$$\frac{337}{81}y^2 = 63^2$$ • Collect like terms.

$$y^2 = \frac{81}{337}\cdot 63^2$$ • Solve for y.

$$y = \sqrt{\frac{81}{337}\cdot 63^2}$$ • Because $y > 0$, we find only the positive square root.

$$y \approx 30.886$$

Now use Equation (2) to find x.

$$x = \frac{16}{9}y \approx \frac{16}{9}\cdot 30.886 \approx 54.908$$

To the nearest tenth of an inch, the width is 54.9 inches and the height is 30.9 inches.

▸ **Try Exercise 40, page 506**

EXERCISE SET 6.3

Concept Check

1. Is $\begin{cases} 3x + 2y = 6 \\ y = 2x^2 \end{cases}$ a nonlinear system of equations? Yes

2. Consider the following nonlinear system of equations, where c is a real number.

$$\begin{cases} \dfrac{x^2}{16} + \dfrac{y^2}{9} = 1 \\ y = x^2 + c \end{cases}$$

Determine the number of solutions of this system for each of the following values of c. Recall that in this section we consider only solutions whose coordinates are real numbers.

a. $c = -5$ 4 **b.** $c = -3$ 3

c. $c = 0$ 2 **d.** $c = 5$ 0

3. The graph of the following nonlinear system consists of a hyperbola and its asymptotes. How many solutions does this system have? 0

$$\begin{cases} \dfrac{x^2}{25} - \dfrac{y^2}{16} = 1 \\ y = \dfrac{4}{5}x \\ y = -\dfrac{4}{5}x \end{cases}$$

4. The graph of the following nonlinear system consists of an ellipse and a hyperbola. How many solutions does this system have? 2

$$\begin{cases} \dfrac{x^2}{9} + \dfrac{y^2}{4} = 1 \\ \dfrac{x^2}{9} - \dfrac{y^2}{4} = 1 \end{cases}$$

In Exercises 5 to 36, solve the system of equations.

5. $\begin{cases} y = x^2 + 3x \\ y = 4x + 6 \end{cases}$ $(-2, -2), (3, 18)$

6. $\begin{cases} y = x^2 + 2x - 3 \\ y = x - 1 \end{cases}$ $(-2, -3), (1, 0)$

7. $\begin{cases} y = 2x^2 - 3x - 3 \\ y = x - 4 \end{cases}$ $\left(\frac{2+\sqrt{2}}{2}, \frac{-6+\sqrt{2}}{2}\right), \left(\frac{2-\sqrt{2}}{2}, \frac{-6-\sqrt{2}}{2}\right)$

8. $\begin{cases} y = -x^2 + 2x - 4 \\ y = \frac{1}{2}x + 1 \end{cases}$ No solution

9. $\begin{cases} x^2 - 3x + y - 5 = 0 \\ x^2 - 2x - y - 7 = 0 \end{cases}$ $\left(-\frac{3}{2}, -\frac{7}{4}\right), (4, 1)$

10. $\begin{cases} y = 2x^2 - x + 1 \\ y = x^2 + 2x + 5 \end{cases}$ $(4, 29), (-1, 4)$

11. $\begin{cases} 2x + 3y = 16 \\ xy = 10 \end{cases}$ $\left(3, \frac{10}{3}\right), (5, 2)$

12. $\begin{cases} x - 2y = 3 \\ xy = -1 \end{cases}$ $\left(2, -\frac{1}{2}\right), (1, -1)$

13. $\begin{cases} 2x - y = 1 \\ xy = 6 \end{cases}$ $\left(-\frac{3}{2}, -4\right), (2, 3)$

14. $\begin{cases} x - 3y = 7 \\ xy = -4 \end{cases}$ $\left(3, -\frac{4}{3}\right), (4, -1)$

15. $\begin{cases} 5x^2 - 3y^2 = -7 \\ -3x + y = -3 \end{cases}$ $\left(\frac{5}{11}, -\frac{18}{11}\right), (2, 3)$

16. $\begin{cases} x^2 + 3y^2 = 7 \\ x + 4y = 6 \end{cases}$ $\left(-\frac{2}{19}, \frac{29}{19}\right), (2, 1)$

