4 CHAPTER REVIEW

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- Multi-Language Glossary
- Vocabulary practice

REVIEW KEY VOCABULARY

- quadratic function, *p. 236*
- standard form of a quadratic function, *p. 236*
- parabola, *p. 236*
- vertex, *p. 236*
- axis of symmetry, *p. 236*
- minimum, maximum value, *p. 238*
- vertex form, *p. 245*
- intercept form, *p. 246*
- monomial, binomial, trinomial, *p. 252*
- quadratic equation, *p. 253*
- standard form of a quadratic equation, *p. 253*
- root of an equation, *p. 253*
- zero of a function, *p. 254*
- square root, *p. 266*
- radical, radicand, *p. 266*
- rationalizing the denominator, *p. 267*
- conjugates, *p. 267*
- imaginary unit i, *p. 275*
- complex number, *p. 276*
- standard form of a complex number, *p. 276*
- imaginary number, *p. 276*
- pure imaginary number, *p. 276*
- complex conjugates, *p. 278*
- complex plane, *p. 278*
- absolute value of a complex number, *p. 279*
- completing the square, *p. 284*
- quadratic formula, *p. 292*
- discriminant, *p. 294*
- quadratic inequality in two variables, *p. 300*
- quadratic inequality in one variable, *p. 302*
- best-fitting quadratic model, *p. 311*

VOCABULARY EXERCISES

1. **WRITING** Given a quadratic function in standard form, explain how to determine whether the function has a maximum value or a minimum value.
If $a < 0$, the function has a maximum value and if $a > 0$, then the function has a minimum value.
2. Copy and complete: A(n) ___?___ is a complex number $a + bi$ where $a = 0$ and $b \neq 0$.
pure imaginary number
3. Copy and complete: A function of the form $y = a(x - h)^2 + k$ is written in ___?___.
vertex form
4. Give an example of a quadratic equation that has a negative discriminant.
***Sample answer:* $y = 3x^2 + 5x + 12$**

REVIEW EXAMPLES AND EXERCISES

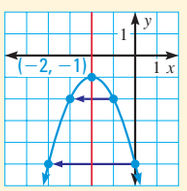
Use the review examples and exercises below to check your understanding of the concepts you have learned in each lesson of Chapter 4.

4.1 Graph Quadratic Functions in Standard Form *pp. 236–243*

EXAMPLE

Graph $y = -x^2 - 4x - 5$.

Because $a < 0$, the parabola opens down. Find and plot the vertex $(-2, -1)$. Draw the axis of symmetry $x = -2$. Plot the y-intercept at $(0, -5)$, and plot its reflection $(-4, -5)$ in the axis of symmetry. Plot two other points: $(-1, -2)$ and its reflection $(-3, -2)$ in the axis of symmetry. Draw a parabola through the plotted points.



EXAMPLE 3 on p. 238 for Exs. 5–7

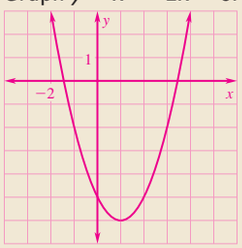
EXERCISES

Graph the function. Label the vertex and axis of symmetry. **5–7. See margin.**

5. $y = x^2 + 2x - 3$ **6.** $y = -3x^2 + 12x - 7$ **7.** $f(x) = -x^2 - 2x - 6$

Extra Example 4.1

Graph $y = x^2 - 2x - 5$.



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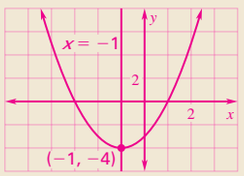

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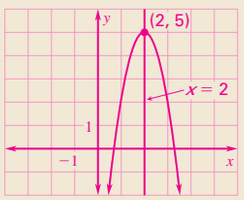

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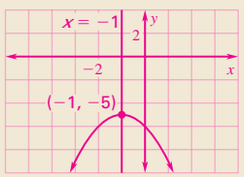
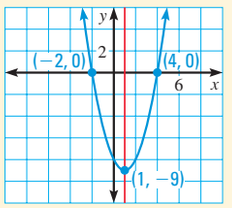


4.2 Graph Quadratic Functions in Vertex or Intercept Form *pp. 245–251*

EXAMPLE

Graph $y = (x - 4)(x + 2)$.

Identify the x-intercepts. The quadratic function is in intercept form $y = a(x - p)(x - q)$ where $a = 1$, $p = 4$, and $q = -2$. Plot the x-intercepts at $(4, 0)$ and $(-2, 0)$.



