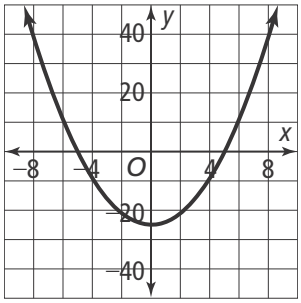
1-1 Additional Practice

Key Features of Functions

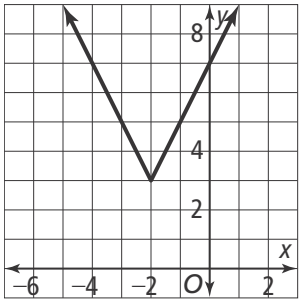
For Items 1–2, identify the following information for the function of each graph:

1.



Domain: **(−∞, ∞)**
Range: **[−25, ∞)**
x-intercepts: **−5, 5**
y-intercepts: **−25**
Interval positive: **(−∞, −5) and (5, ∞)**
Interval negative: **(−5, 5)**
Interval increasing: **(0, ∞)**
Interval decreasing: **(−∞, 0)**
Average rate of change over [−5, 0]: **−5**

2.



Domain: **(−∞, ∞)**
Range: **[3, ∞)**
x-intercepts: **none**
y-intercepts: **7**
Interval positive: **(−∞, ∞)**
Interval negative: **none**
Interval increasing: **(−2, ∞)**
Interval decreasing: **(−∞, −2)**
Average rate of change over [−2, 0]: **2**

3. Sketch a linear graph given the following key features:

Domain: (−∞, ∞)

Range: (−∞, ∞)

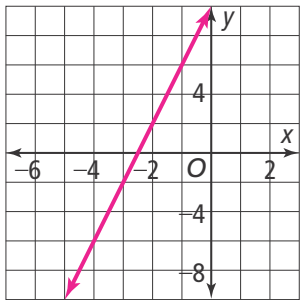
Increasing: (−∞, ∞)

x-intercepts: −2.5

y-intercept: 10

Positive: (−2.5, ∞)

Negative: (−∞, −2.5)

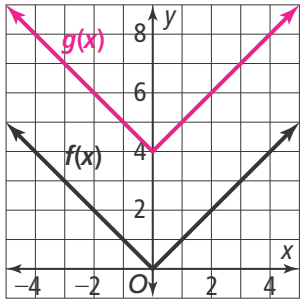


4. Chiang is filling a 50 ft^3 container with water at a rate of 0.5 ft^3/min. Interpret the key features for this situation. **Domain: [0, 100]; Range: [0, 50] Increasing: [0, 100]; Decreasing: N/A; *x*-intercepts: 0; *y*-intercepts: 0; Positive: (0, 100]; Negative: N/A.**

1-2 Additional Practice

Transformations of Functions

1. Graph the function $g(x) = |x| + 4$ as a translation of the parent function f shown. How did the transformation affect the domain and range?



Domain of $f(x)$ and $g(x)$ are the same. Range values are $f(x) = y \geq 0$ and $g(x) = y \geq 4$.

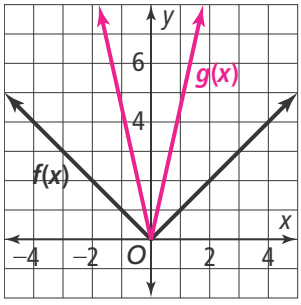
For Items 2 and 3, what is the equation for each reflected graph of $f(x) = x^2 - 4$?

2. Reflect across the x-axis. **$f(x) = -x^2 + 4$**

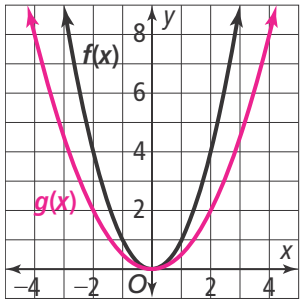
3. Reflect across the y-axis. **$f(x) = x^2 - 4$**

Graph each function as a vertical stretch or compression of the parent function f.

4. $g(x) = 4.5|x|$



5. $g(x) = 0.5x^2$



What transformations of $f(x) = x^2$ are applied to get the function g?

