8. no solution

9. $(1.2, -2.25, 5.1)$

10. a. $\begin{bmatrix} 1 & 1 & 1 & \vdots & 131 \\ 0.05 & 0.10 & 0.25 & \vdots & 21.55 \\ 0 & -1 & 1 & \vdots & 10 \end{bmatrix}$

b. 17 nickels, 52 dimes, and 62 quarters

11. *Sample answer:* $3x - y + 2z = 3$
$-2x + z = 4$
$x - 4y + 5z = 12$

## 1.7 Explorations

1. a. $\begin{pmatrix} 5 & -8 \\ -13 & 19 \end{pmatrix}$ b. $\begin{pmatrix} 1 & 6 \\ -3 & -1 \end{pmatrix}$

c. Each element is the sum of the two corresponding elements.

d. Each element is the difference of the two corresponding elements.

2. a. $\begin{pmatrix} -3 & 2 \\ -9 & -7 \end{pmatrix}$ b. $\begin{pmatrix} 14 & -8 \\ -11 & -12 \end{pmatrix}$

3. Add or subtract the corresponding elements from the two matrices.

4. No, you can't add or subtract matrices with different dimensions.

5. a. $\begin{pmatrix} -21 & -6 \\ 36 & 12 \end{pmatrix}$ b. $\begin{pmatrix} -36 & 32 \\ 24 & -4 \end{pmatrix}$

Multiply the real number by each element in the matrix.

## 1.7 Practice

1. $\begin{bmatrix} 4 & -4 \\ 9 & -10 \end{bmatrix}$

2. $\begin{bmatrix} -2 & 4 \\ -3 & 0 \\ 8 & -3 \end{bmatrix}$

3. not possible

4. $\begin{bmatrix} -6 & 1 & -5 \\ 0 & 13 & 1 \end{bmatrix}$

5. $\begin{bmatrix} 10 & 35 \\ 5 & 15 \end{bmatrix}$

6. $\begin{bmatrix} 3 & -8 \\ -6 & 4 \end{bmatrix}$

7. $\begin{bmatrix} 3 & 5 & 1 \\ 10 & 6 & 9 \end{bmatrix}$

8. $\begin{bmatrix} 25 & 15 & \frac{15}{2} \\ -10 & \frac{5}{2} & -5 \\ 30 & \frac{35}{2} & 35 \end{bmatrix}$

9. $\begin{bmatrix} -15 & 16 \\ -20 & -38 \\ 7 & 59 \end{bmatrix}$

10. $\begin{bmatrix} 1 & -1 & -2 \\ 4 & 1 & -5 \end{bmatrix}$

11. $\begin{bmatrix} 11 & 1 \\ -5 & 1 \end{bmatrix}$

12. $\begin{bmatrix} -4 & -11 \\ 4 & 19 \end{bmatrix}$

13. $\begin{bmatrix} -3.8 & -5.5 \\ 3.5 & 3.6 \end{bmatrix}$

14. $\begin{bmatrix} -0.2 & -8.5 \\ 0.5 & 15.4 \end{bmatrix}$

15. $X = \begin{bmatrix} 1 & 5 \\ 0 & 3 \end{bmatrix}$

16. $X = \begin{bmatrix} 3 & 4 \\ 2 & 4 \end{bmatrix}$

# Chapter 2

## 2.1 Explorations

1. a. D; The graph is a reflection in the $x$-axis and a translation 2 units right of the parent quadratic function.

b. C; The graph is a translation 2 units right and 2 units up of the parent quadratic function.

c. A; The graph is a reflection in the $x$-axis and a translation 2 units left and 2 units down of the parent quadratic function.

d. F; The graph is a vertical shrink followed by a translation 2 units right and 2 units down of the parent quadratic function.

e. B; The graph is a vertical stretch followed by a translation 2 units right of the parent quadratic function.

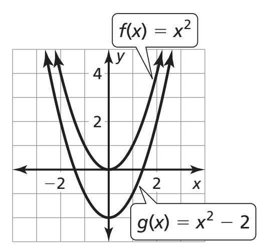
f. E; The graph is a reflection in the $x$-axis and a translation 2 units left and 2 units up of the parent quadratic function.

