

8.7

Exercise Set

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REVIEW

 **Concept Reinforcement** Classify each of the following statements as either true or false.

- The graph of $f(x) = 3x^2 - x + 6$ opens upward. **True**
- The function given by $g(x) = -x^2 + 3x + 1$ has a minimum value. **False**
- The graph of $f(x) = -2(x - 3)^2 + 7$ has its vertex at $(3, 7)$. **True**
- The graph of $g(x) = 4(x + 6)^2 - 2$ has its vertex at $(-6, -2)$. **True**
- The graph of $g(x) = \frac{1}{2}(x - \frac{3}{2})^2 + \frac{1}{4}$ has $x = \frac{1}{4}$ as its axis of symmetry. **False**
- The function given by $f(x) = (x - 2)^2 - 5$ has a minimum value of -5 . **True**
- The y -intercept of the graph of $f(x) = 2x^2 - 6x + 7$ is $(7, 0)$. **False**
- If the graph of a quadratic function f opens upward and has a vertex of $(1, 5)$, then the graph has no x -intercepts. **True**

Complete the square to write each function in the form $f(x) = a(x - h)^2 + k$.

- $f(x) = x^2 - 8x + 2$ $f(x) = (x - 4)^2 + (-14)$
- $f(x) = x^2 - 6x - 1$ $f(x) = (x - 3)^2 + (-10)$
- $f(x) = x^2 + 3x - 5$ $f(x) = (x - (-\frac{3}{2}))^2 + (-\frac{29}{4})$
- $f(x) = x^2 + 5x + 3$ $f(x) = (x - (-\frac{5}{2}))^2 + (-\frac{13}{4})$
- $f(x) = 3x^2 + 6x - 2$ $f(x) = 3(x - (-1))^2 + (-5)$
- $f(x) = 2x^2 - 20x - 3$ $f(x) = 2(x - 5)^2 + (-53)$
- $f(x) = -x^2 - 4x - 7$ $f(x) = -(x - (-2))^2 + (-3)$
- $f(x) = -2x^2 - 8x + 4$ $f(x) = -2(x - (-2))^2 + 12$
- $f(x) = 2x^2 - 5x + 10$ $f(x) = 2(x - \frac{5}{4})^2 + \frac{55}{8}$
- $f(x) = 3x^2 + 7x - 3$ $f(x) = 3(x - (-\frac{7}{6}))^2 + (-\frac{85}{12})$

For each quadratic function, (a) find the vertex and the axis of symmetry and (b) graph the function.

- $f(x) = x^2 + 4x + 5$ 20. $f(x) = x^2 + 2x - 5$
- $f(x) = x^2 + 8x + 20$

- $f(x) = x^2 - 10x + 21$
- $h(x) = 2x^2 - 16x + 25$
- $h(x) = 2x^2 + 16x + 23$
- $f(x) = -x^2 + 2x + 5$
- $f(x) = -x^2 - 2x + 7$
- $g(x) = x^2 + 3x - 10$
- $g(x) = x^2 + 5x + 4$
- $h(x) = x^2 + 7x$
- $h(x) = x^2 - 5x$
- $f(x) = -2x^2 - 4x - 6$
- $f(x) = -3x^2 + 6x + 2$

For each quadratic function, (a) find the vertex, the axis of symmetry, and the maximum or minimum function value and (b) graph the function.

- $g(x) = x^2 - 6x + 13$
- $g(x) = x^2 - 4x + 5$
- $g(x) = 2x^2 - 8x + 3$
- $g(x) = 2x^2 + 5x - 1$
- $f(x) = 3x^2 - 24x + 50$
- $f(x) = 4x^2 + 16x + 13$
- $f(x) = -3x^2 + 5x - 2$
- $f(x) = -3x^2 - 7x + 2$
- $h(x) = \frac{1}{2}x^2 + 4x + \frac{19}{3}$
- $h(x) = \frac{1}{2}x^2 - 3x + 2$

Use a graphing calculator to find the vertex of the graph of each function.

- $f(x) = x^2 + x - 6$ $(-0.5, -6.25)$
- $f(x) = x^2 + 2x - 5$ $(-1, -6)$
- $f(x) = 5x^2 - x + 1$ $(0.1, 0.95)$
- $f(x) = -4x^2 - 3x + 7$ $(-0.375, 7.5625)$
- $f(x) = -0.2x^2 + 1.4x - 6.7$ $(3.5, -4.25)$
- $f(x) = 0.5x^2 + 2.4x + 3.2$ $(-2.4, 0.32)$

Find any x -intercepts and the y -intercept. If no x -intercepts exist, state this.

49. $f(x) = x^2 - 6x + 3$ 50. $f(x) = x^2 + 5x + 2$
51. $g(x) = -x^2 + 2x + 3$ 52. $g(x) = x^2 - 6x + 9$
 (-1, 0), (3, 0); (0, 3) (3, 0); (0, 9)
- Aha! 53. $f(x) = x^2 - 9x$ 54. $f(x) = x^2 - 7x$
 (0, 0), (9, 0); (0, 0) (0, 0), (7, 0); (0, 0)
55. $h(x) = -x^2 + 4x - 4$ (2, 0); (0, -4)
56. $h(x) = -2x^2 - 20x - 50$
57. $g(x) = x^2 + x - 5$ 58. $g(x) = 2x^2 + 3x - 1$
59. $f(x) = 2x^2 - 4x + 6$ 60. $f(x) = x^2 - x + 2$
 No x -intercept; (0, 6) No x -intercept; (0, 2)
- TW 61. The graph of a quadratic function f opens downward and has no x -intercepts. In what quadrant(s) must the vertex lie? Explain your reasoning.
- TW 62. Is it possible for the graph of a quadratic function to have only one x -intercept if the vertex is off the x -axis? Why or why not?

