4.9 EXERCISES

HOMEWORK KEY

- ◯ = **WORKED-OUT SOLUTIONS** on p. WS9 for Exs. 17, 39, and 73
- ★ = **STANDARDIZED TEST PRACTICE** Exs. 2, 44, 45, 68, and 73
- ◆ = **MULTIPLE REPRESENTATIONS** Ex. 74

SKILL PRACTICE

1. **VOCABULARY** Give an example of a quadratic inequality in one variable and an example of a quadratic inequality in two variables.

2. ★ **WRITING** *Explain* how to solve $x^2 + 6x - 8 < 0$ using a table, by graphing, and algebraically.

EXAMPLE 1 on p. 300 for Exs. 3–19

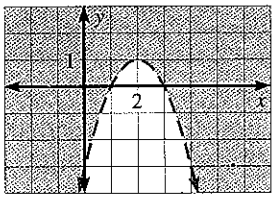
MATCHING INEQUALITIES WITH GRAPHS **Match the inequality with its graph.**

3. $y \leq x^2 + 4x + 3$

4. $y > -x^2 + 4x - 3$

5. $y < x^2 - 4x + 3$

A.



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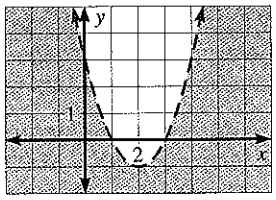

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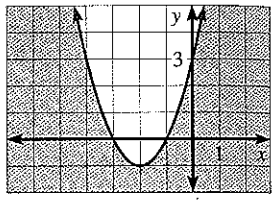


GRAPHING QUADRATIC INEQUALITIES **Graph the inequality.**

6. $y < -x^2$

7. $y \geq 4x^2$

8. $y > x^2 - 9$

9. $y \leq x^2 + 5x$

10. $y < x^2 + 4x - 5$

11. $y > x^2 + 7x + 12$

12. $y \leq -x^2 + 3x + 10$

13. $y \geq 2x^2 + 5x - 7$

14. $y \geq -2x^2 + 9x - 4$

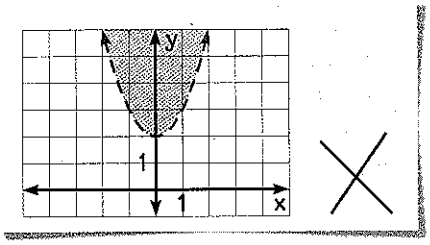
15. $y < 4x^2 - 3x - 5$

16. $y > 0.1x^2 - x + 1.2$

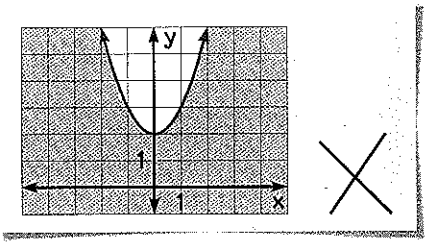
17. $y \leq -\frac{2}{3}x^2 + 3x + 1$

ERROR ANALYSIS **Describe and correct the error in graphing $y \geq x^2 + 2$.**

18.



19.



EXAMPLE 3 on p. 301 for Exs. 20–25

GRAPHING SYSTEMS **Graph the system of inequalities.**

20. $y \geq 2x^2$
$y < -x^2 + 1$

21. $y > -5x^2$
$y > 3x^2 - 2$

22. $y \geq x^2 - 4$
$y \leq -2x^2 + 7x + 4$

23. $y \leq -x^2 + 4x - 4$
$y < 2x^2 + x - 8$

24. $y > 3x^2 + 3x - 5$
$y < -x^2 + 5x + 10$

25. $y \geq x^2 - 3x - 6$
$y \geq 2x^2 + 7x + 6$

EXAMPLE 4 on p. 302 for Exs. 26–34

SOLVING USING A TABLE **Solve the inequality using a table.**

26. $x^2 - 5x < 0$

27. $x^2 + 2x - 3 > 0$

28. $x^2 + 3x \leq 10$

29. $x^2 - 2x \geq 8$

30. $-x^2 + 15x - 50 > 0$

31. $x^2 - 10x < -16$

32. $x^2 - 4x > 12$

33. $3x^2 - 6x - 2 \leq 7$

34. $2x^2 - 6x - 9 \geq 11$

EXAMPLE 5 on p. 302 for Exs. 35–43

SOLVING BY GRAPHING Solve the inequality by graphing.

