9 CHAPTER REVIEW

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- Multi-Language Glossary
- Vocabulary practice

REVIEW KEY VOCABULARY

- quadratic function
- standard form of a quadratic function
- parabola
- parent quadratic function
- vertex of a parabola
- axis of symmetry
- minimum value
- maximum value
- intercept form of a quadratic function
- quadratic equation
- standard form of a quadratic equation
- completing the square
- vertex form of a quadratic function
- quadratic formula

VOCABULARY EXERCISES

1. Copy and complete: The line that passes through the vertex and divides a parabola into two symmetric parts is called the _?_.

Tell whether the function has a *minimum value* or a *maximum value*.

2. $f(x) = 5x^2 - 4x$ **3.** $f(x) = -x^2 + 6x + 2$ **4.** $f(x) = 0.3x^2 - 7.7x + 1.8$

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 this chapter.

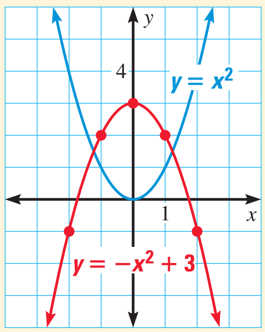
9.1 Graph $y = ax^2 + c$

EXAMPLE

Graph $y = -x^2 + 3$. Compare the graph with the graph of $y = x^2$.

Make a table of values for $y = -x^2 + 3$. Then plot the points from the table and draw a smooth curve through the points.

x	−2	−1	0	1	2
y	−1	2	3	2	−1



Both graphs have the same axis of symmetry, $x = 0$. However, the graph of $y = -x^2 + 3$ has a different vertex than the graph of $y = x^2$, and it opens down. This is because the graph of $y = -x^2 + 3$ is a vertical translation (of 3 units up) and a reflection in the x-axis of the graph of $y = x^2$.

EXAMPLES 1, 2, and 4 for Exs. 5–7

EXERCISES

Graph the function. Compare the graph with the graph of $y = x^2$.

5. $y = -4x^2$ **6.** $y = \frac{1}{3}x^2$ **7.** $y = 2x^2 - 1$

9.2 Graph $y = ax^2 + bx + c$

EXAMPLE

Graph $y = -x^2 + 2x + 1$.

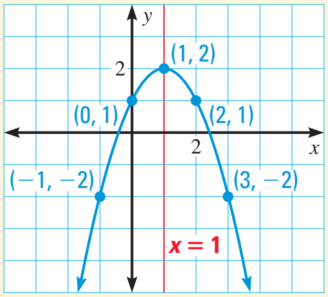
STEP 1 **Determine** whether the parabola opens up or down. Because $a < 0$, the parabola opens down.

STEP 2 **Find** and draw the axis of symmetry:

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

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

STEP 4 **Plot** four more points. Evaluating the function for $x = 0$ and $x = -1$ gives the points $(0, 1)$ and $(-1, -2)$. Plot these points and their reflections in the axis of symmetry.



STEP 5 **Draw** a parabola through the plotted points.

EXERCISES

EXAMPLE 2 for Exs. 8–10

Graph the function. Label the vertex and axis of symmetry.

8. $y = x^2 + 4x + 1$ **9.** $y = 2x^2 - 4x - 3$ **10.** $y = -2x^2 + 8x + 5$

9.3 Solve Quadratic Equations by Graphing

EXAMPLE

Solve $x^2 - 7x = -12$ by graphing.

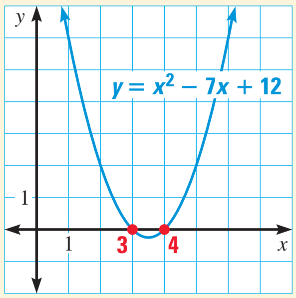
STEP 1 **Write** the equation in standard form.

$x^2 - 7x = -12$ Write original equation.

$x^2 - 7x + 12 = 0$ Add 12 to each side.

STEP 2 **Graph** the related function $y = x^2 - 7x + 12$. The x-intercepts of the graph are 3 and 4.

▶ The solutions of the equation $x^2 - 7x + 12 = 0$ are 3 and 4.



EXERCISES

EXAMPLES 1, 2, and 3 for Exs. 11–13

Solve the equation by graphing.

11. $4x^2 + x + 3 = 0$ **12.** $x^2 + 2x = -1$ **13.** $-x^2 + 8 = 7x$

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9.4 Use Square Roots to Solve Quadratic Equations

EXAMPLE

Solve $5(x-6)^2 = 30$. Round the solutions to the nearest hundredth.

$5(x-6)^2 = 30$	Write original equation.
$(x-6)^2 = 6$	Divide each side by 5.
$x - 6 = \pm\sqrt{6}$	Take square roots of each side.
$x = 6 \pm \sqrt{6}$	Add 6 to each side.

▶ The solutions of the equation are $6 + \sqrt{6} \approx 8.45$ and $6 - \sqrt{6} \approx 3.55$.

EXERCISES

EXAMPLES 1–4 for Exs. 14–19

Solve the equation. Round your solutions to the nearest hundredth, if necessary.

14. $6x^2 - 54 = 0$

15. $3x^2 + 7 = 4$

16. $g^2 + 11 = 24$

17. $7n^2 + 5 = 9$

18. $2(a+7)^2 = 34$

19. $3(w-4)^2 = 5$

9.5 Solve Quadratic Equations by Completing the Square

EXAMPLE

Solve $3x^2 + 12x = 18$ by completing the square.

