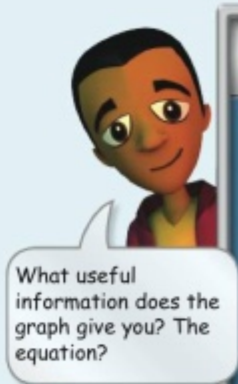
# 4-2 Standard Form of a Quadratic Function

**Common Core State Standards**

**A-CED.A.2** Create equations in two or more variables . . . graph equations on coordinate axes with labels and scales. **Also F-IF.B.4, F-IF.B.6, F-IF.C.8, F-IF.C.9**

**MP 1, MP 3, MP 4**

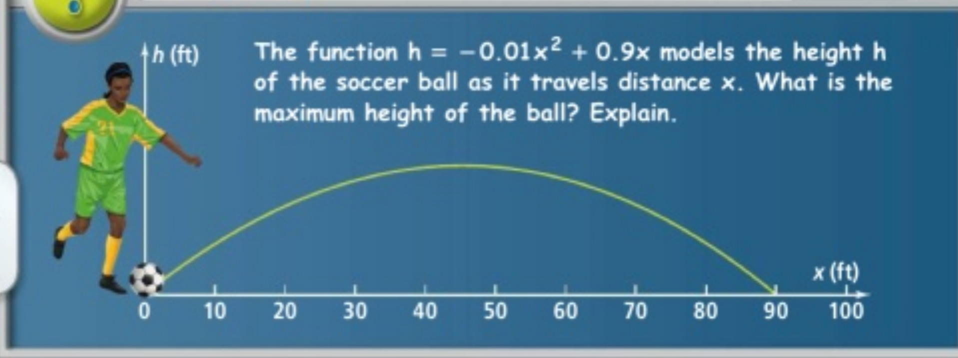
**Objective** To graph quadratic functions written in standard form




MATHEMATICAL PRACTICES

**SOLVE IT! Getting Ready!**

The function $h = -0.01x^2 + 0.9x$ models the height h of the soccer ball as it travels distance x. What is the maximum height of the ball? Explain.




**Lesson Vocabulary**
- standard form

In Lesson 4-1, you worked with quadratic functions written in vertex form. Now you will use quadratic functions in *standard form*. The **standard form** of a quadratic function is $f(x) = ax^2 + bx + c$, where $a \neq 0$.

**Essential Understanding** For any quadratic function $f(x) = ax^2 + bx + c$, the values of *a*, *b*, and *c* provide key information about its graph.

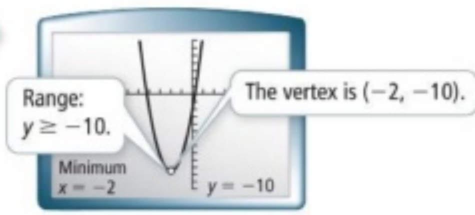
You can find information about the graph of a quadratic function (such as the vertex) easily from the vertex form. Such information is “hidden” in standard form. However, standard form is easier to enter into a graphing calculator.

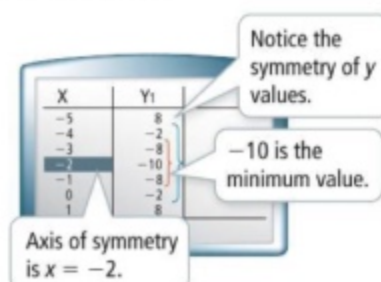
## Problem 1 Finding the Features of a Quadratic Function

**Plan**

**How can you use a calculator to find the features of a quadratic function in standard form?** Graph the function. Then use the **CALC** and **TABLE** features.

