



EXAMPLE 5 Find the zeros of quadratic functions

UNDERSTAND REPRESENTATIONS

If a real number k is a zero of the function $y = ax^2 + bx + c$, then k is an x -intercept of this function's graph and k is also a root of the equation $ax^2 + bx + c = 0$.

Find the zeros of the function by rewriting the function in intercept form.

a. $y = x^2 - x - 12$

b. $y = x^2 + 12x + 36$

Solution

a. $y = x^2 - x - 12$

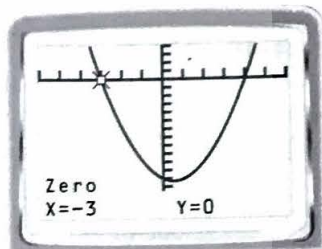
Write original function.

$= (x + 3)(x - 4)$

Factor.

The zeros of the function are -3 and 4 .

CHECK Graph $y = x^2 - x - 12$. The graph passes through $(-3, 0)$ and $(4, 0)$.



b. $y = x^2 + 12x + 36$

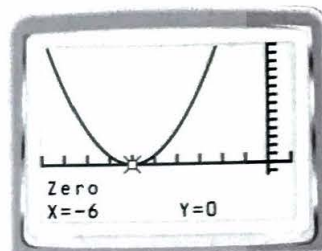
Write original function.

$= (x + 6)(x + 6)$

Factor.

The zero of the function is -6 .

CHECK Graph $y = x^2 + 12x + 36$. The graph passes through $(-6, 0)$.



GUIDED PRACTICE for Example 5

Find the zeros of the function by rewriting the function in intercept form.

10. $y = x^2 + 5x - 14$

11. $y = x^2 - 7x - 30$

12. $f(x) = x^2 - 10x + 25$

4.3 EXERCISES

HOMEWORK KEY

○ = WORKED-OUT SOLUTIONS on p. WS8 for Exs. 33, 47, and 67

★ = STANDARDIZED TEST PRACTICE Exs. 2, 41, 56, 58, 63, and 71

◆ = MULTIPLE REPRESENTATIONS Ex. 68

SKILL PRACTICE

- VOCABULARY** What is a zero of a function $y = f(x)$?
- ★ **WRITING** Explain the difference between a monomial, a binomial, and a trinomial. Give an example of each type of expression.

FACTORING Factor the expression. If the expression cannot be factored, say so.

3. $x^2 + 6x + 5$

4. $x^2 - 7x + 10$

5. $a^2 - 13a + 22$

6. $r^2 + 15r + 56$

7. $p^2 + 2p + 4$

8. $q^2 - 11q + 28$

9. $b^2 + 3b - 40$

10. $x^2 - 4x - 12$

11. $x^2 - 7x - 18$

12. $c^2 - 9c - 18$

13. $x^2 + 9x - 36$

14. $m^2 + 8m - 65$

EXAMPLE 1

on p. 252
for Exs. 3-14

EXAMPLE 2

on p. 253
for Exs. 15–23

FACTORING WITH SPECIAL PATTERNS Factor the expression.

15. $x^2 - 36$

16. $b^2 - 81$

17. $x^2 - 24x + 144$

18. $t^2 - 16t + 64$

19. $x^2 + 8x + 16$

20. $c^2 + 28c + 196$

21. $n^2 + 14n + 49$

22. $s^2 - 26s + 169$

23. $z^2 - 121$

EXAMPLE 3

on p. 254
for Exs. 24–41

SOLVING EQUATIONS Solve the equation.

24. $x^2 - 8x + 12 = 0$

25. $x^2 - 11x + 30 = 0$

26. $x^2 + 2x - 35 = 0$

27. $a^2 - 49 = 0$

28. $b^2 - 6b + 9 = 0$

29. $c^2 + 5c + 4 = 0$

30. $n^2 - 6n = 0$

31. $t^2 + 10t + 25 = 0$

32. $w^2 - 16w + 48 = 0$

33. $z^2 - 3z = 54$

34. $r^2 + 2r = 80$

35. $u^2 = -9u$

36. $m^2 = 7m$

37. $14x - 49 = x^2$

38. $-3y + 28 = y^2$

ERROR ANALYSIS Describe and correct the error in solving the equation.

39.

$x^2 - x - 6 = 0$

$(x - 2)(x + 3) = 0$

~~$x - 2 = 0$ or $x + 3 = 0$~~

~~$x = 2$ or $x = -3$~~

40.

$x^2 + 7x + 6 = 14$

$(x + 6)(x + 1) = 14$

~~$x + 6 = 14$ or $x + 1 = 14$~~

~~$x = 8$ or $x = 13$~~

41. **★ MULTIPLE CHOICE** What are the roots of the equation $x^2 + 2x - 63 = 0$?

Ⓐ 7, -9

Ⓑ -7, -9

Ⓒ -7, 9

Ⓓ 7, 9

EXAMPLE 4

on p. 254
for Exs. 42–43

WRITING EQUATIONS Write an equation that you can solve to find the value of x .42. A rectangular picnic site measures 24 feet by 10 feet. You want to double the site's area by adding the same distance x to the length and the width.43. A rectangular performing platform in a park measures 10 feet by 12 feet. You want to triple the platform's area by adding the same distance x to the length and the width.**EXAMPLE 5**

on p. 255
for Exs. 44–55

FINDING ZEROS Find the zeros of the function by rewriting the function in intercept form.