2. The constant $a$ represents a reflection in the $x$-axis or a vertical stretch or shrink. The constant $h$ represents a horizontal translation and $k$ represents a vertical translation.

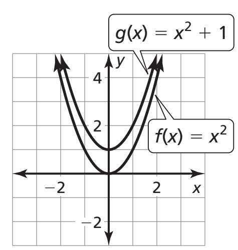
3. $g(x) = (x - 1)^2 - 2$; The graph is a translation 1 unit right and 2 units down of the parent quadratic function.

## 2.1 Practice

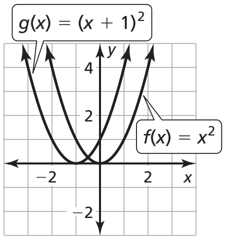
1. The graph of $g$ is a translation 2 units down of the graph of $f$.



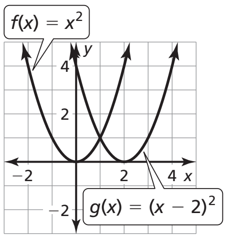

2. The graph of $g$ is a translation 1 unit up of the graph of $f$.



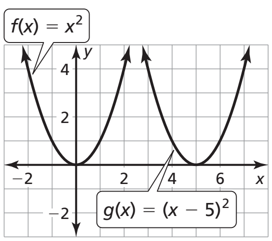
3. The graph of $g$ is a translation 1 unit left of the graph of $f$.



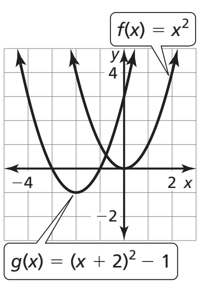

4. The graph of $g$ is a translation 2 units right of the graph of $f$.



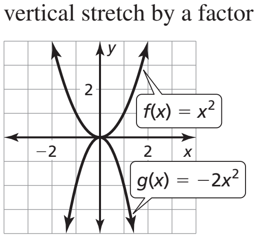

5. The graph of $g$ is a translation 5 units right of the graph of $f$.



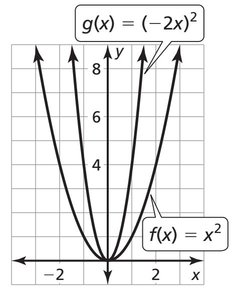

6. The graph of $g$ is a translation 2 units left and 1 unit down of the graph of $f$.



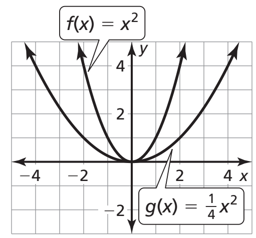

7. The graph of $g$ is a reflection in the x-axis followed by a vertical stretch by a factor of 2 of the graph of $f$.




8. The graph of $g$ is a reflection in the $y$-axis followed by a horizontal shrink of the graph of $f$ by a factor of $\frac{1}{2}$.




9. The graph of $g$ is a vertical shrink by a factor of $\frac{1}{4}$ of the graph of $f$.




10. When $0 < a < 1$ in the function $g(x) = a \cdot f(x)$, the transformation is a vertical shrink, not stretch; The graph of g is a reflection in the x-axis followed by a vertical shrink by a factor of $\frac{1}{3}$ of the graph of the parent quadratic function.

11. The graph is a vertical stretch by a factor of 2, followed by a translation 3 units left and 2 units up of the parent quadratic function; $(-3, 2)$

12. The graph is a reflection in the x-axis, followed by a vertical stretch by a factor of 5 and a translation 1 unit down of the parent quadratic function; $(0, -1)$