**Graphing Calculator** **What are the vertex, the axis of symmetry, the maximum or minimum value, and the range of $y = 2x^2 + 8x - 2$?**



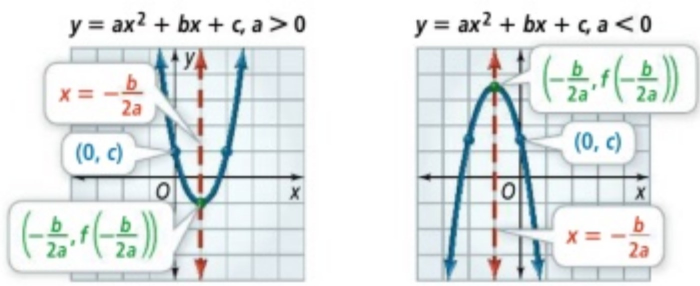
**Got It?** **1.** What are the vertex, axis of symmetry, maximum or minimum value, and range of $y = -3x^2 - 4x + 6$?

You can find information about the quadratic function $f(x) = ax^2 + bx + c$ from the coefficients $a$ and $b$, and from the constant term $c$.

**take note**

## Properties Quadratic Function in Standard Form

- The graph of $f(x) = ax^2 + bx + c$, $a \neq 0$, is a parabola.
- If $a > 0$, the parabola opens upward. If $a < 0$, the parabola opens downward.
- The axis of symmetry is the line $x = -\frac{b}{2a}$.
- The $x$-coordinate of the vertex is $-\frac{b}{2a}$. The $y$-coordinate of the vertex is the $y$-value of the function for $x = -\frac{b}{2a}$, or $y = f\left(-\frac{b}{2a}\right)$.
- The $y$-intercept is $(0, c)$.




**Here's Why It Works** You can expand the vertex form of a quadratic function to determine properties of the graph of a quadratic function written in standard form.

$$\begin{aligned} f(x) &= a(x-h)^2 + k \\ &= a(x^2 - 2hx + h^2) + k \\ &= ax^2 - 2ahx + ah^2 + k \\ &= ax^2 + (-2ah)x + (ah^2 + k) \end{aligned}$$

Compare to the standard form, $f(x) = ax^2 + bx + c$.

$a = a$ a in standard form is the same as a in vertex form.

$b = -2ah$

$-\frac{b}{2a} = h$ Solve for $h$.

Since, $h = -\frac{b}{2a}$, the axis of symmetry is $x = -\frac{b}{2a}$ and the vertex is $(h, k) = \left(-\frac{b}{2a}, f\left(-\frac{b}{2a}\right)\right)$.

## Problem 2 Graphing a Function of the Form $y = ax^2 + bx + c$

**What is the graph of $y = x^2 + 2x + 3$?**

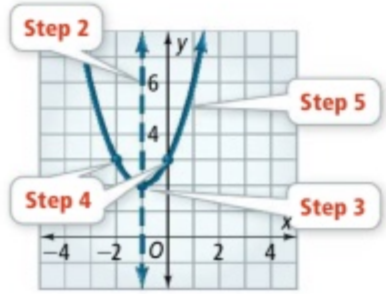
**Step 1** Identify $a$, $b$, and $c$.
$a = 1, b = 2, c = 3$

**Step 2** The axis of symmetry is $x = -\frac{b}{2a}$.
$x = -\frac{2}{2(1)}$
Lightly sketch the line $x = -1$.

**Step 3** The $x$-coordinate of the vertex is also $-\frac{b}{2a}$, or $-1$.
The $y$-coordinate is
$y = (-1)^2 + 2(-1) + 3 = 2$.
Plot the vertex $(-1, 2)$.

**Step 4** Since $c = 3$, the $y$-intercept is $(0, 3)$. The reflection of $(0, 3)$ across $x = -1$ is $(-2, 3)$. Plot both points.

**Step 5** $a > 0$ confirms that the graph opens upward. Draw a smooth curve through the points you found in Steps 3 and 4.




**Think**
**How can you use the axis of symmetry?**
The entire curve on one side of the axis is the mirror image of the curve on the other side.

**Got It? 2.** What is the graph of $y = -2x^2 + 2x - 5$?

## Problem 3 Converting Standard Form to Vertex Form

**What is the vertex form of $y = 2x^2 + 10x + 7$?**

**Plan**
**How do you find $h$, $k$, and $a$?**
Find the vertex. This gives you $h$ and $k$. The value for $a$ is the same in both forms.

