4.2 EXERCISES

HOMEWORK KEY

○ = **WORKED-OUT SOLUTIONS** on p. WS8 for Exs. 19, 29, and 53

★ = **STANDARDIZED TEST PRACTICE** Exs. 2, 12, 22, 49, 54, and 55

SKILL PRACTICE

1. **VOCABULARY** Copy and complete: A quadratic function in the form $y = a(x - h)^2 + k$ is in ? form.

2. ★ **WRITING** *Explain* how to find a quadratic function's maximum value or minimum value when the function is given in intercept form.

EXAMPLE 1 on p. 245 for Exs. 3–12

GRAPHING WITH VERTEX FORM **Graph the function. Label the vertex and axis of symmetry.**

3. $y = (x - 3)^2$
4. $y = (x + 4)^2$
5. $f(x) = -(x + 3)^2 + 5$
6. $y = 3(x - 7)^2 - 1$
7. $g(x) = -4(x - 2)^2 + 4$
8. $y = 2(x + 1)^2 - 3$
9. $f(x) = -2(x - 1)^2 - 5$
10. $y = -\frac{1}{4}(x + 2)^2 + 1$
11. $y = \frac{1}{2}(x - 3)^2 + 2$

12. ★ **MULTIPLE CHOICE** What is the vertex of the graph of the function $y = 3(x + 2)^2 - 5$?

Ⓐ (2, −5) Ⓑ (−2, −5) Ⓒ (−5, 2) Ⓓ (5, −2)

EXAMPLE 3 on p. 247 for Exs. 13–23

GRAPHING WITH INTERCEPT FORM **Graph the function. Label the vertex, axis of symmetry, and x-intercepts.**

13. $y = (x + 3)(x - 3)$
14. $y = (x + 1)(x - 3)$
15. $y = 3(x + 2)(x + 6)$
16. $f(x) = 2(x - 5)(x - 1)$
17. $y = -(x - 4)(x + 6)$
18. $g(x) = -4(x + 3)(x + 7)$
19. $y = (x + 1)(x + 2)$
20. $f(x) = -2(x - 3)(x + 4)$
21. $y = 4(x - 7)(x + 2)$

22. ★ **MULTIPLE CHOICE** What is the vertex of the graph of the function $y = -(x - 6)(x + 4)$?

Ⓐ (1, 25) Ⓑ (−1, 21) Ⓒ (−6, 4) Ⓓ (6, −4)

23. **ERROR ANALYSIS** *Describe* and correct the error in analyzing the graph of the function $y = 5(x - 2)(x + 3)$.

> The x-intercepts of the graph are −2 and 3. ✗

EXAMPLES 5 and 6 on p. 248 for Exs. 24–32

WRITING IN STANDARD FORM **Write the quadratic function in standard form.**

24. $y = (x + 4)(x + 3)$
25. $y = (x - 5)(x + 3)$
26. $h(x) = 4(x + 1)(x - 6)$
27. $y = -3(x - 2)(x - 4)$
28. $f(x) = (x + 5)^2 - 2$
29. $y = (x - 3)^2 + 6$
30. $g(x) = -(x + 6)^2 + 10$
31. $y = 5(x + 3)^2 - 4$
32. $f(x) = 12(x - 1)^2 + 4$

MINIMUM OR MAXIMUM VALUES **Find the minimum value or the maximum value of the function.**

33. $y = 3(x - 3)^2 - 4$
34. $g(x) = -4(x + 6)^2 - 12$
35. $y = 15(x - 25)^2 + 130$
36. $f(x) = 3(x + 10)(x - 8)$
37. $y = -(x - 36)(x + 18)$
38. $y = -12x(x - 9)$
39. $y = 8x(x + 15)$
40. $y = 2(x - 3)(x - 6)$
41. $g(x) = -5(x + 9)(x - 4)$

42. GRAPHING CALCULATOR Consider the function $y = a(x - h)^2 + k$ where $a = 1$, $h = 3$, and $k = -2$. Predict the effect of each change in a, h, or k described in parts (a)–(c). Use a graphing calculator to check your prediction by graphing the original and revised functions in the same coordinate plane.

a. a changes to -3 **b.** h changes to -1 **c.** k changes to 2

MAKING A GRAPH Graph the function. Label the vertex and axis of symmetry.

43. $y = 5(x - 2.25)^2 - 2.75$ **44.** $g(x) = -8(x + 3.2)^2 + 6.4$ **45.** $y = -0.25(x - 5.2)^2 + 8.5$

46. $y = -\frac{2}{3}\left(x - \frac{1}{2}\right)^2 + \frac{4}{5}$ **47.** $f(x) = -\frac{3}{4}(x + 5)(x + 8)$ **48.** $g(x) = \frac{5}{2}\left(x - \frac{4}{3}\right)\left(x - \frac{2}{5}\right)$

49. ★ OPEN-ENDED MATH Write two different quadratic functions in intercept form whose graphs have axis of symmetry $x = 3$.

50. CHALLENGE Write $y = a(x - h)^2 + k$ and $y = a(x - p)(x - q)$ in standard form. Knowing the vertex of the graph of $y = ax^2 + bx + c$ occurs at $x = -\frac{b}{2a}$, show that the vertex of the graph of $y = a(x - h)^2 + k$ occurs at $x = h$ and that the vertex of the graph of $y = a(x - p)(x - q)$ occurs at $x = \frac{p + q}{2}$.

