Math
Spring Operational 2015

Algebra 1
End of Year Released Items

1. What are the zeros of the polynomial $x(x^2 + 4x - 12)$?

   Indicate **all** zeros.

   ☐ A. -12

   ☐ B. -6

   ☐ C. -3

   ☐ D. -2

   ☐ E. 0

   ☐ F. 2
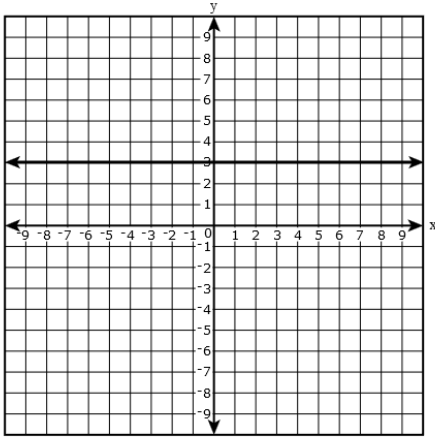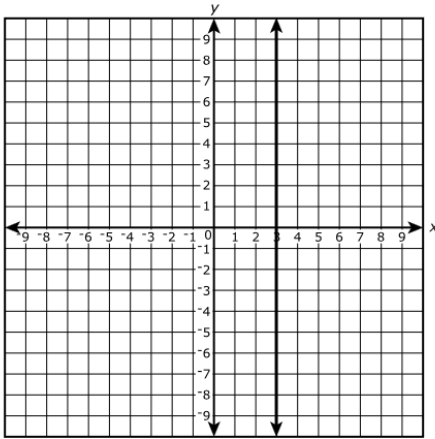
   ☐ G. 6

   ☐ H. 12

2. The function $f(x) = 2x - 3$ has a graph in the xy-coordinate plane.

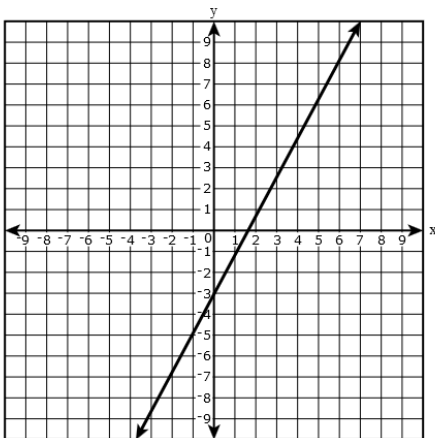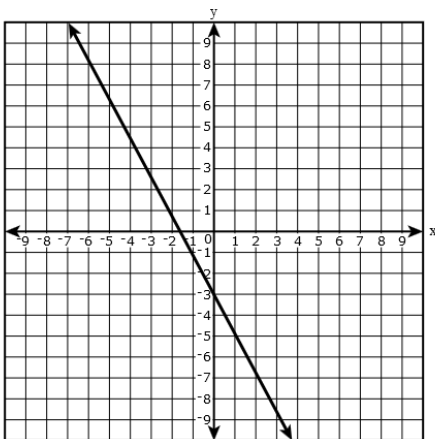Select the graph that depicts the solution set of $f(x)$.

A.

B.

C.

D.

3. The function f is defined as $f(x) = x(x^2 - 4) - 3x(x - 2)$.

Part A

An equivalent form of f is given as $f(x) = x(x - 2)(x - a)$, where a is a constant. What is the value of a?

Enter your answer in the box.

$a = \boxed{}$

Part B

Which values are the zeros of the function f?

Select **all** that apply.

☐ A. -3

☐ B. -2

☐ C. -1

☐ D. 0

☐ E. 1

☐ F. 2

☐ G. 3

4. Select from the drop-down menus to correctly complete the sentences.

The sum $\frac{1}{3} + \frac{\sqrt{5}}{3}$ is [Choose... ▼] because the sum [Choose... ▼] be expressed as a

| rational |
| irrational |

| can |
| cannot |

single fraction with a rational numerator and a rational denominator.

The quotient $\frac{20}{\sqrt{16}}$ is [Choose... ▼] because the quotient [Choose... ▼].

| rational |
| irrational |

| has a square root in its denominator |
| is equal to an integer |

5. A company has developed a new video game console. After completing cost analysis and demand forecasts, the company has determined that the profit function for the new console is $f(g) = -250g^2 + 70{,}000g - 4{,}570{,}000$ where g is the number of consoles sold. What is the domain of the profit function?