$y = 2x^2 + 10x + 7$ Identify $a$ and $b$.

$x = -\frac{b}{2a}$ Find the $x$-coordinate of the vertex.

$= -\frac{10}{2(2)}$

$= -2.5$

$y = 2(-2.5)^2 + 10(-2.5) + 7$ Substitute $x = -2.5$ into the equation.

$= -5.5$

The vertex is $(-2.5, -5.5)$.

$y = a(x - h)^2 + k$ Write the vertex form.

$y = 2[x - (-2.5)]^2 + (-5.5)$ Substitute $a = 2$, $h = -2.5$, $k = -5.5$.

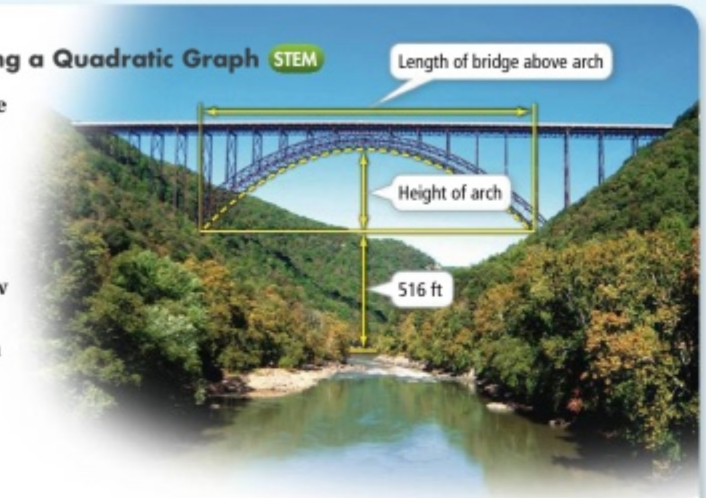
$y = 2(x + 2.5)^2 - 5.5$ Simplify.

The vertex form is $y = 2(x + 2.5)^2 - 5.5$.

**Got It? 3.** What is the vertex form of $y = -x^2 + 4x - 5$?

## Problem 4 Interpreting a Quadratic Graph STEM

**Bridges** The New River Gorge Bridge in West Virginia is the world's largest steel single arch bridge. You can model the arch with the function $y = -0.000498x^2 + 0.847x$, where $x$ and $y$ are in feet. How high above the river is the arch? How long is the section of bridge above the arch?




**Know**
A function that models the arch and the vertical distance from the base of the supports to the water

**Need**
The height of the arch above the support base and the length of the bridge above the arch

**Plan**
Find the vertex. The $y$-coordinate is the height of the arch above the support base. The $x$-coordinate is half the distance between the supports.

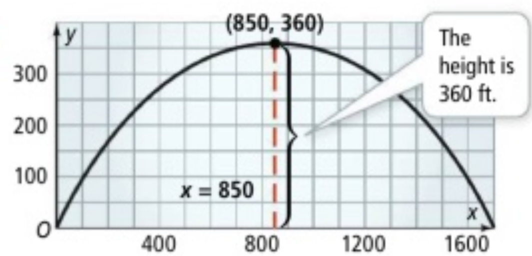
**Think**
**How can you tell that the quadratic function has a maximum value?**
Since $a < 0$, the graph of the function opens down. The function has a maximum value.

**Step 1** Find the vertex of the arch.

$$x = -\frac{b}{2a} = -\frac{0.847}{2(-0.000498)} \approx 850$$

$$y = -0.000498(850)^2 + 0.847(850) \approx 360$$

The vertex is about (850, 360).




**Step 2** Find the height of the arch above its supports.

The $y$-coordinate of the vertex is the height of the arch above its supports. The arch is about 360 ft above its supports.

**Step 3** Find the height of the arch above the river.

The arch is about 360 ft + 516 ft = 876 ft above the river.

