ , represented the upper bound for possible number of hours.
- D. 72 Student chose the level of productivity when it is at its maximum.

# Interim Assessment 4

## Mathematics

### Algebra I

student: \_\_\_\_\_

teacher: \_\_\_\_\_

school: \_\_\_\_\_



**DIRECTIONS**

In this assessment you will answer a total of 11 questions, including 2 constructed-response question(s). Mark all of your answers to the questions on the answer sheet provided.

You may use this test booklet to work out the questions, but remember to mark all of your answers on the answer sheet. For constructed-response questions, record your answers directly on the page in the test booklet.

**Calculator Section**

You may use a calculator to solve the questions in this section.



1. A food truck vendor averages 150 tacos sold when the price per taco is \$4. A study shows that the average number of tacos sold will increase by 25 tacos for every \$1 that the price per taco is lowered.

Which equation models the food truck's average sales in dollars,  $s$ , in terms of the price per taco,  $x$ ?

- A.  $s = 25x + 250$
- B.  $s = -25x + 250$
- C.  $s = 25x^2 + 250x$
- D.  $s = -25x^2 + 250x$

2. Consider the equation below.

$$4t^2 - 28t = 6t^2 - 12t + 26$$

Which equation could be used when completing the square to solve for  $t$ ?

- A.  $(t + 4)^2 = 3$
- B.  $(t + 8)^2 = -13$
- C.  $t^2 + 8t + 4 = -13 + 4$
- D.  $t^2 + 8t + 64 = -13 + 64$

3. If  $x - 4$  is a factor of  $x^2 + bx - 24$ , what is the value of  $b$ ?
- A.  $-10$
  - B.  $-2$
  - C.  $2$
  - D.  $10$

4. Which equations have solutions that are non-real?

Select **all** that apply.

- A.  $t^2 - 5 = 3$
- B.  $2t^2 - 7t = 8$
- C.  $3t^2 + 8 = 3t$
- D.  $t^2 + 2t + 1 = 0$
- E.  $3t^2 + 5t + 10 = 0$

5. Kyree is asked to create a rectangle that has sides with lengths  $x$  and  $x + 8$  and an area of at least  $4 \text{ cm}^2$ . Kyree writes an inequality to help him determine the minimum length of  $x$  in centimeters.

Which of the following inequalities could Kyree use to determine the minimum length of  $x$  in centimeters?

Select **all** that apply.

- A.  $x^2 + 8x \geq 4$
- B.  $x^2 + 8x \leq 4$
- C.  $(x + 4)^2 \geq 4$
- D.  $(x + 4)^2 \geq 20$
- E.  $(x + 4)^2 \leq -12$

**Non-Calculator Section**

You may **not** use a calculator to solve the questions in this section.



6. Factor the expression completely.

$$x^2 + 6x - 40$$

A.  $x(x - 34)$

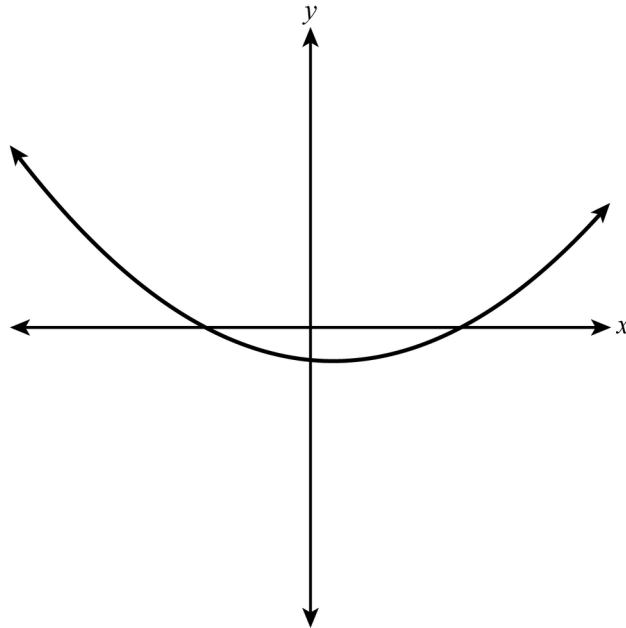
B.  $x(4x - 20)$

C.  $(x + 4)(x - 10)$

D.  $(x - 4)(x + 10)$



7. Use the graph below to answer the following question.



David states that  $f(x) = x^2 - 7x + 10$  could be the function whose graph is shown above because both the function and the graph have one positive zero and one negative zero.