○ A. all integers

○ B. all rational numbers

○ C. all integers greater than or equal to 0

○ D. all rational numbers greater than or equal to 0

6. A 12-foot-long wooden beam is supported on both ends. When a weight load is placed in the center of the beam, it causes the beam to sag. The sag is called *deflection*. The graph shows the deflection of the beam, in inches, as a function of the weight load, in pounds, placed in the center of the beam.
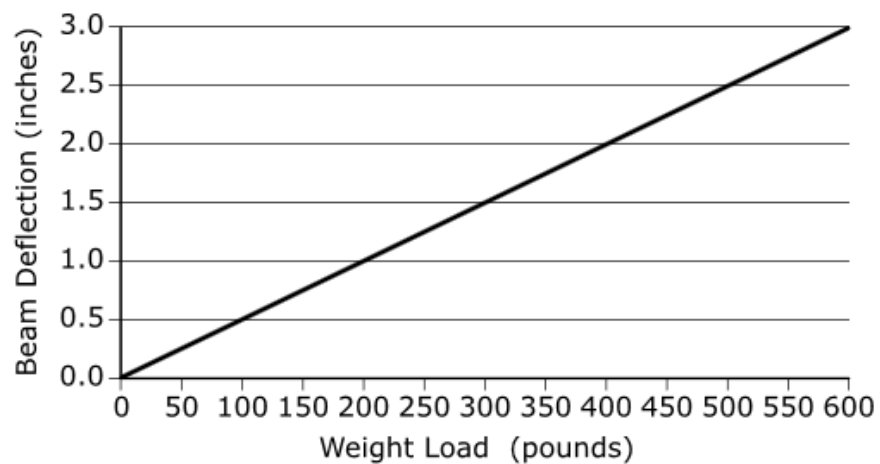
For every 50-pound increase in the weight load, what will be the change in the deflection?

- A. an increase of 0.50 inch

- B. a decrease of 0.50 inch

- C. an increase of 0.25 inch

- D. a decrease of 0.25 inch

7. The table shows values for a linear function, $f(x)$.

x	f(x)
−1	−8
3	−5
7	−2
11	1

What is an equation for $f(x)$?

Drag and drop the numbers into the boxes. **Not** all numbers listed will be used.

$$-\frac{29}{4} \quad -\frac{3}{4} \quad \frac{3}{4} \quad \frac{4}{3} \quad \frac{11}{4}$$

$$f(x) = \boxed{} \, x + \boxed{}$$

8. The quadratic function *f* is represented by the equation, and the table gives some values of the quadratic function *g*.

$$f(x) = x^2 + 6x + 16$$

| x	2	4	6
g(x)	8	5	8

Which statements are true?

Select **all** that apply.

☐ A. The y-intercept of $f(x)$ is greater than the y-intercept of $g(x)$.

☐ B. The y-intercept of $g(x)$ is greater than the y-intercept of $f(x)$.

☐ C. The x-coordinate of the vertex of $f(x)$ is greater than the x-coordinate of the vertex of $g(x)$.

☐ D. The x-coordinate of the vertex of $g(x)$ is greater than the x-coordinate of the vertex of $f(x)$.

☐ E. The y-coordinate of the vertex of $f(x)$ is greater than the y-coordinate of the vertex of $g(x)$.

☐ F. The y-coordinate of the vertex of $g(x)$ is greater than the y-coordinate of the vertex of $f(x)$.

9. A rectangular garden has a length that is 3 feet longer than its width. Let w represent the width of the garden, in feet. The entire garden is surrounded by a 2-foot-wide cement walkway. What does the algebraic expression $(w + 4)(w + 7)$ represent in this context?

○ A. the area of the garden only

○ B. the total area of the garden and walkway

○ C. the perimeter of the garden only

○ D. the perimeter of the walkway only

10. The diagram represents a right rectangular prism with dimensions labeled as algebraic expressions.
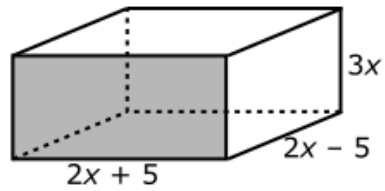
Which of these expressions represents the volume of the prism?

Select **all** that apply.