**Step 4** Find the length of the bridge above the arch.

The $x$-coordinate of the vertex is half the length of the bridge above the arch. The length of that part of the bridge is about 850 ft + 850 ft = 1700 ft long.

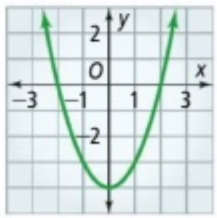
**Got It?** **4. a.** The Zhaozhou Bridge in China is the one of the oldest known arch bridges, dating to A.D. 605. You can model the support arch with the function $f(x) = -0.001075x^2 + 0.131148x$, where $x$ and $y$ are measured in feet. How high is the arch above its supports?

**b. Reasoning** Why does the model in part (a) not have a constant term?

## Lesson Check

### Do you know HOW?

1. Identify the vertex, axis of symmetry, and the maximum or minimum value of the parabola at the right.




**Graph each function.**

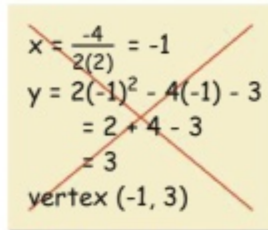
2. $y = x^2 - 2x + 4$
3. $y = -x^2 - 3x + 6$

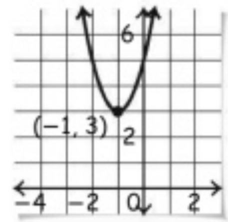
**Write each function in vertex form.**

4. $y = x^2 - 2x + 9$
5. $y = -x^2 + 3x - 1$

### Do you UNDERSTAND? MATHEMATICAL PRACTICES

6. **Error Analysis** A student graphed the function $y = 2x^2 - 4x - 3$. Find and correct the error.




7. **Compare and Contrast** Explain the difference between finding the vertex of a function written in vertex form and finding the vertex of a function written in standard form.

## Practice and Problem-Solving Exercises MATHEMATICAL PRACTICES

**A Practice**

**Identify the vertex, the axis of symmetry, the maximum or minimum value, and the range of each parabola.** See Problem 1.

8. $y = x^2 + 2x + 1$
9. $y = -x^2 + 2x + 1$
10. $y = x^2 + 4x + 1$
11. $y = -x^2 + 2x + 5$
12. $y = 3x^2 - 4x - 2$
13. $y = -2x^2 - 3x + 4$
14. $y = 2x^2 - 6x + 3$
15. $y = -x^2 - x$
16. $y = 2x^2 + 5$

**Graph each function.** See Problem 2.

17. $y = x^2 + 6x + 9$
18. $y = -x^2 - 3x + 6$
19. $y = 2x^2 + 4x$
20. $y = 4x^2 - 12x + 9$
21. $y = -6x^2 - 12x - 1$
22. $y = -\frac{3}{4}x^2 + 6x + 6$
23. $y = 3x^2 - 12x + 10$
24. $y = \frac{1}{2}x^2 + 2x - 8$
25. $y = -4x^2 - 24x - 36$

**Write each function in vertex form.** See Problem 3.

26. $y = x^2 - 4x + 6$
27. $y = x^2 + 2x + 5$
28. $y = 4x^2 + 7x$
29. $y = 2x^2 - 5x + 12$
30. $y = -2x^2 + 8x + 3$
31. $y = \frac{9}{4}x^2 + 3x - 1$

32. **Economics** A model for a company's revenue from selling a software package is $R = -2.5p^2 + 500p$, where $p$ is the price in dollars of the software. What price will maximize revenue? Find the maximum revenue. See Problem 4.

**B Apply**

**Sketch each parabola using the given information.**

**33.** vertex (3, 6), $y$-intercept 2

**34.** vertex $(-1, -4)$, $y$-intercept 3

**35.** vertex (0, 5), point $(1, -2)$

**36.** vertex (2, 3), point (6, 9)

**37. Think About a Plan** Suppose you work for a packaging company and are designing a box that has a rectangular bottom with a perimeter of 36 cm. The box must be 4 cm high. What dimensions give the maximum volume?