17. $\begin{cases} y = x^3 + 4x^2 - 3x - 5 \\ y = 2x^2 - 2x - 3 \end{cases}$ $(-2, 9), (1, -3), (-1, 1)$

18. $\begin{cases} y = x^3 - 2x^2 + 5x + 1 \\ y = x^2 + 7x - 5 \end{cases}$ $(3, 25), (\sqrt{2}, -3 + 7\sqrt{2}), (-\sqrt{2}, -3 - 7\sqrt{2})$

Indicates Try It Exercises

19. $\begin{cases} 2x^2 + y^2 = 9 \\ x^2 - y^2 = 3 \end{cases}$ $(-2, 1), (-2, -1), (2, 1), (2, -1)$

20. $\begin{cases} 3x^2 - 2y^2 = 19 \\ x^2 - y^2 = 5 \end{cases}$ $(3, -2), (3, 2), (-3, 2), (-3, -2)$

21. $\begin{cases} x^2 - 2y^2 = 8 \\ x^2 + 3y^2 = 28 \end{cases}$ $(4, 2), (-4, 2), (4, -2), (-4, -2)$

22. $\begin{cases} 2x^2 + 3y^2 = 5 \\ x^2 - 3y^2 = 4 \end{cases}$ No solution

23. $\begin{cases} 2x^2 + 4y^2 = 5 \\ 3x^2 + 8y^2 = 14 \end{cases}$ No solution

24. $\begin{cases} 2x^2 + 3y^2 = 11 \\ 3x^2 + 2y^2 = 19 \end{cases}$ No solution

25. $\begin{cases} x^2 - 2x + y^2 = 1 \\ 2x + y = 5 \end{cases}$ $\left(\frac{12}{5}, \frac{1}{5}\right), (2, 1)$

26. $\begin{cases} x^2 + y^2 + 5y = 66 \\ 3x + 2y = 22 \end{cases}$ $(4, 5), \left(\frac{110}{13}, -\frac{22}{13}\right)$

27. $\begin{cases} (x-3)^2 + (y+1)^2 = 5 \\ x - 3y = 7 \end{cases}$ $\left(\frac{26}{5}, -\frac{3}{5}\right), (1, -2)$

28. $\begin{cases} (x+2)^2 + (y-2)^2 = 13 \\ 2x + y = 6 \end{cases}$ $\left(\frac{7}{5}, \frac{16}{5}\right), (1, 4)$

29. $\begin{cases} x^2 - 3x + y^2 = 4 \\ 3x + y = 11 \end{cases}$ $\left(\frac{39}{10}, -\frac{7}{10}\right), (3, 2)$

30. $\begin{cases} x^2 + y^2 - 4y = 4 \\ 5x - 2y = 2 \end{cases}$ $\left(\frac{2}{29}, -\frac{24}{29}\right), (2, 4)$

31. $\begin{cases} (x-2)^2 + (y+2)^2 = 160 \\ (x+3)^2 + (y-1)^2 = 162 \end{cases}$ $(6, 10), \left(-\frac{114}{17}, -\frac{190}{17}\right)$

32. $\begin{cases} (x+2)^2 + (y-3)^2 = 10 \\ (x-3)^2 + (y+1)^2 = 13 \end{cases}$ $\left(-\frac{15}{41}, \frac{12}{41}\right), (1, 2)$

33. $\begin{cases} (x+3)^2 + (y-2)^2 = 20 \\ (x-2)^2 + (y-3)^2 = 2 \end{cases}$ $\left(\frac{19}{13}, \frac{22}{13}\right), (1, 4)$

34. $\begin{cases} (x-4)^2 + (y-5)^2 = 8 \\ (x+1)^2 + (y+2)^2 = 34 \end{cases}$ $\left(\frac{102}{37}, \frac{91}{37}\right), (2, 3)$

35. $\begin{cases} (x-1)^2 + (y+1)^2 = 2 \\ (x+2)^2 + (y-3)^2 = 3 \end{cases}$ No solution

36. $\begin{cases} (x+1)^2 + (y-3)^2 = 4 \\ (x-3)^2 + (y+2)^2 = 2 \end{cases}$ No solution

37. Dimensions of a Brochure A rectangular brochure is designed so that it has an area of 37.5 square inches and a perimeter of 25 inches. Find the width and the height of the brochure. Assume the height is greater than the width.
Width: 5 in.; height: 7.5 in.