Find the coordinates of the vertex.

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

$$y = (1 - 4)(1 + 2) = -9$$

Plot the vertex at $(1, -9)$. Draw a parabola through the plotted points as shown.

EXERCISES

EXAMPLES 1, 3, and 4 on pp. 245–247 for Exs. 8–14

Graph the function. Label the vertex and axis of symmetry. 8–13. See margin.

8. $y = (x - 1)(x + 5)$ **9.** $g(x) = (x + 3)(x - 2)$ **10.** $y = -3(x + 1)(x - 6)$

11. $y = (x - 2)^2 + 3$ **12.** $f(x) = (x + 6)^2 + 8$ **13.** $y = -2(x + 8)^2 - 3$

14. BIOLOGY A flea's jump can be modeled by the function $y = -0.073x(x - 33)$ where x is the horizontal distance (in centimeters) and y is the corresponding height (in centimeters). How far did the flea jump? What was the flea's maximum height? **33 cm; about 20 cm**

4.3 Solve $x^2 + bx + c = 0$ by Factoring *pp. 252–258*

EXAMPLE

Solve $x^2 - 13x - 48 = 0$.

Use factoring to solve for x.

$x^2 - 13x - 48 = 0$		Write original equation.
$(x - 16)(x + 3) = 0$		Factor.
$x - 16 = 0$ or	$x + 3 = 0$	Zero product property
$x = 16$ or	$x = -3$	Solve for x.

EXERCISES

EXAMPLE 3 on p. 254 for Exs. 15–21

Solve the equation.

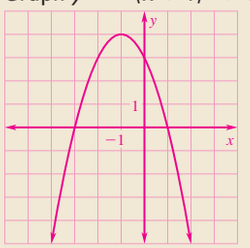
15. $x^2 + 5x = 0$ **−5, 0** **16.** $z^2 = 63z$ **0, 63** **17.** $s^2 - 6s - 27 = 0$ **−3, 9**

18. $k^2 + 12k - 45 = 0$ **−15, 3** **19.** $x^2 + 18x = -81$ **−9** **20.** $n^2 + 5n = 24$ **−8, 3**

21. URBAN PLANNING A city wants to double the area of a rectangular playground that is 72 feet by 48 feet by adding the same distance x to the length and the width. Write and solve an equation to find the value of x.
$(72 + x)(48 + x) = 2(72)(48)$; 24 ft

Extra Example 4.2

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



Extra Example 4.3

Solve $x^2 + 11x - 42 = 0$. **−14, 3**

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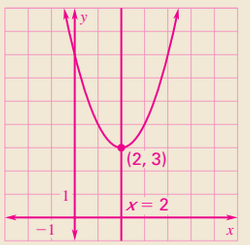

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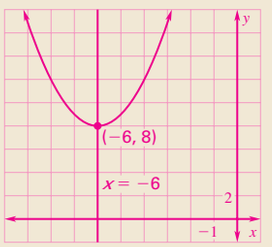

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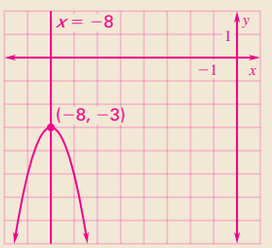

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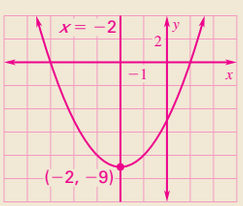

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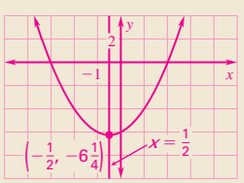

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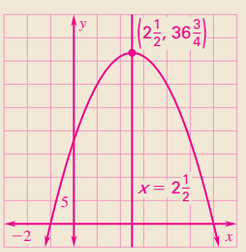

Extra Example 4.4

Solve $12z^2 + 7z = 10$. $-\frac{5}{4}, \frac{2}{3}$

Extra Example 4.5

Solve $2(x + 8)^2 = 108$.
$-8 + 3\sqrt{6}, -8 - 3\sqrt{6}$

Extra Example 4.6

Write $\frac{5 + i}{2 - 3i}$ as a complex number in standard form. $\frac{7}{13} + \frac{17}{13}i$

4 CHAPTER REVIEW

4.4 Solve $ax^2 + bx + c = 0$ by Factoring *pp. 259–264*

EXAMPLE

Solve $-30x^2 + 9x + 12 = 0$.