- How can you model the volume of the box with a quadratic function?
- What information can you get from the function to find the maximum volume?

**38. Landscaping** A town is planning a playground. It wants to fence in a rectangular space using an existing wall. What is the greatest area it can fence in using 100 ft of donated fencing?


**For each function, the vertex of the function's graph is given. Find the unknown coefficients.**

**39.** $y = x^2 + bx + c$; $(3, -4)$

**40.** $y = -3x^2 + bx + c$; $(1, 0)$

**41.** $y = ax^2 + 10x + c$; $(-5, -27)$

**42.** $y = c - ax^2 - 2x$; $(-1, 3)$

STEM **43. Physics** The height of a projectile fired straight up in the air with an initial velocity of 64 ft/s is $h = 64t - 16t^2$, where $h$ is height in feet and $t$ is time in seconds. The table represents the data for another projectile. Which projectile goes higher? How much higher?

| Time ($t$) | Height ($h$) |
|---|---|
| 0.5 | 20 |
| 1 | 32 |
| 1.5 | 36 |
| 2 | 32 |

**44.** A student says that the graph of $y = ax^2 + bx + c$ gets wider as $a$ increases.

**a. Error Analysis** Use examples to show that the student is wrong.

**b. Writing** Summarize the relationship between $|a|$ and the width of the graph of $y = ax^2 + bx + c$.

**For each function, find the $y$-intercept.**

**45.** $y = (x - 1)^2 + 2$

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

**47.** $y = -\frac{2}{3}(x - 9)^2$

**48.** Use the functions $f(x) = 4x + 3$ and $g(x) = \frac{1}{2}x^2 + 2$ to answer parts (a)–(c).

**a.** Which function has a greater rate of change from $x = 0$ to $x = 1$?

**b.** Which function has a greater rate of change from $x = 2$ and $x = 3$?

**c.** Does $g(x)$ ever have a greater rate of change than $f(x)$? Explain.

**Challenge** For each function, the vertex of the function's graph is given. Find $a$ and $b$.

**49.** $y = ax^2 + bx - 27; (2, -3)$

**50.** $y = ax^2 + bx + 5; (-1, 4)$

**51.** $y = ax^2 + bx + 8; (2, -4)$

**52.** $y = ax^2 + bx; (-3, 2)$

**53.** Sketch the parabola with an axis of symmetry $x = 2$, $y$-intercept 1, and point $(3, 2.5)$.

## Apply What You've Learned

MATHEMATICAL PRACTICES
MP 4

Look back at the information about the sandwich shops and at the table of data on page 193.

**a.** Victor plans to use the other shop owner's data to determine the relationship between the number of bags sold, $x$, and the selling price, $s$. Does the other shop owner's data set appear to be linear? Explain.

**b.** Write an equation that models the data in the table. This is Victor's selling-price function.

You can use the following relationship to construct a function that models Victor's profit from selling $x$ bags of chips.

$$\text{Profit} = \text{Revenue} - \text{Cost}$$
$$P(x) = R(x) - C(x)$$

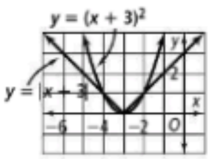
**c.** Write an equation for Victor's cost function $C(x)$.

**d.** Victor's revenue will be the selling price times the number of bags sold. Use your result from part (b) to write and simplify an equation for Victor's revenue function $R(x)$.

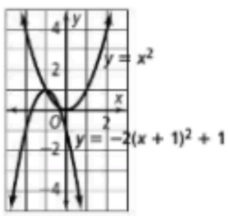
**e.** Use your results from parts (c) and (d) to write an equation for Victor's profit function $P(x)$.