- Is David's statement correct? Justify your answer.
- Provide the zeros of the given function. Show your work.

Respond in the space provided.

8. Which expression reveals the zeros of the function defined by  $-x^2 + 7x - 12$ ?

- A.  $(x + 4)(x - 3)$
- B.  $(-x + 4)(x - 3)$
- C.  $-(x^2 - 7x + 12)$
- D.  $-x(x - 7) - 12$

9. Consider the equation below.

$$x^2 - 36 = 0$$

Which of the following solution methods would **not** transform the equation in a way that would help in solving the equation?

- A. factoring
- B. taking square roots
- C. completing the square
- D. using the quadratic formula

10. Let  $f$  be the function defined by  $f(x) = x^2 + 5x - 2$ .

Which of the following is true?

Select **all** that apply.

- A.  $f(x)$  has a minimum of  $-2$ .
- B.  $f(x)$  has a minimum of  $-\frac{5}{2}$ .
- C.  $f(x)$  has a minimum of  $-\frac{33}{4}$ .
- D. The completed square is  $f(x) = (x + \frac{5}{2})^2 - 2$ .
- E. The completed square is  $f(x) = (x + \frac{5}{2})^2 - \frac{33}{4}$ .

**11.** Melinda derives the quadratic formula from the following equation, and her first four steps are shown below.

$$ax^2 + bx + c = 0, \text{ where } a \neq 0$$

**Melinda's steps:**

**Step 1:**  $x^2 + \frac{b}{a}x + \frac{c}{a} = 0$

**Step 2:**  $x^2 + \frac{b}{a}x = -\frac{c}{a}$

**Step 3:**  $x^2 + \frac{b}{a}x + \left(\frac{b}{2a}\right)^2 = -\frac{c}{a}$

**Step 4:**  $\left(x + \frac{b}{2a}\right)^2 = -\frac{c}{a}$

Are Melinda's first four steps correct?

- If her steps are correct, explain how you know.
- If her steps are incorrect, name the mistake(s) she made and explain how you know.

Respond in the space provided.

Assessment Analysis Guide  
Interim Assessment 4  
**Mathematics**  
**Algebra I**

1

**Item Id: i133892****Item Type: Selected Response**

Standards Description:

HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems.

Primary Standard: cc:HSA-CED.A.1

Points Possible: 1

A food truck vendor averages 150 tacos sold when the price per taco is \$4. A study shows that the average number of tacos sold will increase by 25 tacos for every \$1 that the price per taco is lowered.

Which equation models the food truck's average sales in dollars,  $s$ , in terms of the price per taco,  $x$ ?

A.  $s = 25x + 250$

Student added the \$1 price decrease instead of subtracting and created an equation that represents the number of tacos sold instead of the taco sales; perhaps confused a quadratic situation with a linear situation.

B.  $s = -25x + 250$

Student created an equation that represents the number of tacos sold instead of the taco sales; perhaps confused a quadratic situation with a linear situation.

C.  $s = 25x^2 + 250x$

Student added the \$1 price decrease instead of subtracting.

D.  $s = -25x^2 + 250x$

Correct.

**Item Id: i129688****Item Type: Selected Response**

Standards Description:

HSA-REI.B.4.a Use the method of completing the square to transform any quadratic equation in  $x$  into an equation of the form  $(x - p)^2 = q$  that has the same solutions. Derive the quadratic formula from this form.

Primary Standard: cc:HSA-REI.B.4.a

Points Possible: 1

Consider the equation below.

$$4t^2 - 28t = 6t^2 - 12t + 26$$

Which equation could be used when completing the square to solve for  $t$ ?

A.  $(t + 4)^2 = 3$

Correct.

B.  $(t + 8)^2 = -13$

Student recognized the basic structure of an important step in completing the square but stopped short of completing the square; found  $t^2 + 8t = -13$ , but instead of adding  $(b/2)^2$  to both sides and then factoring, student named  $(t + 8)^2$  as the factored version of  $t^2 + 8t$ .

C.  $t^2 + 8t + 4 = -13 + 4$

Student added -13 to both sides of the equation and then added  $b/2$  to both sides instead of  $(b/2)^2$ .