13. $g(x) = -3x^2 - 3$; $(0, -3)$

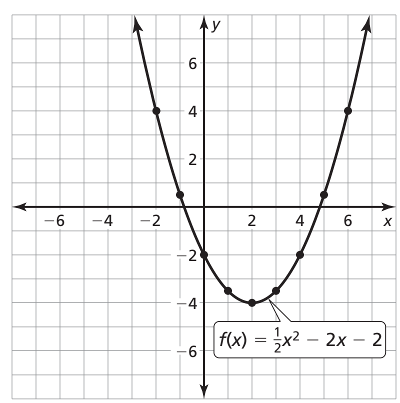
14. $g(x) = -x^2 - 7$; $(0, -7)$

15. **a.** $a = 2, h = 3, k = -4$; $g(x) = (2x - 3)^2 - 4$

**b.** $a = 4, h = 3, k = -4$; $g(x) = 4(x - 3)^2 - 4$

## 2.2 Explorations

1. **a.** 4, 0.5, −2, −3.5, −4, −3.5, −2, 0.5, 4




**b.** $(2, -4)$

**c.** $x = 2$; The equation contains the $x$-coordinate of the vertex.

**d.** $f(x) = \frac{1}{2}(x - 2)^2 - 4$

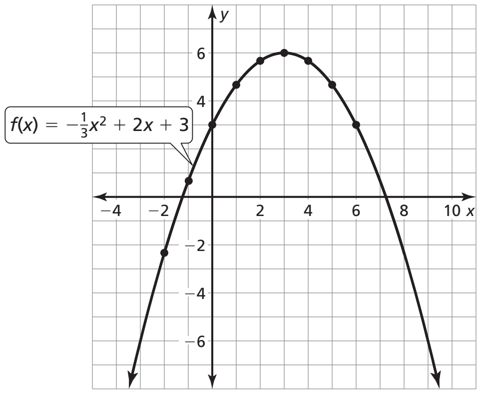
$= \frac{1}{2}(x - 2)(x - 2) - 4$

$= \frac{1}{2}(x^2 - 4x + 4) - 4$

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

$= \frac{1}{2}x^2 - 2x - 2$

**2. a.** $-2\frac{1}{3}, \frac{2}{3}, 3, 4\frac{2}{3}, 5\frac{2}{3}, 6, 5\frac{2}{3}, 4\frac{2}{3}, 3$




**b.** (3, 6)

**c.** $x = 3$; The equation contains the $x$-coordinate of the vertex.

**d.** $f(x) = -\frac{1}{3}(x - 3)^2 + 6$

$= -\frac{1}{3}(x - 3)(x - 3) + 6$

$= -\frac{1}{3}(x^2 - 6x + 9) + 6$

$= -\frac{1}{3}x^2 + 2x - 3 + 6$

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

**3.** The graph of $f$ in the form $y = a(x - h)^2 + k$ is symmetric across the vertical line $x = h$; The graph is a mirror image on each side of the line.

**4. a.** The graph of $f$ is symmetric across the line $x = 1$.

**b.** The graph of $f$ is symmetric across the line $x = -1$.

**c.** The graph of $f$ is symmetric across the line $x = 3$.

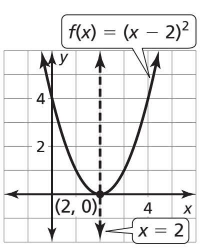
**d.** The graph of $f$ is symmetric across the line $x = -2$.

**e.** The graph of $f$ is symmetric across the line $x = 0$ or the $y$-axis.

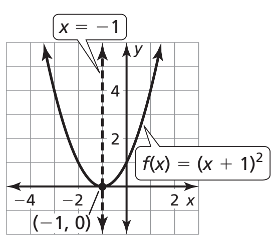
**f.** The graph of $f$ is symmetric across the line $x = 5$.