38. Dimensions of a Container With the lid closed, a takeout box used by a restaurant has a volume of 121 cubic inches. Its length l equals its width w. A strip of tape is wrapped around the box to keep it closed. The length of the tape measures 20 inches, which is 1 inch more than the shortest distance around the box. Find the dimensions of the box.

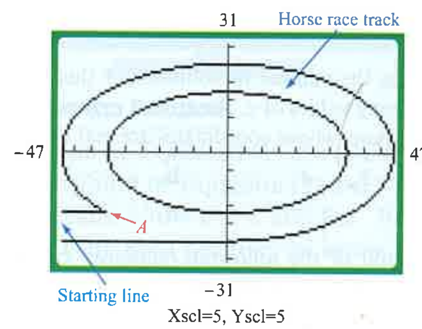
Height: 4 in.; length = width: 5.5 in.

39. Dimensions of Carpets Two square carpets are used in the reception area of a hotel. The sum of the areas of the carpets is 865 square feet. The difference of the areas of the carpets is 703 square feet. Find the dimensions of each carpet.
Small carpet: 9 by 9 ft; large carpet: 28 by 28 ft

40. Dimensions of a Sign A large, rectangular electronic advertising sign for a hotel has a diagonal of 25.0 feet. The height of the sign is 1.6 times its width. Find the width and the height of the sign. Round to the nearest tenth of a foot.
Width: 13.2 ft; height: 21.2 ft

41. Dimensions of Globes A company sells a large globe and a small globe. The volume of the large globe is eight times the volume of the small globe. The difference between the volumes is approximately 15,012.62 cubic inches. Find the radius of each globe. Round to the nearest tenth of an inch.
Large radius: 16.0 in.; small radius: 8.0 in.

42. Horse Race Simulation A student is writing a horse race simulation for a TI-83/TI-83 Plus/TI-84 Plus graphing calculator. The figure below shows the layout of the track.

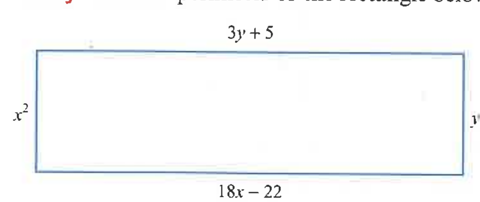


To produce the graph on a graphing calculator, the student needs to know the coordinates of point A in Quadrant III, the point at which the large ellipse

$$\frac{x^2}{47^2} + \frac{y^2}{25^2} = 1$$

intersects the horizontal line segment defined by $y = -16$. Find the coordinates of point A. Round the x value to the nearest tenth. $(-36.1, -16)$

43. Geometry Find the perimeter of the rectangle below. 82 units



44. **Construction** A painter leans a ladder against a vertical wall. The top of the ladder is 7 meters above the ground. When the bottom of the ladder is moved 1 meter farther away from the wall, the top of the ladder is 5 meters above the ground. What is the length of the ladder? Round to the nearest hundredth of a meter. 13.46 m

45. **Analytic Geometry** For what values of the radius r does the line $y = 2x + 1$ intersect (at one or more points) the circle whose equation is $x^2 + y^2 = r^2$? $r \geq \sqrt{\frac{1}{5}}$ or $\frac{\sqrt{5}}{5}$

46. **Geometry** Three rectangles have exactly the same area. The dimensions of the rectangles (as length and width) are a and b; $a - 3$ and $b + 2$; and $a + 3$ and $b - 1$. Find the area of the rectangles. 36 square units

47. **Find Numbers** Find two real numbers that have a sum of 5 and a product of 1.
$\frac{5 - \sqrt{21}}{2} \approx 0.208712$ and $\frac{5 + \sqrt{21}}{2} \approx 4.79129$

48. **Find Numbers** Find two positive real numbers that have a difference of 12 and a product of 5.
$6 + \sqrt{41} \approx 12.4031$ and $\sqrt{41} - 6 \approx 0.403124$

In Exercises 49 to 54, use a graphing utility or WolframAlpha to solve each system of equations. Round approximate values to the nearest ten-thousandth.