☐ A. $7x$

☐ B. $4x^2 - 25$

☐ C. $12x^3 - 75x$

☐ D. $3x\left(4x^2 - 25\right)$

☐ E. $(2x + 5)(6x^2 - 15x)$

☐ F. $12x^3 + 60x^3 + 75x$

☐ G. $12x^3 - 30x^3 + 10x - 25$

11. One day an e-mail is sent to 7 people. That day **each** person who receives the e-mail sends the e-mail to two friends. **Each** friend who receives the e-mail sends it to two more people on the following day. Consider an expression used to determine the number of people who receive the e-mail on day n, if the pattern continues.

Parts of the expression are shown. Interpret the meaning of **each** part of the expression by dragging it to the appropriate box. (Not all parts will be used.)

Drag and drop parts of the expression into the appropriate boxes.

2	7	2^n	$7(2^n)$

Initial number of people who receive the e-mail	The factor by which the number of people who receive the e-mail increases each day	The number of people who receive the e-mail on day n, where $n \geq 2$

12. **Part A**

A dump truck weighs 11.25 tons when empty. A conveyor belt pours sand into the truck at a constant rate of $\frac{1}{4}$ ton per minute until it is full. Let t represent the elapsed time in minutes. Let w represent the weight of the truck after t minutes.

Write an equation for w in terms of t.

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

$$w(t) = \square$$

| ↰	+	−	×	÷	⊟	▢
↱	y^x	$\sqrt{\ }$	$\sqrt[3]{\ }$	=	(·)	%
🗑			▼			

Part B

The dump truck from Part A weighs 18 tons when filled. At the same time the dump truck is being filled, an identical dump truck filled to capacity is being emptied at a rate of $\frac{1}{8}$ ton per minute.

How much sand is in each dump truck when the trucks are the same weight?

Enter your answer in the box.

[   ] tons

13. For a school project, two students, Shona and Miguel, recorded the number of text messages each of them sent each day for a 60-day period. The box plots summarize the recorded data.

Number of Text Messages Sent
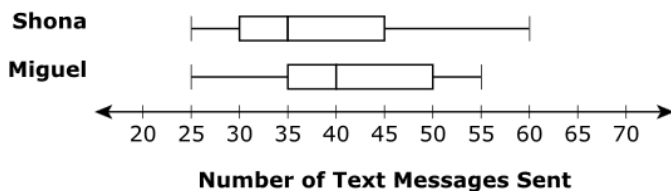
Part A

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

The median of Miguel's data is [Choose... ▾] the median of Shona's data, and the range of

> greater than
> less than
> equal to

Miguel's data is [Choose... ▾] the range of Shona's data.

> greater than
> less than
> equal to

Part B

Select from the drop-down menu to correctly complete the sentence.

Approximately [Choose... ▾] of Miguel's data values are greater than the median of Shona's data.

> 5%
> 10%
> 20%
> 25%
> 50%
> 75%

Part C

Which of the statements can be concluded from the box plots?

Select **all** that apply.

☐ A. For approximately 15 days, Miguel sent 50 or more text messages per day.

☐ B. For at least 5 days, Shona sent 55 or more text messages per day.

☐ C. There was at least one day on which Shona sent 40 text messages.

☐ D. The number of days on which Shona sent more text messages than Miguel is greater than 30.

☐ E. Shona and Miguel each sent 25 text messages on the same day.

Part D

There are different methods of identifying outliers in a set of data values. One method is described.

- Multiply the interquartile range by 1.5.
- Add the result to the third quartile to determine the upper limit, and subtract the result from the first quartile to determine the lower limit.
- Any value greater than the upper limit or less than the lower limit is considered an outlier.

On the 61st day, Shona sent t text messages, which will be considered an outlier based on the described method. Which number could be the value of t?

Select **all** that apply.

☐ A. 5

☐ B. 10

☐ C. 15

☐ D. 65

☐ E. 75

14. A total of 160 students were surveyed from the countries of Australia, Canada, and the United Kingdom. One of the questions asked students to report which hand they considered to be their most dominant. Results are shown in the table.