D.  $t^2 + 8t + 64 = -13 + 64$

Student added -13 to both sides of the equation and then added  $b^2$  to both sides instead of  $(b/2)^2$ .

3

**Item Id: i128828****Item Type: Selected Response**

Standards Description:

HSA-SSE.A.2 Use the structure of an expression to identify ways to rewrite it.

Primary Standard: cc:HSA-SSE.A.2

Points Possible: 1

If  $x - 4$  is a factor of  $x^2 + bx - 24$ , what is the value of  $b$ ?A.  $-10$ Student incorrectly found the second factor to be  $x - 6$ .B.  $-2$ Student added  $-4$  and  $6$  incorrectly.**C.  $2$** 

Correct.

D.  $10$ Student incorrectly found the second factor to be  $x - 6$  and then added  $-4$  and  $-6$  incorrectly.

**Item Id: i129516****Item Type: Multiple Select**

Standards Description:

HSA-REI.B.4.b Solve quadratic equations by inspection (e.g., for  $x^2 = 49$ ), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as  $a \pm bi$  for real numbers  $a$  and  $b$ .

Primary Standard: cc:HSA-REI.B.4.b

Points Possible: 1

Which equations have solutions that are non-real?

Select **all** that apply.

A.  $t^2 - 5 = 3$

Student confused an irrational solution with a non-real solution; may have thought that since the discriminant 32 is not a perfect square, the solutions could not be real.

B.  $2t^2 - 7t = 8$

Student did not change the structure of the equation to be  $ax^2 + bx + c = 0$ , and used 8 as  $c$  instead of using -8 as  $c$ ; identified the discriminant as -15 and determined a negative discriminant would yield non-real solutions.

C.  $3t^2 + 8 = 3t$

Correct.

D.  $t^2 + 2t + 1 = 0$

Student identified the discriminant as 0 and thought this meant the solution(s) could not be real.

E.  $3t^2 + 5t + 10 = 0$

Correct.



**Item Id: i130185****Item Type: Multiple Select**

Standards Description:

HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems.

Primary Standard: cc:HSA-CED.A.1

Secondary Standard(s): cc:HSA-REI.B.4.a;  
cc:HSA-SSE.B.3.b

Points Possible: 1

Kyree is asked to create a rectangle that has sides with lengths  $x$  and  $x + 8$  and an area of at least  $4 \text{ cm}^2$ . Kyree writes an inequality to help him determine the minimum length of  $x$  in centimeters.

Which of the following inequalities could Kyree use to determine the minimum length of  $x$  in centimeters?

Select **all** that apply.

A.  $x^2 + 8x \geq 4$

Correct.

B.  $x^2 + 8x \leq 4$

Student interpreted "at least" to mean that the product of the side lengths had to be less than or equal to the area,  $4 \text{ cm}^2$ .

C.  $(x + 4)^2 \geq 4$

Student used a correct inequality,  $x^2 + 8x \geq 4$ , but did not add 16 to the right side of the inequality when completing the square.

D.  $(x + 4)^2 \geq 20$

Correct.

E.  $(x + 4)^2 \leq -12$

Student interpreted "at least" to mean that the product of the side lengths had to be less than or equal to the area,  $4 \text{ cm}^2$ , created the inequality  $x^2 + 8x \leq 4$ , and then subtracted 16, instead of adding, from the right side when attempting to complete the square, OR used a correct inequality,  $x^2 + 8x \geq 4$ , but subtracted 16 from the right side and reversed the inequality sign when attempting to complete the square.

6

**Item Id: i134026****Item Type: Selected Response**

Standards Description:

HSA-SSE.A.2 Use the structure of an expression to identify ways to rewrite it.

Primary Standard: cc:HSA-SSE.A.2

Points Possible: 1

Factor the expression completely.

$$x^2 + 6x - 40$$

A.  $x(x - 34)$

Student thought an x could be factored out of just the first two terms to get  $x(x + 6 - 40)$  and then combined like terms to get  $x(x - 34)$ .

B.  $x(4x - 20)$

Student thought a 2 could be factored out of all terms since the exponent for the first term is 2 to get  $x(x + 3x - 20)$  and then combined like terms to get  $x(4x - 20)$ .

C.  $(x + 4)(x - 10)$

Student chose factors that would yield a term of  $-6x$  instead of  $6x$ .

D.  $(x - 4)(x + 10)$

Correct.