44. $y = x^2 + 6x + 8$

45. $y = x^2 - 8x + 16$

46. $y = x^2 - 4x - 32$

47. $y = x^2 + 7x - 30$

48. $f(x) = x^2 + 11x$

49. $g(x) = x^2 - 3x$

50. $y = x^2 - 64$

51. $y = x^2 - 25$

52. $f(x) = x^2 - 12x - 45$

53. $g(x) = x^2 + 19x + 84$

54. $y = x^2 + 22x + 121$

55. $y = x^2 + 2x + 1$

56. **★ MULTIPLE CHOICE** What are the zeros of $f(x) = x^2 + 6x - 55$?

Ⓐ -11, -5

Ⓑ -11, 5

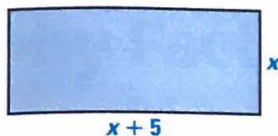
Ⓒ -5, 11

Ⓓ 5, 11

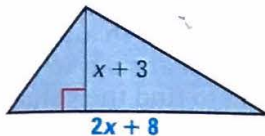
57. **REASONING** Write a quadratic equation of the form $x^2 + bx + c = 0$ that has roots 8 and 11.58. **★ SHORT RESPONSE** For what integers b can the expression $x^2 + bx + 7$ be factored? Explain.

GEOMETRY Find the value of x .

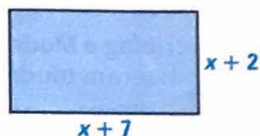
59. Area of rectangle = 36



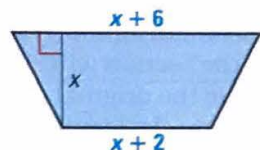
61. Area of triangle = 42



60. Area of rectangle = 84



62. Area of trapezoid = 32



63. **★ OPEN-ENDED MATH** Write a quadratic function with zeros that are equidistant from 10 on a number line.
64. **CHALLENGE** Is there a formula for factoring the *sum* of two squares? You will investigate this question in parts (a) and (b).
- Consider the sum of two squares $x^2 + 16$. If this sum can be factored, then there are integers m and n such that $x^2 + 16 = (x + m)(x + n)$. Write two equations that m and n must satisfy.
 - Show that there are no integers m and n that satisfy both equations you wrote in part (a). What can you conclude?

PROBLEM SOLVING

65. **SKATE PARK** A city's skate park is a rectangle 100 feet long by 50 feet wide. The city wants to triple the area of the skate park by adding the same distance x to the length and the width. Write and solve an equation to find the value of x . What are the new dimensions of the skate park?

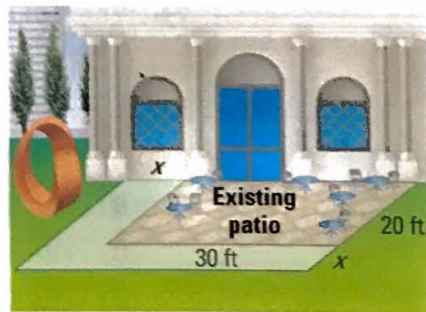
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66. **ZOO** A rectangular enclosure at a zoo is 35 feet long by 18 feet wide. The zoo wants to double the area of the enclosure by adding the same distance x to the length and the width. Write and solve an equation to find the value of x . What are the new dimensions of the enclosure?

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67. **MULTI-STEP PROBLEM** A museum has a café with a rectangular patio. The museum wants to add 464 square feet to the area of the patio by expanding the existing patio as shown.

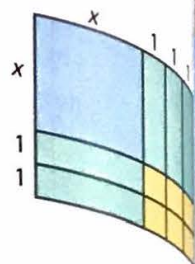
- Find the area of the existing patio.
- Write a verbal model and an equation that you can use to find the value of x .
- Solve your equation. By what distance x should the length and the width of the patio be expanded?



EXAMPLE 4
on p. 254
for Exs. 65–67

68. **MULTIPLE REPRESENTATIONS** Use the diagram shown.

- Writing an Expression** Write a quadratic trinomial that represents the area of the diagram.
- Describing a Model** Factor the expression from part (a). *Explain* how the diagram models the factorization.
- Drawing a Diagram** Draw a diagram that models the factorization $x^2 + 8x + 15 = (x + 5)(x + 3)$.



69. **SCHOOL FAIR** At last year's school fair, an 18 foot by 15 foot rectangular section of land was roped off for a dunking booth. The length and width of the section will each be increased by x feet for this year's fair in order to triple the original area. Write and solve an equation to find the value of x . What is the length of rope needed to enclose the new section?

70. **RECREATION CENTER** A rectangular deck for a recreation center is 21 feet long by 20 feet wide. Its area is to be halved by subtracting the same distance x from the length and the width. Write and solve an equation to find the value of x . What are the deck's new dimensions?

71. **★ SHORT RESPONSE** A square garden has sides that are 10 feet long. A gardener wants to double the area of the garden by adding the same distance x to the length and the width. Write an equation that x must satisfy. Can you solve the equation you wrote by factoring? *Explain* why or why not.

72. **CHALLENGE** A grocery store wants to double the area of its parking lot by expanding the existing lot as shown. By what distance x should the lot be expanded?

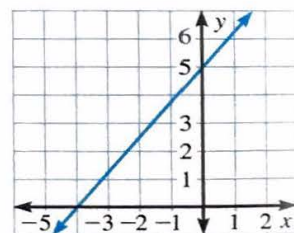


MISSOURI MIXED REVIEW

TEST PRACTICE at classzone.com

73. What is the slope of the line shown?

- (A) $-\frac{5}{4}$ (B) $-\frac{4}{5}$
 (C) $\frac{4}{5}$ (D) $\frac{5}{4}$



74. Which of the following best describes the graphs of the equations below?

$$y = 3x - 2$$

$$-4y = x + 8$$

- The lines have the same x -intercept.
- The lines have the same y -intercept.
- The lines are perpendicular to each other.
- The lines are parallel to each other.