	Right-Hand Dominant	Left-Hand Dominant	Total
Australia	68	11	79
Canada	46	6	52
United Kingdom	25	4	29
Total	139	21	160

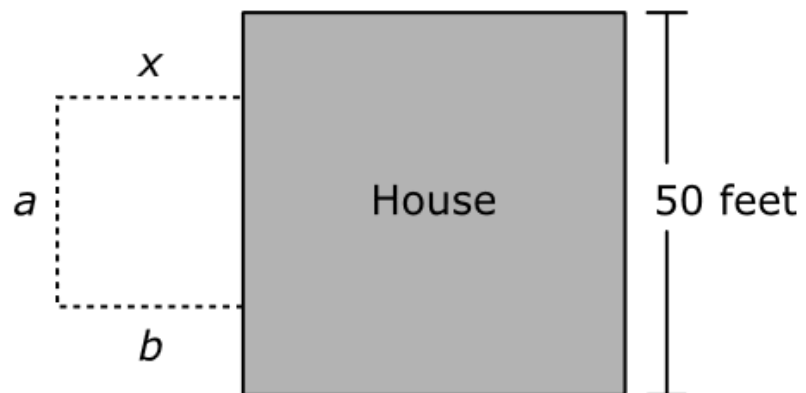Select an option from each drop-down menu to complete the sentence.

The country [Choose... ▼] had the greatest percentage of its students report being right-hand

Australia
Canada
United Kingdom

dominant with approximately [Choose.. ▼] .

68%
86%
88%

15. The figure shows the 50-foot side of a house and a proposed rectangular garden to be fenced in on 3 sides.

The 3 sides, a, b, and x, will be made of 44 feet of fencing.

Part A

Which of the following is an expression for a in terms of x?

- A. $2x + 44$

- B. $2x - 44$
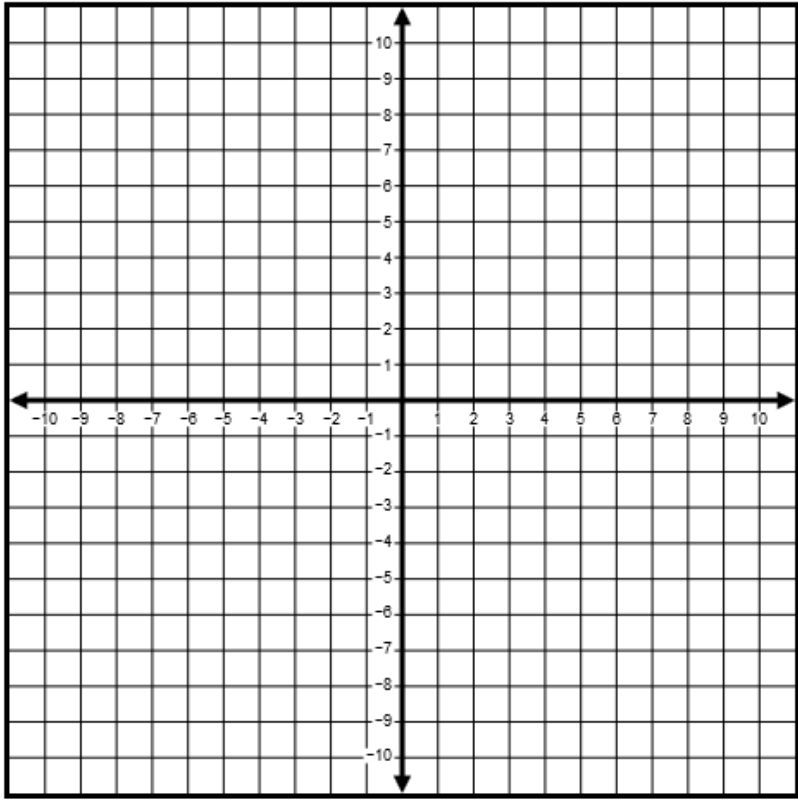
- C. $44 - 2x$

- D. $44 - x + x$

Part B

What is the maximum area, in square feet, for the garden if 44 feet of fencing are used?

Enter your answer in the box.

16. An absolute value function in the form $f(x) = a|x + b| + c$ is graphed in the xy-coordinate plane, where a, b, and c are constants.

Select the Absolute Value button and then drag the points to show the graph $f(x) = -|2x - 6| + 1$.

Absolute Value

17. The value, V, of an investment is given by the function $V(t)$, where t is the number of years since 1995 and V is measured in thousands of dollars. Which equation indicates that the investment had a value of $8,000 in 2005?

   ○ A. $V(8) = 10$

   ○ B. $V(10) = 8$

   ○ C. $V(8,000) = 2005$

   ○ D. $V(2005) = 8,000$

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

To solve the equation $x^2 - x - 2 = 0$ for x by completing the square, a student could use the equivalent equation $\left(x - \boxed{\text{Choose..} \blacktriangledown}\right)^2 = \boxed{\text{Choose..} \blacktriangledown}$.