$-30x^2 + 9x + 12 = 0$		Write original equation.
$10x^2 - 3x - 4 = 0$		Divide each side by -3.
$(5x - 4)(2x + 1) = 0$		Factor.
$5x - 4 = 0$	or $2x + 1 = 0$	Zero product property
$x = \frac{4}{5}$	or $x = -\frac{1}{2}$	Solve for x.

EXAMPLE 5 on p. 261 for Exs. 22–24

EXERCISES

Solve the equation.

22. $16 = 38r - 12r^2$ $\frac{1}{2}, 2\frac{2}{3}$ **23.** $3x^2 - 24x - 48 = 0$ $4 \pm 4\sqrt{2}$ **24.** $20a^2 - 13a - 21 = 0$ $-\frac{3}{4}, 1\frac{2}{5}$

4.5 Solve Quadratic Equations by Finding Square Roots *pp. 266–271*

EXAMPLE

Solve $4(x - 7)^2 = 80$.

$4(x - 7)^2 = 80$	Write original equation.
$(x - 7)^2 = 20$	Divide each side by 4.
$x - 7 = \pm\sqrt{20}$	Take square roots of each side.
$x = 7 \pm 2\sqrt{5}$	Add 7 to each side and simplify.

EXAMPLES 3 and 4 on pp. 267–268 for Exs. 25–28

EXERCISES

Solve the equation.

25. $3x^2 = 108$ ± 6 **26.** $5y^2 + 4 = 14$ $\pm\sqrt{2}$ **27.** $3(p + 1)^2 = 81$ $-1 \pm 3\sqrt{3}$

28. GEOGRAPHY The total surface area of Earth is 510,000,000 square kilometers. Use the formula $S = 4\pi r^2$, which gives the surface area of a sphere with radius r, to find the radius of Earth. about 6371 km

4.6 Perform Operations with Complex Numbers *pp. 275–282*

EXAMPLE

Write $(6 - 4i)(1 - 3i)$ as a complex number in standard form.

$(6 - 4i)(1 - 3i) = 6 - 18i - 4i + 12i^2$	Multiply using FOIL.
$= 6 - 22i + 12(-1)$	Simplify and use $i^2 = -1$.
$= -6 - 22i$	Write in standard form.

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EXAMPLES 2, 4, and 5 on pp. 276–278 for Exs. 29–34

EXERCISES

Write the expression as a complex number in standard form.

29. $-9i(2 - i)$ $-9 - 18i$ **30.** $(5 + i)(4 - 2i)$ $22 - 6i$ **31.** $(2 - 5i)(2 + 5i)$ 29

32. $(8 - 6i) + (7 + 4i)$ $15 - 2i$ **33.** $(2 - 3i) - (6 - 5i)$ $-4 + 2i$ **34.** $\frac{4i}{-3 + 6i}$ $\frac{8}{15} - \frac{4}{15}i$

4.7 Complete the Square

pp. 284–291

EXAMPLE

Solve $x^2 - 8x + 13 = 0$ by completing the square.

$x^2 - 8x + 13 = 0$	Write original equation.
$x^2 - 8x = -13$	Write left side in the form $x^2 + bx$.
$x^2 - 8x + 16 = -13 + 16$	Add $\left(\frac{-8}{2}\right)^2 = (-4)^2 = 16$ to each side.
$(x - 4)^2 = 3$	Write left side as a binomial squared.
$x - 4 = \pm\sqrt{3}$	Take square roots of each side.
$x = 4 \pm \sqrt{3}$	Solve for x.

EXAMPLES 3 and 4 on pp. 285–286 for Exs. 35–37

EXERCISES

Solve the equation by completing the square.

35. $x^2 - 6x - 15 = 0$ $3 \pm 2\sqrt{6}$ **36.** $3x^2 - 12x + 1 = 0$ $2 \pm \frac{\sqrt{33}}{3}$ **37.** $x^2 + 3x - 1 = 0$ $\frac{-3 \pm \sqrt{13}}{2}$

4.8 Use the Quadratic Formula and the Discriminant

pp. 292–299

EXAMPLE

Solve $3x^2 + 6x = -2$.

$3x^2 + 6x = -2$	Write original equation.
$3x^2 + 6x + 2 = 0$	Write in standard form.
$x = \frac{-6 \pm \sqrt{6^2 - 4(3)(2)}}{2(3)}$	Use $a = 3$, $b = 6$, and $c = 2$ in quadratic formula.
$x = \frac{-3 \pm \sqrt{3}}{3}$	Simplify.

EXAMPLES 1, 2, 3, and 5 on pp. 292–295 for Exs. 38–41

EXERCISES

Use the quadratic formula to solve the equation.