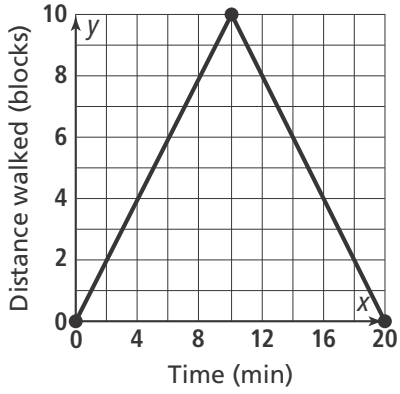
6. $g(x) = 3(x + 2)^2$

translation of 2 units to the left; vertical stretch by 3

7. $g(x) = -(x - 5)^2 + 1$

translation of 5 units to the right; reflection across x-axis; vertical translation up 1

8. Derek walks to his best friend's house at a rate of 1 block per minute, then turns around and walks home. The graph shows the distance Derek walks in the given amount of time. Write an equation for the graph.



$g(x) = -|x - 10| + 10$

9. Given the parent function $f(x) = x^2$, what is the new equation if the function is translated 4 units to the right and 3 units down?

$f(x) = (x - 4)^2 - 3$

1-3 Additional Practice

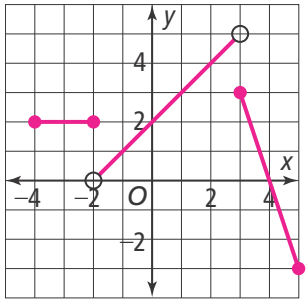
Piecewise-Defined Functions

1. A phone company offers a monthly data plan for $10 a month. The plan includes 2 megabytes of data, and charges $0.10 per megabytes above the 2 megabytes of data. Write a piecewise-defined function for $M(x)$, the cost for x megabytes of data used in a month.

$$M(x) = \begin{cases} 10, & 0 < x \le 2 \\ 10 + 0.10(x - 2), & x > 2 \end{cases}$$

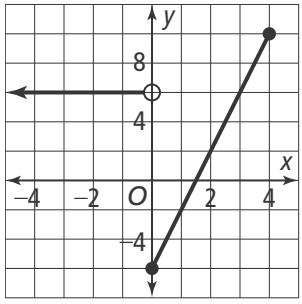
2. Graph the piecewise-defined function. State the domain and range. Identify whether the function is increasing, constant, or decreasing on each interval of the domain.

$$f(x) = \begin{cases} 2, & -4 \le x \le -2 \\ x + 2, & -2 < x < 3 \\ -3x + 12, & 3 \le x \le 5 \end{cases}$$



domain: $-4 \le x \le 5$; range: $-3 \le y < 5$; constant when $-4 \le x \le -2$; increasing when $-2 < x < 3$; decreasing when $3 \le x \le 5$

3. Write the rule that defines the piecewise-defined function in the graph.



$$f(x) = \begin{cases} 6, & x < 0 \\ 4x - 6, & 0 \le x \le 4 \end{cases}$$

4. Write the function f as a piecewise-defined function.

$f(x) = |2x - 8|$ $\quad f(x) = \begin{cases} -2x + 8, & x < 4 \\ 2x - 8, & x \ge 4 \end{cases}$

5. A shipping service uses the weight of a package to determine its postage. The charge is $3 for the first pound and $2 for each additional pound up to 5 pounds. What are the domain and range of the function?

$$f(x) = \begin{cases} 3, & 0 < x \le 1 \\ 5, & 1 < x \le 2 \\ 7, & 2 < x \le 3 \\ 9, & 3 < x \le 4 \\ 11, & 4 < x \le 5 \end{cases}$$

Domain: $0 < x < 5$

Range: {3, 5, 7, 9, 11}

6. You plan to rent a car from XYZ Car Rental Company for a flat rate of $35 a day. If you plan to use the car for 3 days or fewer, you must also pay a $10 insurance fee per day. If you plan to use the car for more than 3 days, there is a $5 insurance fee per day. Write a piecewise-defined function that models this function.

$$f(x) = \begin{cases} 45x, & 1 \le x \le 3 \\ 40x, & x > 3 \end{cases}$$

1-4 Additional Practice

Arithmetic Sequences and Series

Are the following sequences arithmetic? If so, what is the common difference? What is the next term in the sequence?

1. 0, −3, −6, −9….

Yes; −3, −12

2. 2, 3, 5, 8, ….

No.

3. 127, 140, 153, 166….

Yes. 13, 179

Translate between the recursive and explicit definitions for each sequence.