Choose..	Choose..
-1/4	-1/4
1/4	1/4
-1/2	-1/2
1/2	1/2
-9/4	-9/4
9/4	9/4
-3/2	-3/2
3/2	3/2

19. Choose the expressions that are equivalent to $x^2 + 4x + 3$.

Select **all** that apply.

☐ A. $(x+2)^2 - 1$

☐ B. $(x+2)^2 + 1$

☐ C. $(x-1)(x-3)$

☐ D. $(x+1)(x+3)$

☐ E. $(x-1)(x+4)$

20. Complete the sentence by selecting the correct phrase.

The expression $(a^2)^2 - (b^2)^2$ is an example of [Choose... ▼].

a system of equations
a polynomial of degree 2
a difference of squares
a completely factored expression
an exponential function

Which of the listed expressions are equivalent to $(a^2)^2 - (b^2)^2$?

Select **all** that apply.

☐ A. $a^4 - b^4$

☐ B. $a^4 + b^4$

☐ C. $(a^2 + b^2)(a^2 - b^2)$

☐ D. $(a^2 + b^2)(a+b)(a-b)$

☐ E. $(a-b)^4$

21. Carson is a high school student with two part-time jobs. He earns $6 per hour for babysitting, and he earns $8 per hour doing clerical work for his father's business. His goal is to earn at least $96 a week, but because of school, he does not want to work more than 15 hours each week.

Part A

Let b represent the number of hours Carson works in one week at the babysitting job, and let c represent the number of hours Carson works in one week at his father's business. Which inequalities represent the constraints on what Carson can earn and the number of hours he can work in one week?

Select **all** that apply.

☐ A. $b + c \leq 15$

☐ B. $6b + 8c \leq 15$

☐ C. $6b + 8c \geq 15$

☐ D. $b + c \geq 96$

☐ E. $6b + 8c \geq 96$

☐ F. $6b + 8c \leq 96$

Part B

Which combination of numbers of hours would allow Carson to work 15 hours in one week and earn at least $96 ?

Select **all** that apply.

☐ A. 10 hours babysitting and 5 hours clerical

☐ B. 11 hours babysitting and 4 hours clerical

☐ C. 12 hours babysitting and 3 hours clerical

☐ D. 13 hours babysitting and 2 hours clerical

☐ E. 14 hours babysitting and 1 hour clerical

Part C

Suppose Carson worked as a babysitter for 5 hours one week. What is the minimum number of **full** hours he would need to work at his father's business to earn at least $96 that week?

Enter your answer in the box.

☐ hours

Part D

Suppose Carson worked at his father's business for 8 hours one week. What is the minimum number of **full** hours he would need to babysit that week to earn at least $96 that week?

Enter your answer in the box.

☐ hours

22. A parabola with the equation $y = a(x - b)^2 + c$ has a minimum at the point $(2, \ -1)$ and a y-intercept of 3 when graphed in the xy-coordinate plane.

Part A

What are the values of a, b, and c?

Select the **three** that apply.

☐ A. $a = -1$

☐ B. $a = 1$

☐ C. $a = 2$

☐ D. $b = -2$

☐ E. $b = 2$

☐ F. $c = -1$

☐ G. $c = 1$

Part B

What are the x-intercepts of the parabola?

Select **all** that apply.

☐ A. -3

☐ B. -2

☐ C. -1

☐ D. 0

☐ E. 1

☐ F. 2

☐ G. 3

23. Jamie has a plan to save money for a trip. Today, she puts 5 pennies in a jar. Tomorrow, she will put the initial amount in plus another 5 pennies. Each day she will put 5 pennies more than she put into the jar the day before, as shown in the table.

Day	0	1	2	3
Deposit (pennies)	5	10	15	20

Part A

Let $f(d)$ represent the amount of pennies she puts into the jar on day d. What does $f(10) = 55$ mean?

○ A. Jamie will put 10 pennies in the jar on day 55.

○ B. Jamie will put 55 pennies in the jar on day 10.

○ C. Jamie will have 10 pennies in the jar on day 55.

○ D. Jamie will have 55 pennies in the jar on day 10.

Part B

Let $f(d)$ represent the amount of pennies that Jamie puts into the jar on day d. Today is day 0.