35. $x^2 - 6x < 0$

36. $x^2 + 8x \leq -7$

37. $x^2 - 4x + 2 > 0$

38. $x^2 + 6x + 3 > 0$

39. $3x^2 + 2x - 8 \leq 0$

40. $3x^2 + 5x - 3 < 1$

41. $-6x^2 + 19x \geq 10$

42. $-\frac{1}{2}x^2 + 4x \geq 1$

43. $4x^2 - 10x - 7 < 10$

44. ★ **MULTIPLE CHOICE** What is the solution of $3x^2 - x - 4 > 0$?

(A) $x < -1$ or $x > \frac{4}{3}$

(B) $-1 < x < \frac{4}{3}$

(C) $x < -\frac{4}{3}$ or $x > 1$

(D) $1 < x < \frac{4}{3}$

45. ★ **MULTIPLE CHOICE** What is the solution of $2x^2 + 9x \leq 56$?

(A) $x \leq -8$ or $x \geq 3.5$

(B) $-8 \leq x \leq 3.5$

(C) $x \leq 0$ or $x \geq 4.5$

(D) $0 \leq x \leq 4.5$

EXAMPLE 7 on p. 303 for Exs. 46–57

SOLVING ALGEBRAICALLY Solve the inequality algebraically.

46. $4x^2 < 25$

47. $x^2 + 10x + 9 < 0$

48. $x^2 - 11x \geq -28$

49. $3x^2 - 13x > 10$

50. $2x^2 - 5x - 3 \leq 0$

51. $4x^2 + 8x - 21 \geq 0$

52. $-4x^2 - x + 3 \leq 0$

53. $5x^2 - 6x - 2 \leq 0$

54. $-3x^2 + 10x > -2$

55. $-2x^2 - 7x \geq 4$

56. $3x^2 + 1 < 15x$

57. $6x^2 - 5 > 8x$

58. **GRAPHING CALCULATOR** In this exercise, you will use a different graphical method to solve Example 6 on page 303.

a. Enter the equations $y = 7.51x^2 - 16.4x + 35.0$ and $y = 100$ into a graphing calculator.

b. Graph the equations from part (a) for $0 \leq x \leq 9$ and $0 \leq y \leq 300$.

c. Use the *intersect* feature to find the point where the graphs intersect.

d. During what years was the number of participating teams greater than 100? *Explain* your reasoning.

CHOOSING A METHOD Solve the inequality using any method.

59. $8x^2 - 3x + 1 < 10$

60. $4x^2 + 11x + 3 \geq -3$

61. $-x^2 - 2x - 1 > 2$

62. $-3x^2 + 4x - 5 \leq 2$

63. $x^2 - 7x + 4 > 5x - 2$

64. $2x^2 + 9x - 1 \geq -3x + 1$

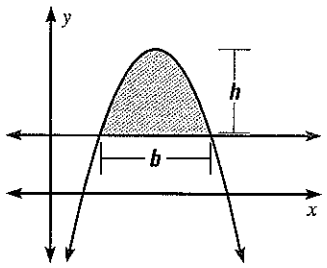
65. $3x^2 - 2x + 1 \leq -x^2 + 1$

66. $5x^2 + x - 7 < 3x^2 - 4x$

67. $6x^2 - 5x + 2 < -3x^2 + x$

68. ★ **OPEN-ENDED MATH** Write a quadratic inequality in one variable that has a solution of $x < -2$ or $x > 5$.

69. **CHALLENGE** The area A of the region bounded by a parabola and a horizontal line is given by $A = \frac{2}{3}bh$ where b and h are as defined in the diagram. Find the area of the region determined by each pair of inequalities.



a. $y \leq -x^2 + 4x$
$y \geq 0$

b. $y \geq x^2 - 4x - 5$
$y \leq 3$

PROBLEM SOLVING

EXAMPLE 2 on p. 301 for Exs. 70–71

70. ENGINEERING A wire rope can safely support a weight W (in pounds) provided $W \leq 8000d^2$ where d is the rope's diameter (in inches). Graph the inequality.

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71. WOODWORKING A hardwood shelf in a wooden bookcase can safely support a weight W (in pounds) provided $W \leq 115x^2$ where x is the shelf's thickness (in inches). Graph the inequality.

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EXAMPLE 6 on p. 303 for Exs. 72–74

72. ARCHITECTURE The arch of the Sydney Harbor Bridge in Sydney, Australia, can be modeled by $y = -0.00211x^2 + 1.06x$ where x is the distance (in meters) from the left pylons and y is the height (in meters) of the arch above the water. For what distances x is the arch above the road?