## 2.2 Practice

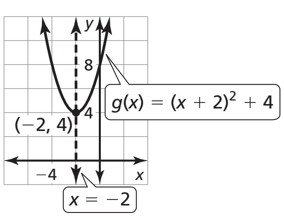
**1.**



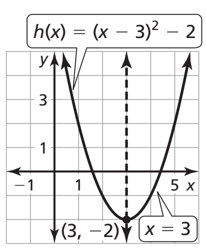

**2.**



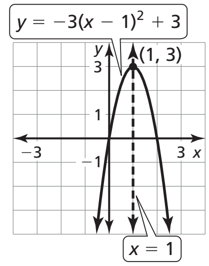

**3.**



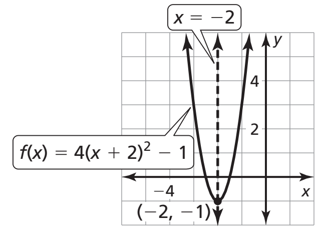

**4.**



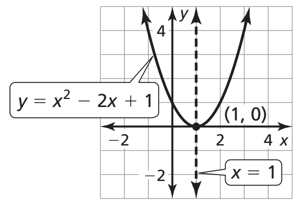

**5.**



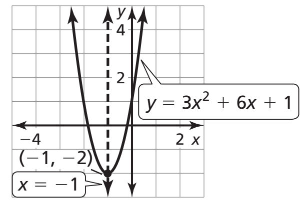

**6.**



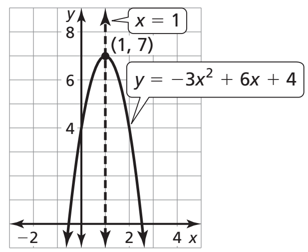

**7.**



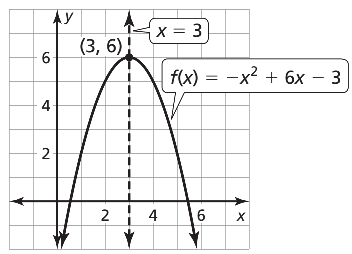

**8.**



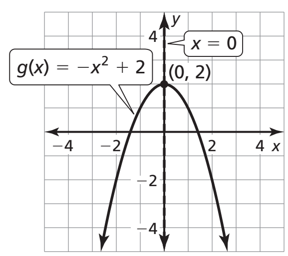

**9.**



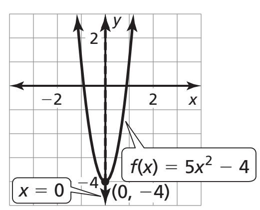

**10.**




**11.**




**12.**




**13.** Both graphs have the same axis of symmetry, $x = -2$.

**14.** C; It has the largest leading coefficient, $a = 3$.

**15.** minimum: 2; domain: all real numbers, range: $y \geq 2$; increasing to the right of $x = 0$; decreasing to the left of $x = 0$

**16.** minimum: −3; domain: all real numbers, range: $y \geq -3$; increasing to the right of $x = 0$; decreasing to the left of $x = 0$

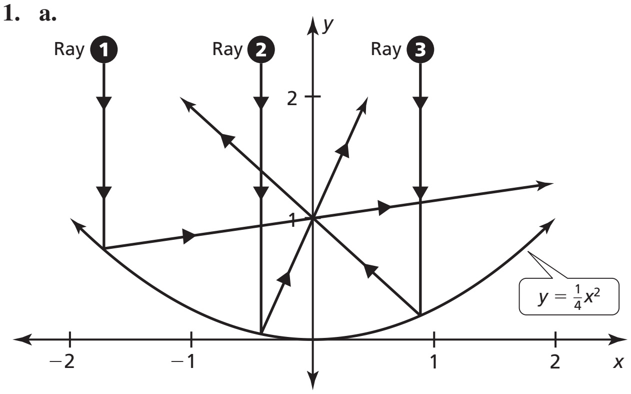
**17.** maximum: 3; domain: all real numbers, range: $y \leq 3$; increasing to the left of $x = 2$; decreasing to the right of $x = 2$

**18.** maximum: 11; domain: all real numbers, range: $y \leq 11$; increasing to the left of $x = 1$; decreasing to the right of $x = 1$

