4.10 EXERCISES

HOMEWORK KEY

- ◯ = **WORKED-OUT SOLUTIONS** on p. WS9 for Exs. 19, 35, and 49
- ★ = **STANDARDIZED TEST PRACTICE** Exs. 2, 15, 16, 43, 44, and 51
- ◆ = **MULTIPLE REPRESENTATIONS** Ex. 50

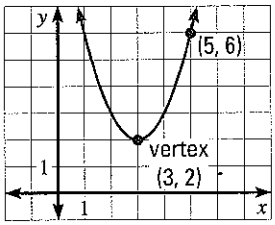
SKILL PRACTICE

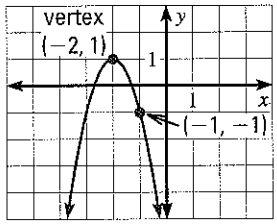
1. **VOCABULARY** Copy and complete: When you perform quadratic regression on a set of data, the quadratic model obtained is called the ___?___.

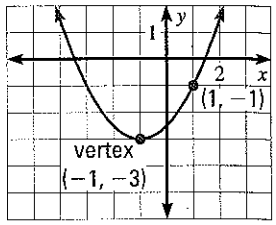
2. ★ **WRITING** *Describe* how to write an equation of a parabola if you know three points on the parabola that are not the vertex or x-intercepts.

EXAMPLE 1 on p. 309 for Exs. 3–15

WRITING IN VERTEX FORM **Write a quadratic function in vertex form for the parabola shown.**

3. 

4. 

5. 

WRITING IN VERTEX FORM **Write a quadratic function in vertex form whose graph has the given vertex and passes through the given point.**

6. vertex: $(-4, 1)$
   point: $(-2, 5)$

7. vertex: $(1, 6)$
   point: $(-1, 2)$

8. vertex: $(5, -4)$
   point: $(1, 20)$

9. vertex: $(-3, 3)$
   point: $(1, -1)$

10. vertex: $(5, 0)$
    point: $(2, -27)$

11. vertex: $(-4, -2)$
    point: $(0, 30)$

12. vertex: $(2, 1)$
    point: $(4, -2)$

13. vertex: $(-1, -4)$
    point: $(2, -1)$

14. vertex: $(3, 5)$
    point: $(7, -3)$

15. ★ **MULTIPLE CHOICE** The vertex of a parabola is $(5, -3)$ and another point on the parabola is $(1, 5)$. Which point is also on the parabola?

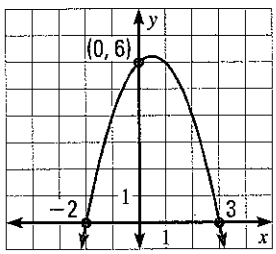
    Ⓐ $(0, 3)$ Ⓑ $(-1, 9)$ Ⓒ $(-1, 15)$ Ⓓ $(7, 7)$

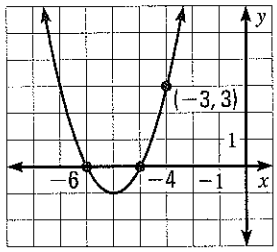
EXAMPLE 2 on p. 309 for Exs. 16–26

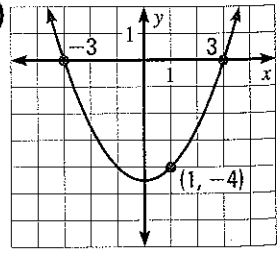
16. ★ **MULTIPLE CHOICE** The x-intercepts of a parabola are 4 and 7 and another point on the parabola is $(2, -20)$. Which point is also on the parabola?

    Ⓐ $(1, 21)$ Ⓑ $(8, -4)$ Ⓒ $(5, -40)$ Ⓓ $(5, 4)$

WRITING IN INTERCEPT FORM **Write a quadratic function in intercept form for the parabola shown.**

17. 

18. 

19. 

WRITING IN INTERCEPT FORM Write a quadratic function in intercept form whose graph has the given x-intercepts and passes through the given point.

20. x-intercepts: 2, 5
point: (4, −2)

21. x-intercepts: −3, 0
point: (2, 10)

22. x-intercepts: −1, 4
point: (2, 4)

23. x-intercepts: 3, 7
point: (6, −9)

24. x-intercepts: −5, −1
point: (−7, −24)

25. x-intercepts: −6, 3
point: (0, −9)

ERROR ANALYSIS *Describe* and correct the error in writing a quadratic function whose graph has the given x-intercepts or vertex and passes through the given point.