SKILL REVIEW

To prepare for Section 8.8, review solving systems of three equations in three unknowns (Section 3.4).

Solve. [3.4]

63. $x + y + z = 3,$
 $x - y + z = 1,$
 $-x - y + z = -1$
 (1, 1, 1)
64. $x - y + z = -6,$
 $2x + y + z = 2,$
 $3x + y + z = 0$
 (-2, 5, 1)
65. $z = 8,$
 $x + y + z = 23,$
 $2x + y - z = 17$
 (10, 5, 8)
66. $z = -5,$
 $2x - y + 3z = -27,$
 $x + 2y + 7z = -26$
 (-3, 6, -5)
67. $1.5 = c,$
 $52.5 = 25a + 5b + c,$
 $7.5 = 4a + 2b + c$
 (2.4, -1.8, 1.5)
68. $\frac{1}{2} = c,$
 $5 = 9a + 6b + 2c,$
 $29 = 81a + 9b + c$
 $(\frac{1}{3}, \frac{1}{6}, \frac{1}{2})$

SYNTHESIS

- TW 69. If the graphs of two quadratic functions have the same x -intercepts, will they also have the same vertex? Why or why not?
- TW 70. Suppose that the graph of $f(x) = ax^2 + bx + c$ has $(x_1, 0)$ and $(x_2, 0)$ as x -intercepts. Explain why the graph of $g(x) = -ax^2 - bx - c$ will also have $(x_1, 0)$ and $(x_2, 0)$ as x -intercepts.

For each quadratic function, find (a) the maximum or minimum value and (b) the x - and y -intercepts. Round to the nearest hundredth.

71. $f(x) = 2.31x^2 - 3.135x - 5.89$
72. $f(x) = -18.8x^2 + 7.92x + 6.18$
73. $g(x) = -1.25x^2 + 3.42x - 2.79$
74. $g(x) = 0.45x^2 - 1.72x + 12.92$

75. Graph the function

$$f(x) = x^2 - x - 6.$$

Then use the graph to approximate solutions to each of the following equations.

- a) $x^2 - x - 6 = 2$ -2.4, 3.4
 b) $x^2 - x - 6 = -3$ -1.3, 2.3

76. Graph the function

$$f(x) = \frac{x^2}{2} + x - \frac{3}{2}.$$

Then use the graph to approximate solutions to each of the following equations.

- a) $\frac{x^2}{2} + x - \frac{3}{2} = 0$ -3, 1
 b) $\frac{x^2}{2} + x - \frac{3}{2} = 1$ -3.4, 1.4
 c) $\frac{x^2}{2} + x - \frac{3}{2} = 2$ -3.8, 1.8

Find an equivalent equation of the type

$$f(x) = a(x - h)^2 + k.$$

77. $f(x) = mx^2 - nx + p$
 $f(x) = m\left(x - \frac{n}{2m}\right)^2 + \frac{4mp - n^2}{4m}$

78. $f(x) = 3x^2 + mx + m^2$

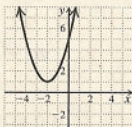
79. A quadratic function has $(-1, 0)$ as one of its intercepts and $(3, -5)$ as its vertex. Find an equation for the function.

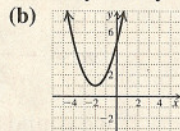
80. A quadratic function has $(4, 0)$ as one of its intercepts and $(-1, 7)$ as its vertex. Find an equation for the function.

Graph.

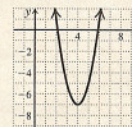
81. $f(x) = |x^2 - 1|$
82. $f(x) = |x^2 - 3x - 4|$
83. $f(x) = |2(x - 3)^2 - 5|$

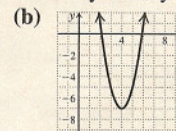
Try Exercise Answers: Section 8.7

19. (a) Vertex: $(-2, 1)$; axis of symmetry: $x = -2$; (b) 

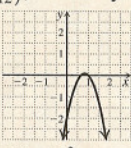


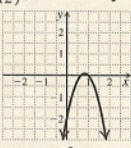
$$f(x) = x^2 + 4x + 5$$

23. (a) Vertex: $(4, -7)$; axis of symmetry: $x = 4$; (b) 



$$h(x) = 2x^2 - 16x + 25$$

39. (a) Vertex: $(\frac{5}{6}, \frac{1}{12})$; axis of symmetry: $x = \frac{5}{6}$; maximum: $\frac{1}{12}$; (b) 



$$f(x) = -3x^2 + 5x - 2$$

43. $(-0.5, -6.25)$ 49. $(3 - \sqrt{6}, 0), (3 + \sqrt{6}, 0); (0, 3)$