**f.** You have now written four functions. Which functions are linear functions and which are quadratic functions?

**43.** similar: same vertex $(-3, 0)$ and open upward, same domain (all real numbers), same range $(y \geq 0)$, same $x$-intercept, $(-3, 0)$; different: $y = |x + 3|$ is an absolute value function with $y$-intercept $(0, 3)$, and $y = (x + 3)^2$ is a quadratic function with $y$-intercept $(0, 9)$




**45.** stretch vertically by a factor of 2, reflect across the $x$-axis, translate 1 unit to the left and 1 unit up




**47. a.** 10; 9; −1 **b.** 9; 6; −3 **c.** 6; 1; −5
**d.** The rate of change decreases at a greater rate.
**e.** Yes; the rates of change increase as you move away from the origin on the negative $x$-axis.

**49.** $y = -7(x - 1)^2 + 2$

**51.** $y = -7x^2 + 5$

**53.** Answers may vary. Sample: $y = (x + 10)^2 - 4$

**55.** Answers may vary. Sample: $k = -2$, $a = 3$; $y = 3(x - 1)^2 - 2$

**57.** Answers may vary. Sample: $a = -6$, $k = 35$; $y = -6(x + 1)^2 + 35$

**59. a.** $ah^2 + k$ **b.** when $h = 0$

**61.** $y = \frac{1}{2}(x + 3)^2$ **63.** $y = -\frac{1}{4}(x - 4)^2$

**65.** $y = -4(x + 3)^2$ **67.** G

**69.** $2x + 2y = 225$

$2y = 225 - 2x$

$y = \frac{225}{2} - x$

$A = xy = x\left(\frac{225}{2} - x\right)$

$A = -x^2 + 112.5x$

Graph the function. There is a max. at about (56.25, 3164.06), so the max. area is about 3164.06 ft$^2$ and the length of each side is 56.25 ft.

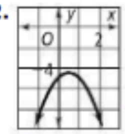
**70.** (3, 2) **71.** (−10, 6) **72.** (1, 0, 3)

**73.** (0, 0) **74.** (−1, 0) **75.** (5, 0)

## Lesson 4-2 pp. 202–208

**Got It? 1.** vertex: $\left(-\frac{2}{3}, 7\frac{1}{3}\right)$; axis of symmetry: $x = -\frac{2}{3}$; maximum: $7\frac{1}{3}$; range: $y \leq 7\frac{1}{3}$

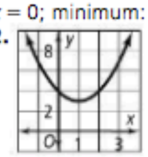
**2.**



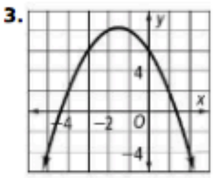
**3.** $y = -(x - 2)^2 - 1$ **4. a.** 4 ft **b.** because the $y$-intercept is (0, 0)

**Lesson Check 1.** vertex: (0, −4); axis of symmetry: $x = 0$; minimum: −4

**2.**



**3.**



**4.** $y = (x - 1)^2 + 8$ **5.** $y = -\left(x - \frac{3}{2}\right)^2 + \frac{5}{4}$

**6.** Error in calculation of $x$. The correct calculation is:

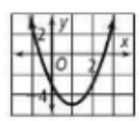
$x = \frac{-(-4)}{2(2)} = 1$

$y = 2(1) - 4(1) - 3$

$= 2 - 4 - 3$

$= -5$

Vertex: (1, −5)

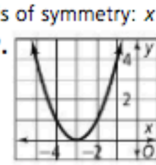


**7.** The vertex of a function written in vertex form can easily be determined. It is $(h, k)$ where $f(x) = a(x - h)^2 + k$. The vertex of a function in standard form is $\left(\frac{-b}{2a}, f\left(\frac{-b}{2a}\right)\right)$ where $f(x) = ax^2 + bx + c$.