PROBLEM SOLVING

EXAMPLES 2 and 4 on pp. 246–247 for Exs. 51–54

51. BIOLOGY The function $y = -0.03(x - 14)^2 + 6$ models the jump of a red kangaroo where x is the horizontal distance (in feet) and y is the corresponding height (in feet). What is the kangaroo's maximum height? How long is the kangaroo's jump?

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52. CIVIL ENGINEERING The arch of the Gateshead Millennium Bridge forms a parabola with equation $y = -0.016(x - 52.5)^2 + 45$ where x is the horizontal distance (in meters) from the arch's left end and y is the distance (in meters) from the base of the arch. What is the width of the arch?

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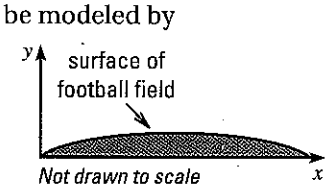
53. MULTI-STEP PROBLEM Although a football field appears to be flat, its surface is actually shaped like a parabola so that rain runs off to both sides. The cross section of a field with synthetic turf can be modeled by

$$y = -0.000234x(x - 160)$$

where x and y are measured in feet.

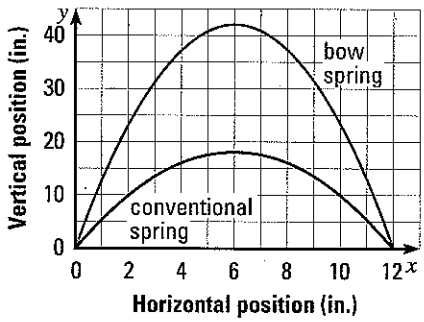


a. What is the field's width?

b. What is the maximum height of the field's surface?

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

54. ★ SHORT RESPONSE A jump on a pogo stick with a conventional spring can be modeled by $y = -0.5(x - 6)^2 + 18$, and a jump on a pogo stick with a bow spring can be modeled by $y = -1.17(x - 6)^2 + 42$, where x and y are measured in inches. *Compare* the maximum heights of the jumps on the two pogo sticks. Which constants in the functions affect the maximum heights of the jumps? Which do not?



55. ★ EXTENDED RESPONSE A kernel of popcorn contains water that expands when the kernel is heated, causing it to pop. The equations below give the "popping volume" y (in cubic centimeters per gram) of popcorn with moisture content x (as a percent of the popcorn's weight).

Hot-air popping: $y = -0.761(x - 5.52)(x - 22.6)$

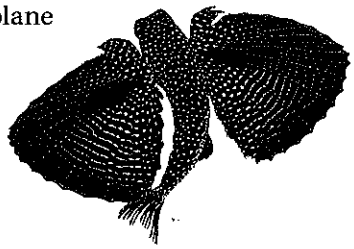
Hot-oil popping: $y = -0.652(x - 5.35)(x - 21.8)$

a. Interpret For hot-air popping, what moisture content maximizes popping volume? What is the maximum volume?

b. Interpret For hot-oil popping, what moisture content maximizes popping volume? What is the maximum volume?

c. Graphing Calculator Graph the functions in the same coordinate plane. What are the domain and range of each function in this situation? *Explain* how you determined the domain and range.

56. CHALLENGE Flying fish use their pectoral fins like airplane wings to glide through the air. Suppose a flying fish reaches a maximum height of 5 feet after flying a horizontal distance of 33 feet. Write a quadratic function $y = a(x - h)^2 + k$ that models the flight path, assuming the fish leaves the water at (0, 0). *Describe* how changing the value of a, h, or k affects the flight path.



MIXED REVIEW

PREVIEW
Prepare for Lesson 4.3 in Exs. 57–64.

Solve the equation.

57. $x - 5 = 0$ *(p. 18)*

58. $2x + 3 = 0$ *(p. 18)*

59. $23x - 14 = -5x - 7$ *(p. 18)*

60. $-5(3x + 4) = 17x + 2$ *(p. 18)*

61. $|x - 9| = 16$ *(p. 51)*

62. $|4x + 9| = 27$ *(p. 51)*

63. $|7 - 2x| = 1$ *(p. 51)*

64. $|3 - 5x| = 7$ *(p. 51)*

Use the given matrices to perform the indicated operation, if possible. If not possible, state the reason.

$$A = \begin{bmatrix} -1 & 3 \\ 2 & -5 \end{bmatrix}, B = \begin{bmatrix} 2 & -6 \\ 3 & 8 \end{bmatrix}, C = \begin{bmatrix} -1 & 4 \\ -2 & 3 \end{bmatrix}, D = \begin{bmatrix} 3 & 0 & -1 \\ 6 & 1 & 4 \end{bmatrix}, E = \begin{bmatrix} 1 & -2 & 4 \\ 3 & -1 & 5 \end{bmatrix}$$

65. $2A + B$ *(p. 187)*

66. $3(B + C)$ *(p. 187)*

67. $D - 4E$ *(p. 187)*

68. AB *(p. 195)*

69. $A(B - C)$ *(p. 195)*

70. $4(CD)$ *(p. 195)*