**19.** **a.** noon **b.** 75 customers

## 2.3 Explorations

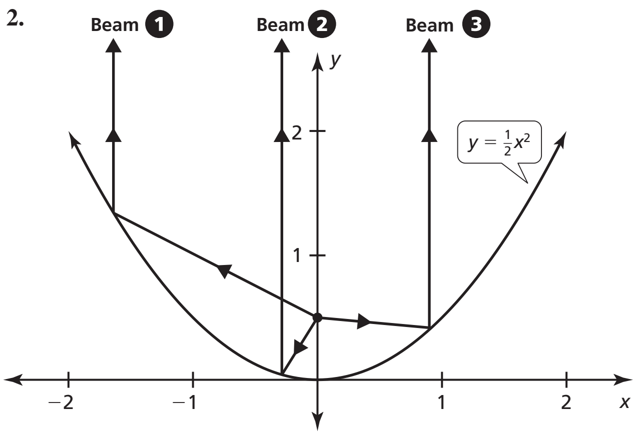
**1.** **a.**




**b.** All the reflected rays cross through the point (0, 1).

**c.** (0, 1); This is the best place for the receiver because any ray entering the satellite dish will hit the receiver.

**2.**




All beams leaving the parabola are parallel; yes; With a spotlight, all beams of light should be pointed at the same object.

**3.** a point on the inside of a parabola that lies on the axis of symmetry

**4.** The focus lies on the axis of symmetry, and all lines parallel to the axis of symmetry hit the parabola and reflect to intersect at the focus.

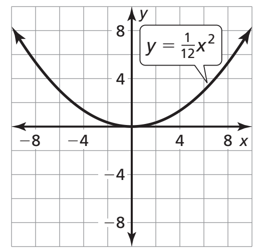
## 2.3 Practice

**1.** $y = \frac{1}{8}x^2$ **2.** $y = -\frac{1}{12}x^2$ **3.** $y = -\frac{1}{24}x^2$

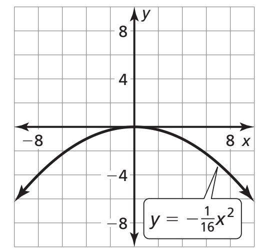
**4.** $y = -\frac{1}{16}x^2$ **5.** $y = -\frac{1}{4}x^2$ **6.** $y = -\frac{1}{8}x^2$

**7.** A; The directrix is below the focus.

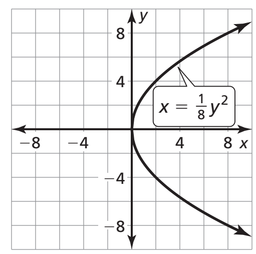
**8.** focus: (0, 3), directrix: $y = -3$, axis of symmetry: $x = 0$




**9.** focus: (0, −4), directrix: $y = 4$, axis of symmetry: $x = 0$




**10.** focus: (2, 0), directrix: $x = -2$, axis of symmetry: $y = 0$




**11.** 12 in; The receiver is at the focus.

**12.** $x = \frac{1}{8}y^2$ **13.** $x = -\frac{1}{16}y^2$ **14.** $y = \frac{1}{3}x^2$

**15.** $x = \frac{1}{24}y^2$ **16.** $y = \frac{1}{8}x^2$ **17.** $x = -\frac{1}{4}y^2$

**18.** vertex: (1, 3), focus: (1, 6), directrix: $y = 0$, axis of symmetry: $x = 1$; The graph is a vertical shrink by a factor of $\frac{1}{3}$, followed by a translation 1 unit right and 3 units up.

**19.** vertex: (−5, −2), focus: (−5, −4), directrix: $y = 0$, axis of symmetry: $x = -5$; The graph is a vertical shrink by a factor of $\frac{1}{2}$, followed by a reflection in the $x$-axis and a translation 5 units left and 2 units down.

**20.** vertex: (2, −4), focus: (3, −4), directrix: $x = 1$, axis of symmetry: $y = -4$; The graph is a translation 2 units right and 4 units down.

**21.** vertex: (−6, 10), focus: (−6, 3), directrix: $y = 17$, axis of symmetry: $x = -6$; The graph is a vertical shrink by a factor of $\frac{1}{7}$, followed by a reflection in the $x$-axis and a translation 6 units left and 10 units up.

## 2.4 Explorations

**1.** **a.** positive; The parabola opens up.

**b.** $t = -\dfrac{b}{2a}$

**c.** 2008

**d.** increasing; The graph is increasing to the right of the year of the minimum profit, so the profit is currently increasing.