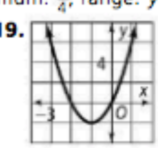
**Exercises 9.** vertex: (1, 2); axis of symmetry: $x = 1$; maximum: 2; range: $y \leq 2$ **11.** vertex: (1, 6); axis of symmetry: $x = 1$; maximum: 6; range: $y \leq 6$

**13.** vertex: $\left(-\frac{3}{4}, 5\frac{1}{8}\right)$; axis of symmetry: $x = -\frac{3}{4}$; maximum: $5\frac{1}{8}$; range: $y \leq 5\frac{1}{8}$ **15.** vertex: $\left(-\frac{1}{2}, \frac{1}{4}\right)$; axis of symmetry: $x = -\frac{1}{2}$; maximum: $\frac{1}{4}$; range: $y \leq \frac{1}{4}$

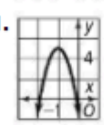
**17.**



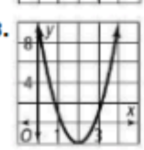
**19.**

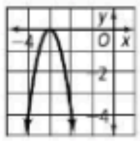


**21.**



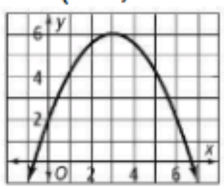
**23.**

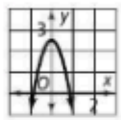


**25.**


**27.** $y = (x+1)^2 + 4$ **29.** $y = 2\left(x - \frac{5}{4}\right)^2 + \frac{71}{8}$

**31.** $y = \frac{9}{4}\left(x + \frac{2}{3}\right)^2 - 2$

**33.**


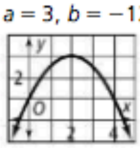
**35.**


**37.** 4 cm × 9 cm × 9 cm **39.** $b = -6$; $c = 5$

**41.** $a = 1$; $c = -2$ **43. a.** The projectile represented by the equation goes higher by 28 feet. **b.** equation: $t = 0.27$ s and $t = 3.73$ s; table: $t = 0.38$ s and $t = 2.62$ s

**45.** (0, 3) **47.** (0, −54) **49.** $a = -6$, $b = 24$

**51.** $a = 3$, $b = -12$

**53.**


## Lesson 4-3 pp. 209–214

**Got It? 1.** $y = -3x^2 + x$ **2a.** Rocket 2 **b.** Rocket 1: D: $0 \le t \le 9.4$, R: $0 \le h \le 352.6$; Rocket 2: D: $0 \le t \le 12$, R: $0 \le h \le 580$ **c.** The domains tell you how many seconds the rockets were in the air. The domains are different because the rockets were in the air for different amounts of time.
**3.** $y = -0.329x^2 + 9.798x + 15.571$; 88.5°F at 2:53 P.M. (although the meteorologist's prediction is 89° at 3 P.M.)
**Lesson Check 1.** $y = -2x^2 + 3x - 1$
**2.** $y = 2x^2 + 6x + 7.5$ **3.** $y = -2x^2 + 10x - 13.5$
**4.** Answers may vary. Sample: A rough plot of the data will indicate whether the data are collinear (linear regression) or non-collinear where the data follows a curve (quadratic regression). **5.** A parabola that opens up always attains greater values than one that opens down. **6.** $y$ is not a function of $x$ since for one value of $x$, "3," there are 2 values of $y$, "4" and "0."
**Exercises 7.** $y = -x^2 + 3x - 4$ **9.** $y = 2x^2 - x + 3$
**11.** $y = x^2 - 6x + 3$ **13.** $y = x^2 + 2x$
**15.** $y = -x^2 + x - 2$ **17. a.** $y = -16x^2 + 33x + 46$, where $x$ is the number of seconds after release and $y$ is the height in ft **b.** 28.5 ft **c.** about 63 ft **19.** yes; $y = -2x^2 + 3x + 5$ **21.** yes; $y = 0.625x^2 - 1.75x + 1$
**23.** $y = 0.005x^2 - 1.95x + 120$; 66 mm
**25. a.** $y = -0.004x^2 + 0.859x + 27.53$ **b.** Answers may vary. Sample: domain: integers from −10 to 17; range: whole numbers from 18 to 42 **c.** the year 2003 **d.** The year 2022; the year is outside the domain of the data pts. **27. a.** (3, 5) **b.** 3; substitute $x$- and $y$-values in the general form of a quadratic, then solve the resulting linear system for the coefficients.