Select the statement that is true.

○ A. $f(d+1) = f(d)$

○ B. $f(d+1) = 5(f(d))$

○ C. $f(d+1) = f(d) + 1$

○ D. $f(d+1) = f(d) + 5$

24. The parabola $f(x) = (x-2)^2 + 1$ is graphed in the *xy*-coordinate plane.

Part A

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

The vertex of the parabola is 2 units | Choose... ▼ | the origin and 1 unit | Choose... ▼ | the origin.

| up from |
| down from |
| right of |
| left of |

| up from |
| down from |
| right of |
| left of |

Part B

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

How does the function $f(x+3)$ compare to $f(x)$?

$f(x+3)$ has a | Choose... ▼ | shift 3 units | Choose... ▼ | $f(x)$.

| vertical |
| horizontal |

| up from |
| down from |
| right of |
| left of |

25. A small company manufactures a certain item and sells it online. The company has a business model where the cost C, in dollars, to make x items is given by the equation $C = \frac{20}{3}x + 50$ and the revenue R, in dollars, made by selling x items is given by the equation $R = 10x$. The break-even point is the point where the cost and revenue equations intersect.

Part A

Graph the cost and revenue equations on the *xy*-coordinate plane provided. Plot two points, then a line will connect the points.
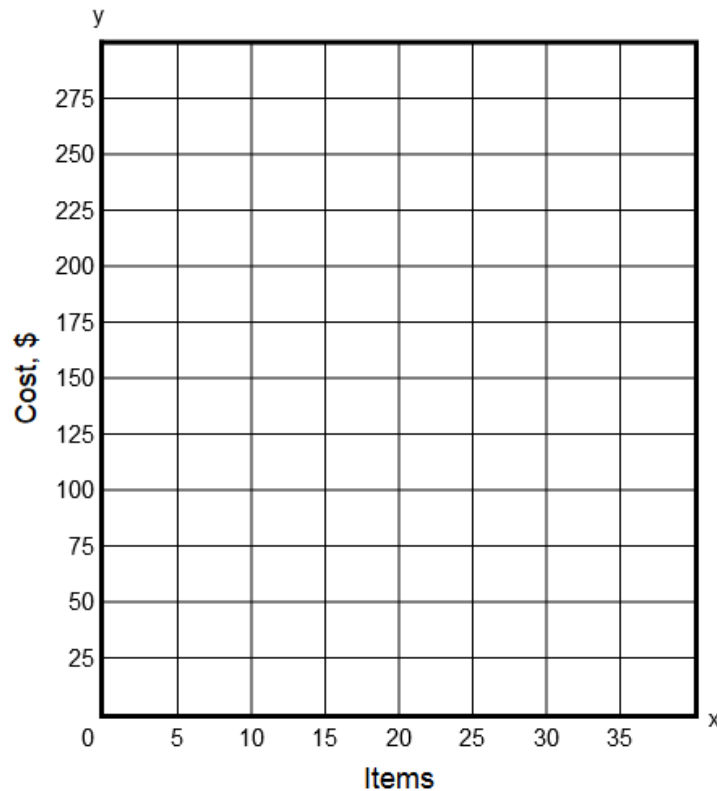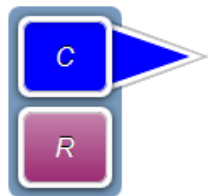
Part B

How many items must the company sell to break even?

Enter your answer in the box.

26. Tonya's class planted sunflowers and the students are tracking the growth of their individual plants. The table shows the height of Tonya's plant t days after she planted her sunflower seed.

Time (days)	Height (inches)
10	4
20	8
30	12
40	16

Part A

If the growth of the sunflower continues at the same rate, what is the expected height, in inches, on day 55?
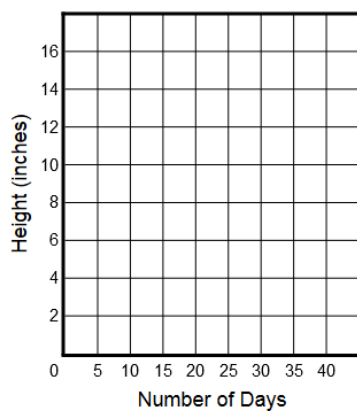
Enter your answer in the box.

[ ] inches

Part B

Based on the data in the table, which function is an appropriate model for the height, h, in inches, at time t?