**Item Id: i129482****Item Type: Constructed Response**

Standards Description:

HSF-IF.C.8

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

Standard(s) for Mathematical Practice:

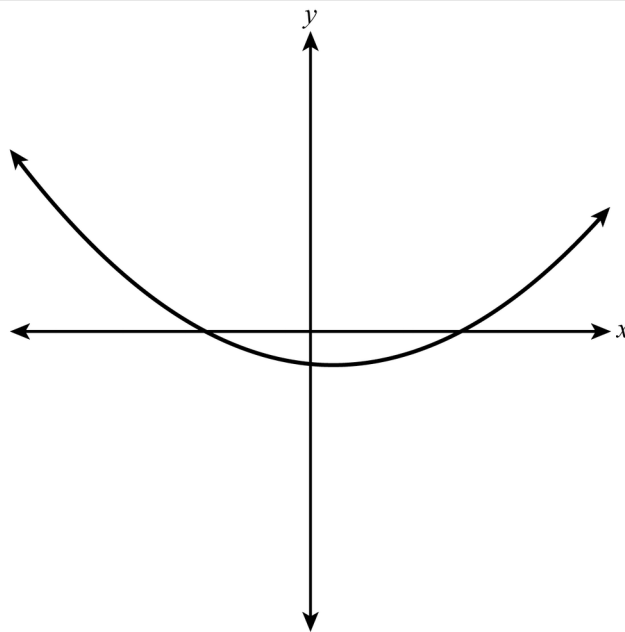
MP3 Construct viable arguments and critique the reasoning of others.

Students must evaluate the validity of David's statement and construct an argument to support their conclusion.

Primary Standard: cc:HSF-IF.C.8

Points Possible: 4

Use the graph below to answer the following question.



David states that  $f(x) = x^2 - 7x + 10$  could be the function whose graph is shown above because both the function and the graph have one positive zero and one negative zero.

- Is David's statement correct? Justify your answer.
- Provide the zeros of the given function. Show your work.

Respond in the space provided.

**Exemplar Student Response:**

*Equivalent answers and alternate explanations are also accepted. When prompted, answers may vary due to rounding or estimation.*

It is true that the graph shows one negative zero to the left of the  $y$ -axis and one positive zero to the right of the  $y$ -axis. However, both zeros of the given function are positive and would be graphed to the right of the  $y$ -axis. Therefore, the given function could not be the function whose graph is shown, and David's statement is incorrect.

$$x^2 - 7x + 10 = (x - 5)(x - 2)$$

$$x - 5 = 0 \text{ or } x - 2 = 0$$

$$x = 5 \text{ or } x = 2$$

The zeros of the function are 5 and 2.

**Evidence Statement(s):**

1. Student understood that a graph showing one negative zero and one positive zero could not be the graph of a function that has two positive zeros.
2. Student found the zeros of the function to be 5 and 2.

**Common Misconception(s):**

- Student thought the given function had two negative zeros, perhaps because the coefficient of  $x$  is negative and the constant is positive.
- Student correctly factored the given function to get  $(x - 5)(x - 2)$  but thought the zeros were  $-5$  and  $-2$ .
- Student thought that David is correct, perhaps because they thought that a function with at least one positive term and one negative term would have one positive zero and one negative zero.

8

**Item Id: i117390****Item Type: Selected Response**

Standards Description:

HSA-SSE.B.3.a Factor a quadratic expression to reveal the zeros of the function it defines.

Primary Standard: cc:HSA-SSE.B.3.a

Points Possible: 1

Which expression reveals the zeros of the function defined by  $-x^2 + 7x - 12$ ?

A.  $(x + 4)(x - 3)$

Student did not account for  $x^2$  being negative.

B.  $(-x + 4)(x - 3)$

Correct.

C.  $-(x^2 - 7x + 12)$

Student thought that the zeros could be revealed by factoring out -1 from the function.

D.  $-x(x - 7) - 12$

Student thought that the zeros could be revealed by factoring out -x from  $(-x^2 + 7x)$ .

**Item Id: i140007****Item Type: Selected Response**

Standards Description:

HSA-REI.B.4.b Solve quadratic equations by inspection (e.g., for  $x^2 = 49$ ), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as  $a \pm bi$  for real numbers  $a$  and  $b$ .