26. x-intercepts: 4, −3; point: (5, −5)

$y = a(x - 5)(x + 5)$

$-3 = a(4 - 5)(4 + 5)$

$-3 = -9a$

$\frac{1}{3} = a$, so $y = \frac{1}{3}(x - 5)(x + 5)$ ✗

27. vertex: (2, 3); point: (1, 5)

$y = a(x - 2)(x - 3)$

$5 = a(1 - 2)(1 - 3)$

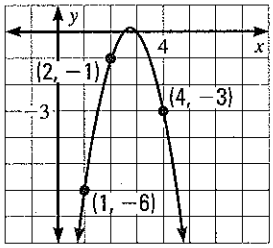
$5 = 2a$

$\frac{5}{2} = a$, so $y = \frac{5}{2}(x - 2)(x - 3)$ ✗

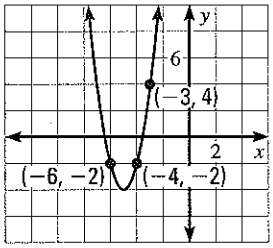
EXAMPLE 3 on p. 310 for Exs. 28–39

WRITING IN STANDARD FORM Write a quadratic function in standard form for the parabola shown.

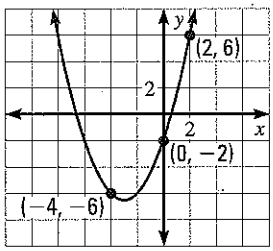
28.



29.



30.



WRITING IN STANDARD FORM Write a quadratic function in standard form for the parabola that passes through the given points.

31. (−4, −3), (0, −2), (1, 7)

32. (−2, −4), (0, −10), (3, −7)

33. (−2, 4), (0, 5), (1, −11)

34. (−1, −1), (1, 11), (3, 7)

35. (−1, 9), (1, 1), (3, 17)

36. (−6, −1), (−3, −4), (3, 8)

37. (−2, −13), (2, 3), (4, 5)

38. (−6, 29), (−4, 12), (2, −3)

39. (−3, −2), (3, 10), (6, −2)

WRITING QUADRATIC FUNCTIONS Write a quadratic function whose graph has the given characteristics.

40. passes through:
(−0.5, −1), (2, 8), (11, 25)

41. x-intercepts: −11, 3
passes through: (1, −192)

42. vertex: (4.5, 7.25)
passes through: (7, −3)

43. ★ **OPEN-ENDED MATH** Draw a parabola that passes through (−2, 3). Write a function for the parabola in standard form, intercept form, and vertex form.

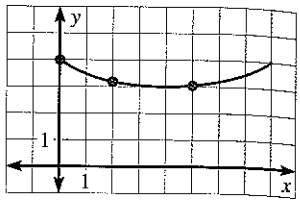
44. ★ **SHORT RESPONSE** Suppose you are given a set of data pairs (x, y). *Describe* how you can use ratios to determine whether the data can be modeled by a quadratic function of the form $y = ax^2$.

45. **CHALLENGE** Find a function of the form $y = ax^2 + bx + c$ whose graph passes through (1, −4), (−3, −16), and (7, 14). *Explain* what the model tells you about the points.

PROBLEM SOLVING

EXAMPLES 1 and 3 on pp. 309–310 for Exs. 46–47

46. ANTENNA DISH Three points on the parabola formed by the cross section of an antenna dish are (0, 4), (2, 3.25), and (5, 3.0625). Write a quadratic function that models the cross section.



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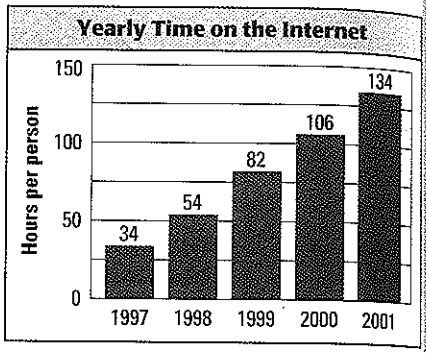
47. FOOTBALL Two points on the parabolic path of a kicked football are (0, 0) and the vertex (20, 15). Write a quadratic function that models the path.

@HomeTutor for problem solving help at classzone.com

EXAMPLE 4 on p. 311 for Exs. 48–50

48. MULTI-STEP PROBLEM The bar graph shows the average number of hours per person per year spent on the Internet in the United States for the years 1997–2001.