38. $x^2 + 4x - 3 = 0$ $-2 \pm \sqrt{7}$ **39.** $9x^2 = -6x - 1$ $-\frac{1}{3}$ **40.** $6x^2 - 8x = -3$ $\frac{4 \pm i\sqrt{2}}{6}$

41. VOLLEYBALL A person spikes a volleyball over a net when the ball is 9 feet above the ground. The volleyball has an initial vertical velocity of −40 feet per second. The volleyball is allowed to fall to the ground. How long is the ball in the air after it is spiked? about 0.2 sec

Extra Example 4.7

Solve $x^2 + 10x + 17 = 0$ by completing the square. $-5 + 2\sqrt{2}$, $-5 - 2\sqrt{2}$

Extra Example 4.8

Solve $2x^2 - 5x + 8 = 0$. $\frac{5 + i\sqrt{39}}{4}$, $\frac{5 - i\sqrt{39}}{4}$

4 CHAPTER REVIEW

4.9 Graph and Solve Quadratic Inequalities

pp. 300–307

EXAMPLE

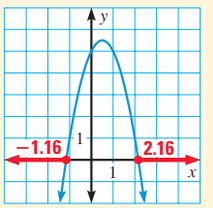
Solve $-2x^2 + 2x + 5 \le 0$.

The solution consists of the x-values for which the graph of $y = -2x^2 + 2x + 5$ lies on or below the x-axis. Find the graph's x-intercepts by letting $y = 0$ and using the quadratic formula to solve for x.

$$x = \frac{-2 \pm \sqrt{2^2 - 4(-2)(5)}}{2(-2)}$$

$$= \frac{-2 \pm \sqrt{44}}{-4} = \frac{-1 \pm \sqrt{11}}{-2}$$

$x \approx -1.16$ or $x \approx 2.16$



Sketch a parabola that opens down and has -1.16 and 2.16 as x-intercepts. The solution of the inequality is approximately $x \le -1.16$ or $x \ge 2.16$.

EXERCISES

Solve the inequality by graphing.

42. $2x^2 - 11x + 5 < 0$
$0.5 < x < 5$

43. $-x^2 + 4x + 3 \ge 0$
$-0.65 \le x \le 4.6$

44. $\frac{1}{2}x^2 + 3x - 6 > 0$
$x < -7.6$ or $x > 1.6$

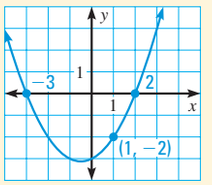
EXAMPLE 5 on p. 302 for Exs. 42–44

4.10 Write Quadratic Functions and Models

pp. 309–315

EXAMPLE

Write a quadratic function for the parabola shown.



Because you are given the x-intercepts $p = -3$ and $q = 2$, use the intercept form $y = a(x - p)(x - q) = a(x + 3)(x - 2)$.

Use the other given point, $(1, -2)$, to find a.

$-2 = a(1 + 3)(1 - 2)$ — Substitute 1 for x and -2 for y.

$-2 = -4a$ — Simplify coefficient of a.

$\frac{1}{2} = a$ — Solve for a.

▶ A quadratic function for the parabola is $y = \frac{1}{2}(x + 3)(x - 2)$.

EXERCISES

Write a quadratic function whose graph has the given characteristics.

45. x-intercepts: -3, 2; passes through: $(3, 12)$
$y = 2(x + 3)(x - 2)$

46. passes through: $(5, 2)$, $(0, 2)$, $(8, -6)$
$y = -\frac{1}{3}(x + 1)(x - 6)$

47. vertex: $(2, 7)$; passes through: $(4, 2)$
$y = -\frac{5}{4}(x - 2)^2 + 7$

48. **SOCCER** The parabolic path of a soccer ball that is kicked from the ground passes through the point $(0, 0)$ and has vertex $(12, 7)$ where the coordinates are in feet. Write a quadratic function that models the soccer ball's path. See margin.

EXAMPLES 1 and 2 on p. 309 for Exs. 45–48

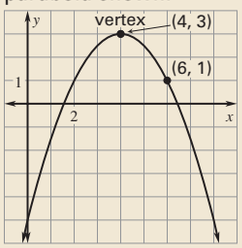
Extra Example 4.9

Solve $x^2 + 3x - 6 < 0$.

approximately $-4.37 < x < 1.37$

Extra Example 4.10

Write a quadratic function for the parabola shown.



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

48. $y = -\frac{7}{144}(x - 12)^2 + 7$