



UNDERSTAND

- 11. Use Appropriate Tools** How could you use a graphing calculator to determine whether you have correctly solved a quadratic equation by completing the square?
- 12. Error Analysis** Describe and correct the error a student made in solving a quadratic equation by completing the square.

$$\begin{aligned} 0 &= x^2 + 16x - 5 \\ 5 &= x^2 + 16x + 64 \\ 5 &= (x + 8)^2 \\ x &= -8 \pm \sqrt{5} \end{aligned}$$



- 13. Higher Order Thinking** What number do you need to add to $x^2 + \frac{7}{2}x$ in order to create a perfect square trinomial? Explain.
- 14. Reason** Does the geometric model hold for finding the number that completes the square of the expression $x^2 - 12x$? Explain.
- 15. Error Analysis** When given the equation $-23 = x^2 + 8x$, a student says that you can add 64 to each side of the equation to complete the square. Is the student correct? If not, describe and correct the error.
- 16. Construct Arguments** Explain why you should not try to complete the square when solving $0 = x^2 - 4$.
- 17. Use Structure** Jacob completed the square to rewrite the equation $f(x) = -2x^2 + 12x - 13$ as $f(x) = -2(x - 3)^2 + 5$. Which form of the equation is more helpful for identifying the key features of the graph? Explain.

PRACTICE

Use square roots to solve the quadratic equations.

SEE EXAMPLE 1

18. $9 = x^2 + 2x + 1$ 19. $16 = x^2 - 10x + 25$
20. $50 = 2x^2 + 16x + 32$ 21. $5 = 3x^2 - 36x + 108$
22. $7 = x^2 + 4x + 4$ 23. $-4 = x^2 + 14x + 49$

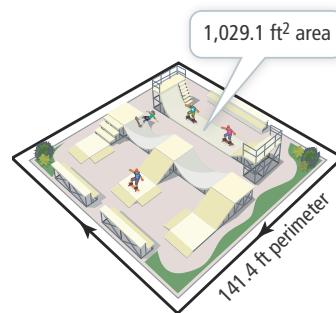
Rewrite the equations in the form $(x - p)^2 = q$.

SEE EXAMPLE 2

24. $0 = x^2 - 18x + 64$ 25. $x^2 + 22x + 120.5 = 0$
26. $x^2 + 3x - \frac{27}{4} = 0$ 27. $0 = 4x^2 + 4x - 14$
28. $0 = x^2 - \frac{3}{2}x - \frac{70}{8}$ 29. $x^2 + 0.6x - 19.1 = 0$

Solve the following quadratic equations by completing the square. SEE EXAMPLES 3 AND 4

30. $x^2 + 8x + 60 = 0$ 31. $x^2 + 14x = 51$
32. $4x^2 + 16x - 65 = 0$ 33. $7x^2 + 56x - 22 = 0$
34. $3x^2 - 6x + 13 = 0$ 35. $x^2 - 0.4x - 1.2 = 0$
36. $x^2 + 6x = 59$ 37. $8x^2 + 16x = 42$
38. $5x^2 - 25 = 10x$ 39. $-2x^2 - 12x + 18 = 0$
40. $-3x^2 - 24x - 19 = 0$ 41. $17 - x^2 - 18x = 0$
42. What is the length and width of the skate park?

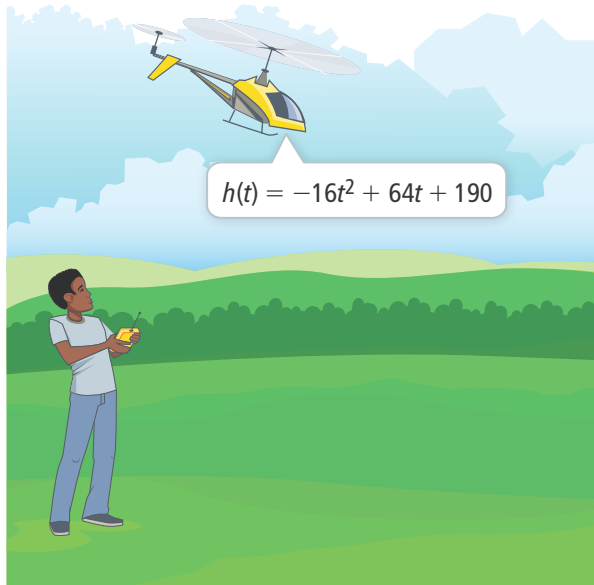


Write the equation in vertex form. Identify the maximum or minimum value of the graph of the equation. SEE EXAMPLE 5

43. $y = x^2 + 4x - 13$ 44. $y = x^2 - 14x + 71$
45. $y = -2x^2 - 20x - 58$ 46. $y = -3x^2 + 36x - 93$
47. $y = 6x^2 - 42x + 74.5$ 48. $y = 0.5x^2 + 0.5x + 2.125$

APPLY

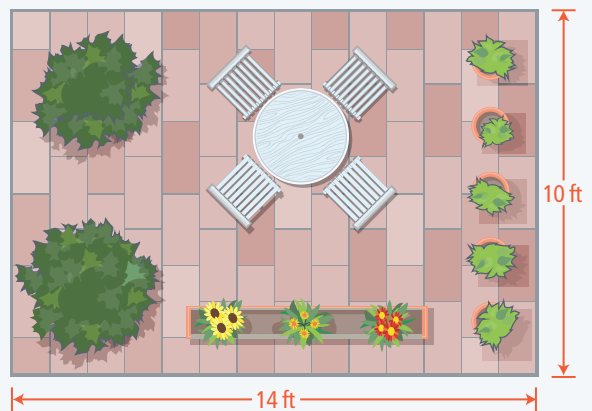
49. **Make Sense and Persevere** Keenan launches a model helicopter. The height of the helicopter, in feet, is given by the equation $h = -16t^2 + 64t + 190$, where t is the time in seconds. To the nearest hundredth, how many seconds will it take the helicopter to hit the ground? What is the maximum height of the helicopter?



50. **Use Structure** The decreasing population, p , of owls in a national park is being monitored by ecologists and is modeled by the equation $p = -0.4t^2 + 128t + 1,200$, where t is the number of months since the ecologists started observing the owls.
- If this model is accurate, when will the population reach its maximum?
 - What is the maximum population? Round to the nearest whole number.
 - Use the equation to determine in how many months the population of owls will disappear.
51. **Make Sense and Persevere** Between 2000 and 2005, the number of skateboarders s in the United States, in millions, can be approximated by the equation $s = 0.33t^2 + 2.27t + 3.96$, where t represents the number of years since 2000. If this model is accurate, in what year did 9.8 million people skateboard?

ASSESSMENT PRACTICE

52. The roots of $f(x) = -2x^2 + 8x + 13$ are _____ and _____. The vertex of the parabola is at _____.
53. **SAT/ACT** Solve $x^2 + 2x - 5 = 0$.
- $-5, 1$
 - $-1 \pm \sqrt{5}$
 - $-1 \pm \sqrt{6}$
 - $1 \pm \sqrt{5}$
 - $-3, 1$
54. **Performance Task** Yumiko has a rectangular-shaped patio. She wants to double the area of the patio by increasing the length and width by the same amount.



Part A Write a function to calculate the number of feet Yumiko would need to add to the length and width. Explain your reasoning.

Part B To the nearest hundredth, what are the new dimensions of the patio?