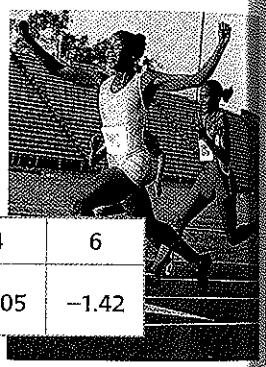


a. Use a graphing calculator to create a scatter plot.

b. Use the quadratic regression feature of the calculator to find the best-fitting quadratic model for the data.

c. Use your model from part (b) to predict the average number of hours a person will spend on the Internet in 2010.

49. RUNNING The table shows how wind affects a runner's performance in the 200 meter dash. Positive wind speeds correspond to tailwinds, and negative wind speeds correspond to headwinds. The change t in finishing time is the difference beween the runner's time when the wind speed is s and the runner's time when there is no wind.



Wind speed (m/sec), s	−6	−4	−2	0	2	4	6
Change in finishing time (sec), t	2.28	1.42	0.67	0	−0.57	−1.05	−1.42

a. Use a graphing calculator to find the best-fitting quadratic model.

b. Predict the change in finishing time when the wind speed is 10 m/sec.

50. ◆ MULTIPLE REPRESENTATIONS The table shows the number of U.S. households (in millions) with color televisions from 1970 through 2000.

Years since 1970	0	5	10	15	20	25	30
Households with color TVs (millions)	21	47	63	78	90	94	101

a. Drawing a Graph Make a scatter plot of the data. Draw the parabola that you think best fits the data.

b. Writing a Function Estimate the coordinates of three points on the parabola. Use the points to write a quadratic function for the data.

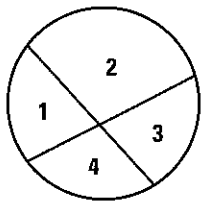
c. Making a Table Use your function from part (b) to make a table of data for the years listed in the original table above. *Compare* the numbers of households given by your function with the numbers in the original table.

○ = WORKED-OUT SOLUTIONS on p. WS1 ★ = STANDARDIZED TEST PRACTICE ◆ = MULTIPLE REPRESENTATIONS

51. ★ **MULTIPLE CHOICE** The Garabit Viaduct in France has a parabolic arch as part of its support. Three points on the parabola that models the arch are (0, 0), (40, 38.2), and (165, 0) where x and y are measured in meters. Which point is also on the parabola?

Ⓐ (10, −11.84) Ⓑ (26.74, 25) Ⓒ (80, 51.95) Ⓓ (125, 45)

52. **CHALLENGE** Let R be the maximum number of regions into which a circle can be divided using n chords. For example, the diagram shows that $R = 4$ when $n = 2$. Copy and complete the table. Then write a quadratic model giving R as a function of n.



n	0	1	2	3	4	5	6
R	?	?	4	?	?	?	?

MIXED REVIEW

PREVIEW
Prepare for Lesson 5.1 in Exs. 53–58.

Evaluate the expression for the given value of the variable. *(p. 10)*

53. $x^2 - 3$ when $x = 5$
54. $3a^5 - 10$ when $a = -1$
55. x^4 when $x = -2$
56. $4u^3 - 15$ when $u = 3$
57. $v^2 + 3v - 5$ when $v = 5$
58. $-y^3 + 2y + 5$ when $y = 2$

Solve the system of linear equations. *(p. 160)*

59. $4x + 5y = 18$, $-x + 2y = 15$
60. $3x + 7y = 1$, $4x + 5y = 23$
61. $3x + 4y = -1$, $2x + 6y = -31$
62. $3x + y = 10$, $-x + 2y = 20$
63. $4x + 5y = 2$, $-3x + 2y = 33$
64. $2x + 3y = -1$, $10x + 7y = -1$

QUIZ *for Lessons 4.8–4.10*

Use the quadratic formula to solve the equation. *(p. 292)*

1. $x^2 - 4x + 5 = 0$
2. $2x^2 - 8x + 1 = 0$
3. $3x^2 + 5x + 4 = 0$

Graph the inequality. *(p. 300)*

4. $y < -3x^2$
5. $y > -x^2 + 2x$
6. $y \geq -x^2 + 2x + 3$

Solve the inequality. *(p. 300)*

7. $0 \geq x^2 + 5$
8. $12 \leq x^2 - 7x$
9. $2x^2 + 2 > -5x$

Write a quadratic function whose graph has the given characteristics. *(p. 309)*

10. vertex: (5, 7); passes through: (3, 11)
11. x-intercepts: −3, 5; passes through: (7, −40)
12. passes through: (−1, 2), (4, −23), (2, −7)

13. **SPORTS** A person throws a baseball into the air with an initial vertical velocity of 30 feet per second and then lets the ball hit the ground. The ball is released 5 feet above the ground. How long is the ball in the air? *(p. 292)*