○ A. $h(t) = 4t$

○ B. $h(t) = \frac{1}{4}t$

○ C. $h(t) = \frac{5}{2}t$

○ D. $h(t) = \frac{2}{5}t$

Part C

On the given *xy*-coordinate plane, graph $h(t)$.

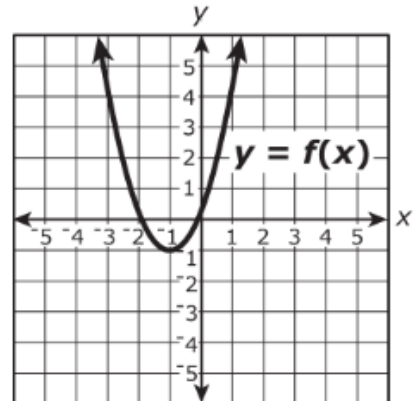To graph a line, select two points on the coordinate plane. A line will be drawn through the points.

Part D

What is an appropriate domain for the function in context?

○ A. integers only

○ B. nonnegative integers only

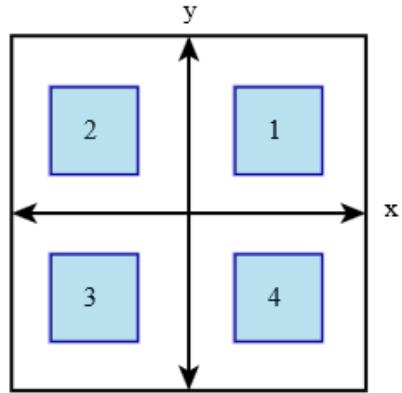○ C. all real numbers

○ D. all nonnegative real numbers

27. A quadratic function $f(x)$ is graphed in the xy-coordinate plane.

In which quadrant would the vertex of $f(x+3) + 2$ be located?

Select the correct quadrant.

28. The height, in inches, of each of three boys is 54.0, 48.5, and 46.0, respectively. The height of a fourth boy is denoted by h inches.

The average height, A, of the 4 boys can be expressed as a function of h in the form $A(h) = \dfrac{c+h}{d}$, where c and d are constants. What are the values of c and d?

Enter your answers in the boxes.

$c = \boxed{}$ and $d = \boxed{}$

Select an option from each drop-down menu to complete the sentence.

The appropriate domain for the function A is [Choose... ▼]; the function is

Choose... ▼
decreasing and linear
decreasing and nonlinear
increasing and linear
increasing and nonlinear

the set of all real numbers
the set of positive real numbers
the set of all integers
the set of positive integers