## Lesson 4-4 pp. 216–223

**Got It? 1. a.** $(x + 10)(x + 4)$ **b.** $(x - 5)(x - 6)$
**c.** $-(x + 2)(x - 16)$ **2. a.** $7(n^2 - 3)$ **b.** $9(x + 2)(x - 1)$
**c.** $4(x^2 + 2x + 3)$ **3. a.** $(x + 1)(4x + 3)$
**b.** $(x - 2)(2x - 3)$ **c.** No; $2x^2 + 2x + 2 = 2(x^2 + x + 1)$, there are no real factors of $a$ and $c$ whose product is 1 and whose sum is 1. **4.** $(8x - 1)^2$
**5.** $(4x - 9)(4x + 9)$
**Lesson Check 1.** $(x + 4)(x + 2)$ **2.** $(x - 12)(x - 1)$
**3.** $(x - 9)(x + 9)$ **4.** $(5y - 6)(5y + 6)$ **5.** $(y - 3)^2$
**6.** $(2x - 1)^2$ **7.** $5x$ **8.** $4a^2$ **9.** 6 **10.** $7h$ **11.** No; the middle term is not twice the product of the square root of the end terms. **12.** For $a \ne 1$, look for two factors whose sum is $b$ and whose product is $ac$. For $a = 1$, look for two factors whose sum is $b$ and whose product is $c$.
**13.** $a^2 - 2ab + b^2 - 25$ Group the first 3 terms.
$= (a^2 - 2ab + b^2) - 25$
$= (a - b)^2 - 5^2$
$= (a - b - 5)(a - b + 5)$
**Exercises 15.** $(x + 2)(x + 3)$ **17.** $(x + 2)(x + 8)$
**19.** $(x + 2)(x + 20)$ **21.** $-(x - 1)(x - 12)$
**23.** $(x - 4)(x - 6)$ **25.** $(x - 4)(x - 9)$
**27.** $-(x - 4)(x + 5)$ **29.** $(c - 7)(c + 9)$
**31.** $-(t - 11)(t + 4)$ **33.** $5b$; $5b(5b - 4)$
**35.** 5; $5(t + 1)(t - 2)$ **37.** 9; $9(3p^2 - p + 2)$
**39.** $(x - 8)(2x - 3)$ **41.** $(m - 3)(2m - 5)$
**43.** $(x - 12)(2x - 3)$ **45.** $(y + 4)(5y - 8)$
**47.** $(x + 1)^2$ **49.** $(k - 9)^2$
**51.** cannot be factored; 8 is not a perfect square and there are no positive factors of 32 that have a sum of 16.
**53.** $(x - 2)(x + 2)$ **55.** cannot be factored; This is a sum of squares, not a difference of squares.
**57.** $(5x - 1)$ cm by $(5x - 1)$ cm **59.** $2(3z + 2)(3z - 2)$
**61.** $16(2t + 1)(2t - 1)$ **63.** $3(y + 5)(y + 3)$
**65.** $3(x + 1)(x - 9)$ **67.** $2(x - 5)(2x - 1)$
**69.** $-\left(\frac{1}{4}s - 1\right)\left(\frac{1}{4}s + 1\right)$
**71.** The third line should be $x(2x - 5) - (2x - 5)$, and the final line should be $(x - 1)(2x - 5)$. **73.** $y$; $y(y - 1)$
**75.** 10; $10(x - 3)(x + 3)$ **77.** 2; $2(x^2 - 37x + 6)$ **79.** D
**81.** Answers may vary. **83.** $(0.5t + 0.4)(0.5t - 0.4)$
**85.** $(x + 12)(x - 3)$ **87.** $(2x + 9)(3x + 14)$
**89.** Factor the GCF, $4x^2$, from the terms to get $4x^2(x^2 + 6x + 8)$. Look for numbers whose product is 8 and whose sum is 6. The numbers 4 and 2 work. The complete factorization is $4x^2(x + 4)(x + 2)$.