4. $a_n \begin{cases} 6, n = 1 \\ a_{n-1} + 3, n > 1 \end{cases}$

$a_n = 6 + 3(n - 1)$

5. $a_n = 12 - 2(n - 1)$

$a_n = \begin{cases} 12, n = 1 \\ a_{n-1} - 2, n > 1 \end{cases}$

6. $a_n = 5 - 4(n - 1)$

$a_n = \begin{cases} 5, n = 1 \\ a_{n-1} - 4, n > 1 \end{cases}$

7. Each year, a volunteer organization expects to add 5 more people for whom the group provides home maintenance services. This year, the organization provides the service for 32 people.

a. Write an explicit formula for the number of people the organization expects to serve each year. **$a_n = a_{n-1} + 5$, where $a_1 = 32$**

b. How many people would the organization expect to serve during the year, 20 years from now? **127 people**

Find the sum of an arithmetic series with the given number of terms, a_1 and a_n.

8. 9 terms; 2, 5, 8, 11….

126

9. 12 terms; −2, 2, 6, 10,….

240

10. 20 terms; 5, 10, 15, 20, ….

1,050

Find the sum of each of the following series.

11. $\sum_{n=2}^{5} (5n + 3)$

82

12. $\sum_{n=1}^{4} (2n + 0.5)$

22

13. $\sum_{n=1}^{4} (-n - 3)$

−22

14. A marching band formation consists of 6 rows. The first row has 9 musicians, the second has 11, the third has 13 and so on. How many musicians are in the last row and how many musicians are there in all? **19 musicians; 84 musicians**

15. A student identifies the series 10, 15, 20, 25, 30 as an infinite arithmetic series. Is he correct? Explain. **Sample answer: No, the series is a finite arithmetic series. An infinite arithmetic series would continue indefinitely and have an ellipsis, or "…", at the end of the series, which indicates the series goes on infinitely. There is no ellipsis at the end of this series.**

1-5 Additional Practice

Solving Equations and Inequalities by Graphing

Use a graph to solve each equation.

1. $4x + 6 = 8x - 10$

$x = 4$

2. $-\frac{3}{4}x - 2 = -\frac{1}{2}x + 1$

$x = -12$

3. $|4 - 2x| + 5 = 9$

$x = 0$ or 4

Use a graph to solve each inequality.

4. $x^2 + 4x - 5 < 0$

$-5 < x < 1$

5. $x^2 - x - 12 \geq 0$

$x \leq -3$ or $x \geq 4$

6. $-2x + 5 < -7 - 3x$

$x < -12$

Use a graph and a table to solve the equation. Round to the nearest thousandth if necessary.

7. $x^2 + 3x - 5 = 4x + 3$

$x \approx -2.372$ and 3.372

8. $x^2 - 7x - 5 = \frac{1}{2}x - 4$

$x \approx -0.131$ and 7.631

9. $x^2 - 4x - 1 = x^2 + 2x + 4$

$x \approx -0.833$

Use graphing technology to approximate the solutions of the equation to the nearest tenth.

10. $\frac{1}{3}x^2 + 2x - 9 = 6 + |x - 2|$

$x \approx -12.9$ and 4.9

11. $x^2 + 5x - 2 = 6 + |3x + 1|$

$x \approx -8.8$ and 2.2

12. $3 + |x - 3| = \frac{1}{3}|x + 2| + 5$

$x \approx 0.3$ and 8.5

13. David begins the summer with a savings of $54.00 more than Fatima. David's job pays $8.25 per hour. Fatima's job pays $9.75. If they both work the same amount of time each day, how many hours of work will it take David to have as much money as Fatima? Write an inequality and then solve.

$54 + 8.25x \leq 9.75x$ $x \geq 36$; David will need to work at least 36 hours to have as much money as Fatima.

14. If you use a graph and a table to solve an equation that shows two expressions equal to one another, how can you use algebra to check your answer?

Input the approximate answer into each expression. Check to see if the result, which is an estimate, is close to the correct answer. If the answer is too far from the correct answer, then you may need to reexamine the table and graph.

1-6 Additional Practice

Linear Systems

Solve the following system of equations.

1. $\begin{cases} y = 7 - x \\ x + 3y = 7 \end{cases}$
(7, 0)

2. $\begin{cases} 4x + 3y = -16 \\ -x + y = 4 \end{cases}$
(−4, 0)

3. $\begin{cases} 2x - 4y = -4 \\ 3x - y = 4 \end{cases}$
(2, 2)

Solve the following system of equations.