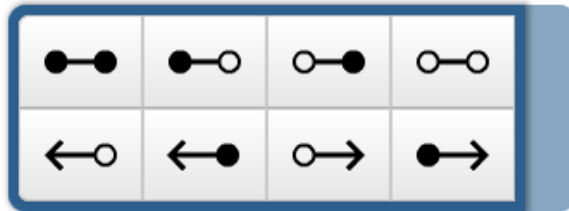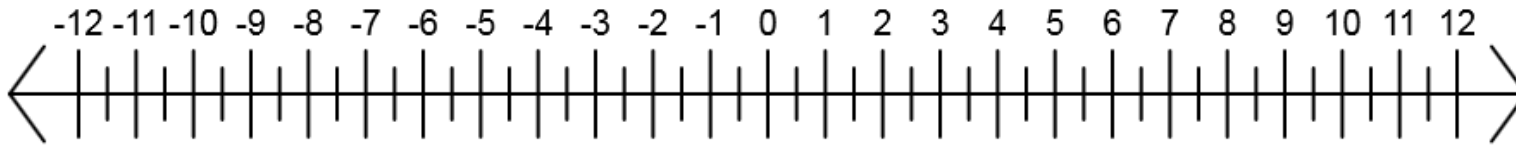29. The graphs of $f(x) = -x^3 - 4$ and $g(x) = 0.5x^2 + x + 4$ are given.
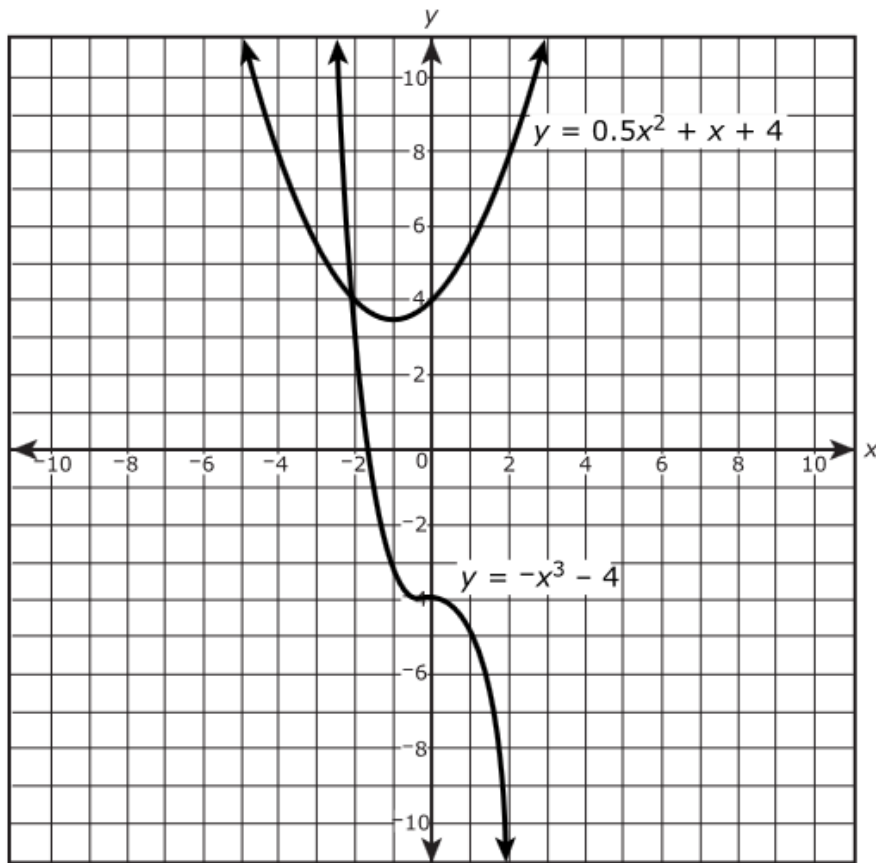
Use the graphs to find the solution to the equation $-x^3 - 4 = 0.5x^2 + x + 4$.

Enter your answer in the box.

$x = \boxed{}$

30. Solve $4 - \dfrac{2}{3}x > 2 - x$ for x. Plot the solution set on the number line.

Select a solution set indicator. Then, select the number line and drag the point(s) to appropriate location(s).

31. A worker earned a 2% increase in her annual salary for each of 4 years. She plans to continue working in her position for an additional n years. If she continues to earn a 2% increase in her annual salary, which statement describes the expression that can be used to calculate the total percent increase in her annual salary from the first year to the last year?

- A. The expression $1.02^{(4n)}$ can be used because $\left(1.02^4\right)^n = 1.02^{(4n)}$.

- B. The expression $1.02^{(4n)}$ can be used because $1.02^4 \times 1.02^n = 1.02^{(4n)}$.

- C. The expression $1.02^{(4+n)}$ can be used because $1.02^4 \times 1.02^n = 1.02^{(4+n)}$.

- D. The expression $1.02^{(4+n)}$ can be used because $1.02^4 + 1.02^n = 1.02^{(4+n)}$.

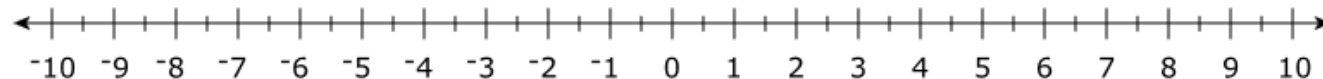32. Consider the function $f(x) = x^2 + bx - 16$, where b is a constant.

Part A

If the function has an axis of symmetry at $x = 5$, what is the value of b?

Enter your answer in the box.

<div style="border:1px solid black; width:120px; height:50px;"></div>

Part B

If $b = -6$, what are the zero(s) of the function?

Select the location(s) to plot the zero(s) on the number line.

33. What is the sum of the roots of the equation $2x^2 + 5x - 3 = 0$?

- A. -3.5

- B. -2.5

- C. -1.5

- D. 2.5

34. The area, A, of a rectangular parking lot is given by the equation $A = 16s^2 + 25$. Jacob knows the area of the parking lot and wants to find s. Solve $A = 16s^2 + 25$ for s.

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

$s = \square$