73. ★ SHORT RESPONSE The length L (in millimeters) of the larvae of the black porgy fish can be modeled by

$$L(x) = 0.00170x^2 + 0.145x + 2.35, 0 \leq x \leq 40$$

where x is the age (in days) of the larvae. Write and solve an inequality to find at what ages a larvae's length tends to be greater than 10 millimeters. *Explain* how the given domain affects the solution.

74. ◆ MULTIPLE REPRESENTATIONS A study found that a driver's reaction time $A(x)$ to audio stimuli and his or her reaction time $V(x)$ to visual stimuli (both in milliseconds) can be modeled by

$$A(x) = 0.0051x^2 - 0.319x + 15, 16 \leq x \leq 70$$

$$V(x) = 0.005x^2 - 0.23x + 22, 16 \leq x \leq 70$$

where x is the driver's age (in years).

a. Writing an Inequality Write an inequality that you can use to find the x-values for which $A(x)$ is less than $V(x)$.

b. Making a Table Use a table to find the solution of the inequality from part (a). Your table should contain x-values from 16 to 70 in increments of 6.

c. Drawing a Graph Check the solution you found in part (b) by using a graphing calculator to solve the inequality $A(x) < V(x)$ graphically. *Describe* how you used the domain $16 \leq x \leq 70$ to determine a reasonable solution.

d. Interpret Based on your results from parts (b) and (c), do you think a driver would react more quickly to a traffic light changing from green to yellow or to the siren of an approaching ambulance? *Explain*.

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

75. SOCCER The path of a soccer ball kicked from the ground can be modeled by

$$y = -0.0540x^2 + 1.43x$$

where x is the horizontal distance (in feet) from where the ball was kicked and y is the corresponding height (in feet).

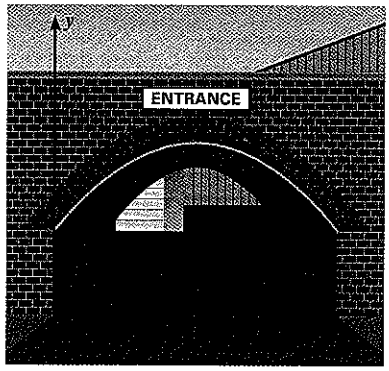
a. A soccer goal is 8 feet high. Write and solve an inequality to find at what values of x the ball is low enough to go into the goal.

b. A soccer player kicks the ball toward the goal from a distance of 15 feet away. No one is blocking the goal. Will the player score a goal? *Explain* your reasoning.

76. MULTI-STEP PROBLEM A truck that is 11 feet tall and 7 feet wide is traveling under an arch. The arch can be modeled by

$$y = -0.0625x^2 + 1.25x + 5.75$$

where x and y are measured in feet.



a. Will the truck fit under the arch? *Explain* your reasoning.

b. What is the maximum width that a truck 11 feet tall can have and still make it under the arch?

c. What is the maximum height that a truck 7 feet wide can have and still make it under the arch?

77. CHALLENGE For clear blue ice on lakes and ponds, the maximum weight w (in tons) that the ice can support is given by

$$w(x) = 0.1x^2 - 0.5x - 5$$

where x is the thickness of the ice (in inches).

a. Calculate What thicknesses of ice can support a weight of 20 tons?

b. Interpret *Explain* how you can use the graph of $w(x)$ to determine the minimum x-value in the domain for which the function gives meaningful results.

MIXED REVIEW

Graph the function.

78. $y = 3x + 7$ *(p. 89)*

79. $f(x) = -4x + 5$ *(p. 89)*

80. $y = \frac{1}{2}|x|$ *(p. 123)*

81. $y = |x - 2|$ *(p. 123)*

82. $y = |x + 6| - 1$ *(p. 123)*

83. $g(x) = x^2 - 8$ *(p. 236)*

84. $f(x) = x^2 + 4x + 3$ *(p. 236)*

85. $y = 2x^2 - 9x + 4$ *(p. 236)*

86. $y = \frac{1}{4}x^2 - 2x + 1$ *(p. 236)*

PREVIEW
Prepare for Lesson 4.10 in Exs. 87–92.

Solve the system of equations. *(p. 178)*

87.
$x + y + z = -2$
$4x + 2y + z = 3$
$z = -3$

88.
$x + y + z = 3$
$2x + 3y - z = -8$
$z = 4$

89.
$4x + 2y + z = -6$
$x + y + z = -3$
$16x + 4y + z = 0$

90.
$x + y + z = 8$
$9x - 3y + z = 0$
$4x - 2y + z = -1$

91.
$x + y + z = 5$
$2x - 3y + 3z = 9$
$-x + 7y - z = 11$

92.
$x + y + z = 1$
$x - y + z = 1$
$3x + y + 3z = 3$