4. $\begin{cases} 2x + 3y - z = 9 \\ -2x - y + 2z = 2 \\ x + y - 2z = 3 \end{cases}$
(−5, 6, −1)

5. $\begin{cases} 4x - 2y - z = 5 \\ x + 4y - z = -1 \\ 2x - 2y - 2z = -2 \end{cases}$
(2, 0, 3)

6. $\begin{cases} -3x + 2y + 5z = -10 \\ -x - 2y + 3z = 6 \\ 2x - y - z = 8 \end{cases}$
(3, −3, 1)

Write the matrix for the system of equations.

7. $\begin{cases} 3x + y = -4 \\ -2x + 4y = 7 \end{cases}$
$\left[\begin{array}{cc|c} 3 & 1 & -4 \\ -2 & 4 & 7 \end{array}\right]$

8. $\begin{cases} 4x - y + 2z = 10 \\ 5x + 2y - 3z = 0 \\ x - 3y + z = 6 \end{cases}$
$\left[\begin{array}{ccc|c} 4 & -1 & 2 & 10 \\ 5 & 2 & -3 & 0 \\ 1 & -3 & 1 & 6 \end{array}\right]$

9. $\begin{cases} 3x - 2y + z = 6 \\ 4x - 6z = 6 \\ -3x - 4z = -10 \end{cases}$
$\left[\begin{array}{ccc|c} 3 & -2 & 1 & 6 \\ 4 & 0 & -6 & 6 \\ 0 & -3 & -4 & -10 \end{array}\right]$

10. Last year, a baseball team paid $20 per bat and $12 per glove, spending a total of $552. They bought 34 pieces of equipment. What are a system of equations and an augmented matrix that can represent this situation?

$\begin{cases} 20x + 12y = 552 \\ x + y = 34 \end{cases}$ $\left[\begin{array}{cc|c} 20 & 12 & 552 \\ 1 & 1 & 34 \end{array}\right]$

11. Write the system of equations for the matrix. $\left[\begin{array}{ccc|c} 2 & 5 & 0 & 13 \\ -3 & 1 & 2 & 6 \\ 4 & 0 & -3 & 5 \end{array}\right]$

$\begin{cases} 2x + 5y = 13 \\ -3x + y + 2z = 6 \\ 4x - 3z = 5 \end{cases}$

1-7 Additional Practice

Solving Linear Systems Using Matrices

Solve each linear system of equations as a matrix.

1. $\begin{cases} 6x - y = 8 \\ -3x + 3y = 6 \end{cases}$

(2, 4)

2. $\begin{cases} x - 2y + 3z = 18 \\ 9x + 2y - z = -2 \\ -6x - y + 2z = 4 \end{cases}$

(1, −4, 3)

3. $\begin{cases} 3x - 4y + 8z = 1 \\ 2y - 3z = -9 \\ -2x + 3y - 5z = 2 \end{cases}$

(−9, 3, 5)

Solve the following system of equations.

4. $\left[\begin{array}{cc|c} 2 & -6 & -7 \\ -1 & 3 & 14 \end{array}\right]$

(−4.625, 2.25)

5. $\left[\begin{array}{ccc|c} 5 & 3 & -4 & -11 \\ -1 & 6 & 4 & 5 \\ 0 & 8 & -1 & 0 \end{array}\right]$

(2, 0, 3)

6. $\left[\begin{array}{ccc|c} 5 & 3 & -4 & -11 \\ -1 & 6 & 4 & 5 \\ 0 & 8 & 6 & 14 \end{array}\right]$

(3, −2, 5)

Solve each system of equations using technology with matrices.

7. $\begin{cases} 4x + y - 2z = 3 \\ 2y + z = 4 \\ 3x - 3y - z = 9 \end{cases}$

(4, −1, 6)

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

(2, 3, −5)

9. $\begin{cases} 3x + 5z = -4 \\ -2x + y - 3z = 9 \\ -x - 2y + 9z = 0 \end{cases}$

(−3, 6, 1)

10. The movie theater sells popcorn in three different sizes. A small popcorn costs $2, a medium popcorn costs $5, and a large popcorn costs $10. Ruby sold 250 total containers of popcorn for a total of $1,726. Ruby sold twice as many large containers as small ones.

a. How many of each size popcorn did Ruby sell?