Primary Standard: cc:HSA-REI.B.4.b

Points Possible: 1

Consider the equation below.

$$x^2 - 36 = 0$$

Which of the following solution methods would **not** transform the equation in a way that would help in solving the equation?

A. factoring

Student thought the equation could not be factored because they mistakenly manipulated the equation to be  $x^2 = -36$  and knew there were not two real-number factors that could be multiplied to get  $-36$ .

B. taking square roots

Student thought the square root of  $x^2 - 36$  could not be found; did not recognize they could manipulate the equation to  $x^2 = 36$  and take the square root of both sides.

**C. completing the square**

Correct.

D. using the quadratic formula

Student thought that, since the equation does not have a  $bx$  term, the quadratic formula could not be used.

10

**Item Id: i129918****Item Type: Multiple Select**

Standards Description:

HSA-SSE.B.3.b Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

Primary Standard: cc:HSA-SSE.B.3.b

Points Possible: 1

Let  $f$  be the function defined by  $f(x) = x^2 + 5x - 2$ .

Which of the following is true?

Select **all** that apply.

A.  $f(x)$  has a minimum of  $-2$ .

Student attempted to complete the square, but did not subtract  $(5/2)^2$  from the function to counterbalance the extra term that would be created by  $(x + 5/2)^2$ , OR confused the y-intercept and the minimum.

B.  $f(x)$  has a minimum of  $-\frac{5}{2}$ .

Student mistook the x-value of the vertex for the minimum value of the function.

**C.  $f(x)$  has a minimum of  $-\frac{33}{4}$ .**

Correct.

D. The completed square is  $f(x) = (x + \frac{5}{2})^2 - 2$ .

Student attempted to complete the square, but did not subtract  $(5/2)^2$  from the function to counterbalance the extra term that would be created by  $(x + 5/2)^2$ .

**E. The completed square is  $f(x) = (x + \frac{5}{2})^2 - \frac{33}{4}$ .**

Correct.



**Item Id: i129522****Item Type: Constructed Response**

Standards Description:

HSA-REI.B.4.a Use the method of completing the square to transform any quadratic equation in  $x$  into an equation of the form  $(x - p)^2 = q$  that has the same solutions. Derive the quadratic formula from this form.

Standard(s) for Mathematical Practice:

MP7 Look for and make use of structure.

Students use the structure of the given quadratic equation to determine the best strategy for isolating the  $x$  in order to derive the quadratic formula.

Primary Standard: cc:HSA-REI.B.4.a

Points Possible: 2

Melinda derives the quadratic formula from the following equation, and her first four steps are shown below.

$$ax^2 + bx + c = 0, \text{ where } a \neq 0$$

**Melinda's steps:**

**Step 1:**  $x^2 + \frac{b}{a}x + \frac{c}{a} = 0$

**Step 2:**  $x^2 + \frac{b}{a}x = -\frac{c}{a}$

**Step 3:**  $x^2 + \frac{b}{a}x + \left(\frac{b}{2a}\right)^2 = -\frac{c}{a}$

**Step 4:**  $\left(x + \frac{b}{2a}\right)^2 = -\frac{c}{a}$

Are Melinda's first four steps correct?

- If her steps are correct, explain how you know.
- If her steps are incorrect, name the mistake(s) she made and explain how you know.

Respond in the space provided.

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**Exemplar Student Response:**

*Equivalent answers and alternate explanations are also accepted. When prompted, answers may vary due to rounding or estimation.*

Melinda's steps are incorrect. In Step 3, Melinda correctly added  $(\frac{b}{2a})^2$  to the left side of the equation, but did not also add it to the right side. Because of this mistake, the expressions on both sides of the equation are not equivalent, and the equations in Step 3 and Step 4 are not equivalent to the equations in Step 1 and Step 2.

**Evidence Statement(s):**

1. Student identified that Melinda's steps did not correctly represent how to use the method of completing the square to derive the quadratic formula.
2. Student named the steps that are not equivalent to the other steps.
3. Student explained that, by forgetting to add  $(\frac{b}{2a})^2$  to the right side of the equation, Melinda's steps did not maintain equivalency.

**Common Misconception(s):**

- Student did not identify Step 3 as incorrect; may not have understood that when adding a term to one side of an equation, the same term needs to be added to the other side to maintain equivalency.
- Student identified Step 1 as incorrect; may not have understood why dividing by  $a$  is necessary, and therefore thought it was an incorrect step.