$3x^2 + 12x = 18$	Write original equation.
$x^2 + 4x = 6$	Divide each side by 3.
$x^2 + 4x + 2^2 = 6 + 2^2$	Add $\left(\frac{4}{2}\right)^2$, or 2^2, to each side.
$(x+2)^2 = 10$	Write left side as the square of a binomial.
$x + 2 = \pm\sqrt{10}$	Take square roots of each side.
$x = -2 \pm \sqrt{10}$	Subtract 2 from each side.

▶ The solutions of the equation are $-2 + \sqrt{10} \approx 1.16$ and $-2 - \sqrt{10} \approx -5.16$.

EXERCISES

EXAMPLES 2 and 3 for Exs. 20–23

Solve the equation by completing the square. Round your solutions to the nearest hundredth, if necessary.

20. $x^2 - 14x = 51$

21. $2a^2 + 12a - 4 = 0$

22. $2n^2 + 4n + 1 = 10n + 9$

23. $5g^2 - 3g + 6 = 2g^2 + 9$

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9.6 Solve Quadratic Equations by the Quadratic Formula

EXAMPLE

Solve $4x^2 + 3x = 1$.

$$4x^2 + 3x = 1 \quad \text{Write original equation.}$$

$$4x^2 + 3x - 1 = 0 \quad \text{Write in standard form.}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad \text{Quadratic formula}$$

$$= \frac{-3 \pm \sqrt{3^2 - 4(4)(-1)}}{2(4)} \quad \text{Substitute values in the quadratic formula: } a = 4, b = 3, \text{ and } c = -1.$$

$$= \frac{-3 \pm \sqrt{25}}{8} = \frac{-3 \pm 5}{8} \quad \text{Simplify.}$$

▶ The solutions of the equation are $\frac{-3+5}{8} = \frac{1}{4}$ and $\frac{-3-5}{8} = -1$.

EXERCISES

EXAMPLES 1–3 for Exs. 24–29

Use the quadratic formula to solve the equation. Round your solutions to the nearest hundredth, if necessary.

24. $x^2 - 2x - 15 = 0$ **25.** $2m^2 + 7m - 3 = 0$ **26.** $-w^2 + 5w = 3$

27. $5n^2 - 7n = -1$ **28.** $t^2 - 4 = 6t + 8$ **29.** $2h - 1 = 10 - 9h^2$

9.7 Solve Systems with Quadratic Equations

EXAMPLE

Solve the system using substitution: $y = x + 10$ Equation 1

$y = x^2 + x + 1$ Equation 2

STEP 1 **Solve** one of the equations for y. Equation 1 is already solved for y.

STEP 2 **Substitute** $x + 10$ for y in Equation 2 and solve for x.

$$y = x^2 + x + 1 \quad \text{Write original equation 2.}$$

$$x + 10 = x^2 + x + 1 \quad \text{Substitute } x + 10 \text{ for } y.$$

$$9 = x^2 \quad \text{Solve for } x^2$$

$$x = -3 \text{ or } x = 3 \quad \text{Solve for } x$$

STEP 3 **Substitute** both -3 and 3 for y in Equation 1

$$y = -3 + 7 = 4 \text{ and } y = 3 + 7 = 10$$

▶ The solutions of the system are $(-3, 4)$ and $(3, 10)$.

EXERCISES

EXAMPLES 1–3 for Exs. 30–33

Solve the system using the substitution method or a graphing calculator.

30. $y = x + 8$, $y = x^2 + 2x + 2$

31. $x + y = 0$, $y = 2x^2 - 3x - 4$

32. $2x + y = 1$, $y = 3x^2 - x - 1$

33. Solve $4x^2 - 2x - 1 = 2x + 2$ using a system of equations.

9 CHAPTER REVIEW

9.8 Compare Linear, Exponential, and Quadratic Models

EXAMPLE

Use differences or ratios to tell whether the table of values represents a *linear function*, an *exponential function*, or a *quadratic function*.

a.

x	−1	0	1	2
y	5	3	1	−1

Differences: −2 −2 −2

▶ The table of values represents a linear function.

b.

x	−1	0	1	2
y	4	5	4	1

First differences: 1 −1 −3

Second differences: −2 −2

▶ The table of values represents a quadratic function.

EXAMPLE 2
for Exs. 34–35

EXERCISES

Tell whether the table of values represents a *linear function*, an *exponential function*, or a *quadratic function*.

34.

x	1	2	3	4	5	6
y	1	2	4	8	16	32

35.

x	−2	−1	0	1	2	3
y	0	3	6	9	12	15

9.9 Model Relationships

EXAMPLE

Decide which function is increasing more rapidly.

Linear Function 1 has an *x*-intercept of −3 and a *y*-intercept of 2.

Linear Function 2 includes the points in the table below.

x	−2	−1	0	1	2
y	−3	−2.5	−2	−1.5	−1

The points (−3, 0) and (0, 2) are on the graph of Linear Function 1, so its slope is $\frac{2-0}{0-(-3)} = \frac{2}{3}$. The table for Linear Function 2 shows that for each increase of 1 in the value of *x*, there is an increase of 0.5 in the value of *y*. The slope of the graph of Linear Function 2 is $= \frac{0.5}{1} = \frac{1}{2}$. So, Linear Function 1 is increasing more rapidly.

EXAMPLES 1–2
for Exs. 36–37

EXERCISES

36. Linear Function 1 has a *y*-intercept of 3 and a slope of –1. Linear Function 2 has an *x*-intercept of 4 and a *y*-intercept of 3. Which linear function is decreasing more rapidly?

37. The population of a city is increasing at a rate of 2.5% per decade. What type of function would be a good model for this situation?