68 small, 46 medium, 136 large

b. How much money was made from selling the small-size popcorn?

$136

11. Write a matrix for a system of equations that does not have a unique solution.

Sample answer:

$$\left[\begin{array}{cc|c} 2 & -6 & -7 \\ -1 & 3 & 14 \end{array}\right]$$

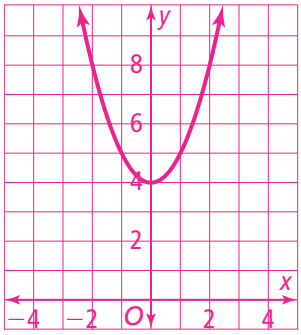
2-1 Additional Practice

Vertex Form of a Quadratic Function

Graph each function. Describe how it was translated from $f(x) = x^2$.

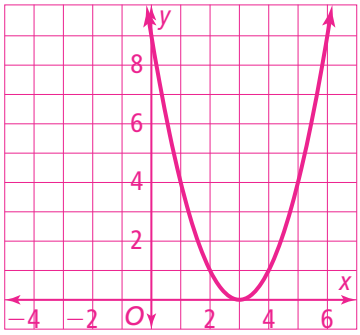
1. $f(x) = x^2 + 4$

translated up 4 units



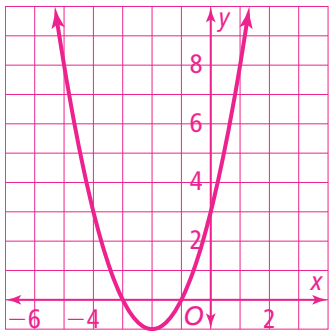
2. $f(x) = (x - 3)^2$

translated right 3 units



3. $f(x) = (x + 2)^2 - 1$

translated 1 unit down and 2 units left



Identify the vertex, axis of symmetry, the maximum or minimum value, and the domain and the range of each function.

4. $y = (x - 2)^2 + 3$

Vertex: (2, 3); Axis of Symmetry: $x = 2$; Minimum: $y = 3$; Domain: $(-\infty, \infty)$; Range: $(3, \infty)$

5. $f(x) = -0.2(x + 3)^2 + 2$

Vertex: (−3, 2); Axis of Symmetry: $x = -3$; Maximum: $y = 2$; Domain: $(-\infty, \infty)$; Range: $(-\infty, 2]$

6. $y = (x + 4)^2 - 1$

Vertex: (−4, −1); Axis of Symmetry: $x = -4$; Minimum: $y = -1$; Domain: $(-\infty, \infty)$; Range: $(-1, \infty)$

Write the equation of each parabola in vertex form.

7. vertex (3, −2), point (2, 3)

$y = 5(x - 3)^2 - 2$

8. vertex (−4, −24), point (−5, −25)

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

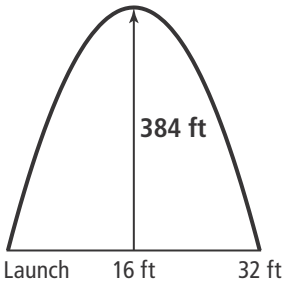
9. vertex (−12.5, 35.5), point (1, 400)

$y = 2(x + 12.5)^2 + 35.5$

10. Given the function $f(x) = x^2$, Write the equation function $g(x)$ whose graph is a translation 5 units left and 3 units down. $g(x) = (x + 5)^2 - 3$

11. The diagram shows the path of a model rocket launched from the ground. It reaches a maximum altitude of 384 ft when it is above a location 16 ft from the launch site. What quadratic function models the height of the rocket?

$f(x) = -1.5(x - 16)^2 + 384$



2-2 Additional Practice

Standard Form of a Quadratic Function

Find the vertex of a quadratic function written in standard form.

1. $f(x) = 3x^2 + 18x + 32$ Vertex: (−3, 5)

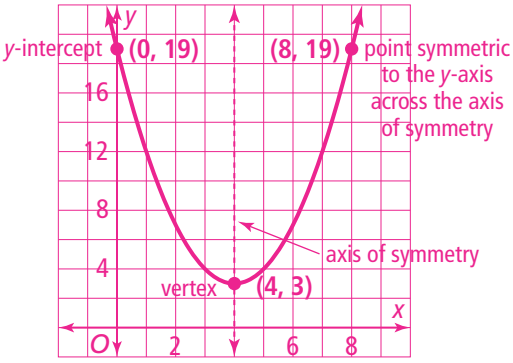
2. $f(x) = x^2 + 2x - 5$ Vertex: (−1, −6)

3. $f(x) = -3x^2 + 18x - 27$ Vertex: (3, 0)

Find the vertex, axis of symmetry, and *y*-intercept of the functions, then sketch the graph.