49. $\begin{cases} y = 2^x \\ y = x + 1 \end{cases}$ (0, 1), (1, 2)

50. $\begin{cases} y = \log_2 x \\ y = x - 3 \end{cases}$ (0.1375, −2.8625), (5.4449, 2.4449)

51. $\begin{cases} y = e^{-x} \\ y = x^2 \end{cases}$ (0.7035, 0.4949)

52. $\begin{cases} y = \ln x \\ y = -x + 4 \end{cases}$ (2.9263, 1.0737)

53. $\begin{cases} y = \sqrt{x} \\ y = \dfrac{1}{x - 1} \end{cases}$ (1.7549, 1.3247)

54. $\begin{cases} y = \dfrac{6}{x + 1} \\ y = \dfrac{x}{x - 1} \end{cases}$ (2, 2), $\left(3, \frac{3}{2}\right)$

In Exercises 55 to 60, solve the system of equations for rational-number ordered pairs.

55. $\begin{cases} y = x^2 + 4 \\ x = y^2 - 24 \end{cases}$ (1, 5)

56. $\begin{cases} y = x^2 - 5 \\ x = y^2 - 13 \end{cases}$ (3, 4)

57. $\begin{cases} x^2 - 3xy + y^2 = 5 \\ x^2 - xy - 2y^2 = 0 \end{cases}$ (−1, 1), (1, −1)

(*Hint:* Factor the second equation. Now use the zero product principle and the substitution principle.)

58. $\begin{cases} x^2 + 2xy - y^2 = 1 \\ x^2 + 3xy + 2y^2 = 0 \end{cases}$ No rational-number solution

(*Hint:* See Exercise 57.)

59. $\begin{cases} 2x^2 - 4xy - y^2 = 6 \\ 4x^2 - 3xy - y^2 = 6 \end{cases}$ (1, −2), (−1, 2)

(*Hint:* Subtract the two equations.)

60. $\begin{cases} 3x^2 + 2xy - 5y^2 = 11 \\ x^2 + 3xy + y^2 = 11 \end{cases}$ (2, 1), (−2, −1)

(*Hint:* Subtract the two equations.)

Enrichment Exercises

61. **The Parade Problem** A parade that is 2 miles in length moves forward 2 miles at a constant rate of 4 miles per hour. During this time, a security guard rides a bicycle, at a constant rate, from the front of the parade to the back of the parade and then returns to the front.

a. How far did the security guard ride?
$2 + 2\sqrt{2}$ mi

b. What was the security guard's rate, in miles per hour, during this time period?
$4 + 4\sqrt{2}$ mph

62. **Number of Solutions** Determine the number of solutions of the following nonlinear system of equations. Explain how you determined your answer.

$$\begin{cases} 100x = 10^y \\ y = 2 + \log x \end{cases}$$

There are an infinite number of solutions, because the equations are equivalent.

MID-CHAPTER 6 QUIZ

~~1.~~ Solve: $\begin{cases} 2x - 3y = -15 \\ -3x + 4y = 19 \end{cases}$
(3, 7) [6.1]

2. Solve: $\begin{cases} 6x - 3y = -9 \\ -2x + y = 3 \end{cases}$
(c, $2c + 3$) [6.1]

3. Give an example of an inconsistent system of equations in two variables. Answers will vary. [6.1]

~~4.~~ Find an equation of the form $y = ax^2 + bx + c$ whose graph passes through the points (−1, 6), (2, 3), and (3, 10).
$y = 2x^2 - 3x + 1$ [6.2]

5. Solve: $\begin{cases} 3x^2 + y^2 = 28 \\ x^2 - y^2 = 8 \end{cases}$ (3, 1), (3, −1), (−3, 1), (−3, −1) [6.3]