**2.** **a.** The height is not decreasing at a linear rate.

**b.** $h = -16t^2 + 400$

**c.** The function fits the scatter plot because the graph crosses through all 5 points.

**d.** 5 sec; Substituting $h = 0$ into the equation and solving for $t$ results in $t = \pm 5$.

**3.** A quadratic function can be used to model any real-life situation that involves a parabolic arc.

4. *Sample answer:* an object in free fall, or a person jumping off a diving board

## 2.4 Practice

1. $y = \frac{7}{16}(x - 2)^2 - 3$
2. $y = -\frac{1}{18}(x - 3)^2 - 8$
3. $y = -9(x + 1)^2 + 4$
4. $y = \frac{8}{5}(x - 10)(x - 6)$
5. $y = \frac{3}{16}(x - 2)(x - 8)$
6. $y = -\frac{2}{7}(x + 14)(x + 2)$
7. **a.** $y = -\frac{5}{9}(x - 1)^2 + 5$

   **b.** $y = -\frac{5}{9}x^2 + \frac{10}{9}x + \frac{40}{9}$

   **c.** $y = -\frac{5}{9}(x + 2)(x - 4)$

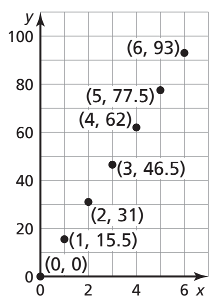
   **d.** $y = -\frac{5}{9}x^2 + \frac{10}{9}x + \frac{40}{9}$

   **e.** yes; intercept form; Two intercepts were given.
8. 9.21 ft

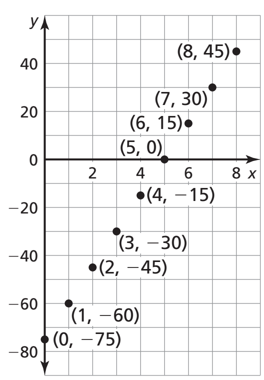
## 2.4 Extension Practice

1. **a.** The domain is descrete. You cannot sell a portion of a ticket. Because $x$ represents the number of tickets sold, it must be a whole number.

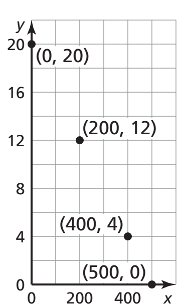
   **b.** The maximum number of tickets you can sell is 6. So, the domain is 0, 1, 2, 3, 4, 5, and 6.




2. **a.** The domain is descrete. You cannot have a portion of a customer. Because $x$ represents the number of customers, it must be a whole number.




   **b.** There is no limit to the number of customers. So, there is no maximum value for $x$.

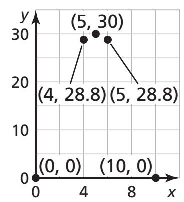



3. **a.** The domain is continuous. You can measure distance by parts of a mile. Because $x$ represents the number of miles driven, $x$ can be any value greater than or equal to 0 and less than or equal to the distance at which the tank becomes empty.

   **b.** $g = 0$ gallons when $x = 500$ miles. So, the domain of $x$ is $0 \le x \le 500$.

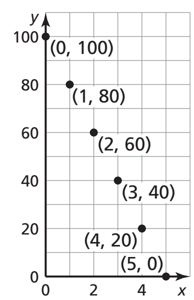
4. **a.** The domain is continuous. You can measure time by parts of a second. Because x represents the time in seconds after the softball is thrown into the air, x can be any value greater than or equal to 0 and less than or equal to the time at which the softball hits the ground.

   **b.**




5. **a.** The domain is discrete. You cannot ship a portion of a box. Because x represents the number of boxes shipped, it must be a whole number.

   **b.** The maximum number of boxes shipped is limited by the number of glasses. The number of glasses cannot be negative. So, the domain is 0, 1, 2, 3, 4, and 5.




6. **a.** The domain is continuous. You can measure distance by parts of a foot. Because $x$ represents the distance in feet from the bird's original perch, $x$ can be any value greater than or equal to 0.

   **b.**