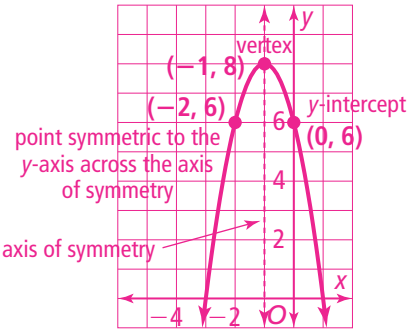
4. $f(x) = x^2 - 8x + 19$

Vertex (4, 3)
Axis of symmetry $x = 4$
Y-intercept (0, 19)
point symmetric to *y*-axis (8, 19)



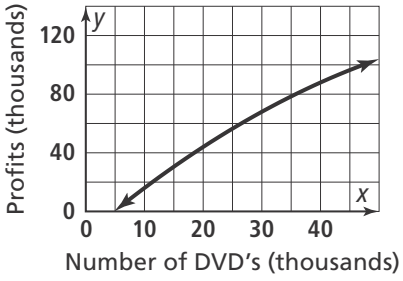
5. $f(x) = -2x^2 - 4x + 6$

Vertex (−1, 8)
Axis of symmetry $x = -1$
Y-intercept (0, 6)
point symmetric to *y*-axis (−2, 6)



Interpret the graph of a quadratic function.

6. A small independent movie company determines the profit *P* for producing *n* DVD copies of a recent release is $P = -0.02n^2 + 3.40n - 16$. *P* is the profit in thousands of dollars and *n* is in thousands of units.



a. How many DVDs should the company produce to maximize the profit? 85,000 DVDs

b. What will the maximum profit be? $128,500

What is the equation of a parabola that passes through the following points?

7. (1, −1), (2, −5), (3, −7) $f(x) = x^2 - 7x + 5$

8. (2, −8), (3, −8), (6, 4) $f(x) = x^2 - 5x - 2$

9. (−3, 2), (1, −6), (4, 9) $f(x) = x^2 - 7$

2-3 Additional Practice

Factored Form of a Quadratic Function

Factor each quadratic expression.

1. $x^2 + 4x - 21$

$(x - 3)(x + 7)$

2. $x^2 - 2x - 15$

$(x + 3)(x - 5)$

3. $2x^2 - 17x + 30$

$(2x - 5)(x - 6)$

Identify the zeros of each function.

4. $y = 5(x - 3)(x + 5)$

$x = 3, x = -5$

5. $y = (x - 9)(x + 4)$

$x = 9, x = -4$

6. $y = (x - 7)^2$

$x = 7$

Solve each quadratic equation by factoring.

7. $x^2 = -5x$

$0, -5$

8. $-2x^2 + 5x + 12 = 0$

$-\frac{3}{2}, 4$

9. $7x^2 + 25x + 12$

$-\frac{4}{7}, -3$

10. $5x^2 = 3x + 2$

$-\frac{2}{5}, 1$

11. $-4x^2 + 15x + 4 = 0$

$-\frac{1}{4}, 4$

12. $x^2 - 4x + 3 = 0$

$1, 3$

Identify the interval(s) on which each quadratic function is positive or negative as shown.

13. $y = 2x^2 - 17x + 30$ Positive

$x < \frac{5}{2}$ and $x > 6$

14. $y = -7x^2 + 35x - 28$ Positive

$1 < x < 4$

15. $y = -x^2 - 6x - 8$ Negative

$x < -4$ and $x > -2$

16. $y = 2x^2 - 4x - 16$ Negative

$-2 < x < 4$

17. A rock is thrown upward from the edge of a bridge and onto a road that is 10 feet below the bridge. The function $h(x) = -x^2 + 3x + 10$ gives the height, h, in feet, the rock travels in x seconds from the time it was thrown. When will the rock hit the road?

The rock will hit the ground after 5 seconds.

18. Write an equation of a parabola with x-intercepts at $\left(\frac{1}{4}, 0\right)$ and $(-7, 0)$ which passes through the point $(0, 7)$.

$y = -(4x - 1)(x + 7)$