CHAPTER 9

Solving Quadratic Equations

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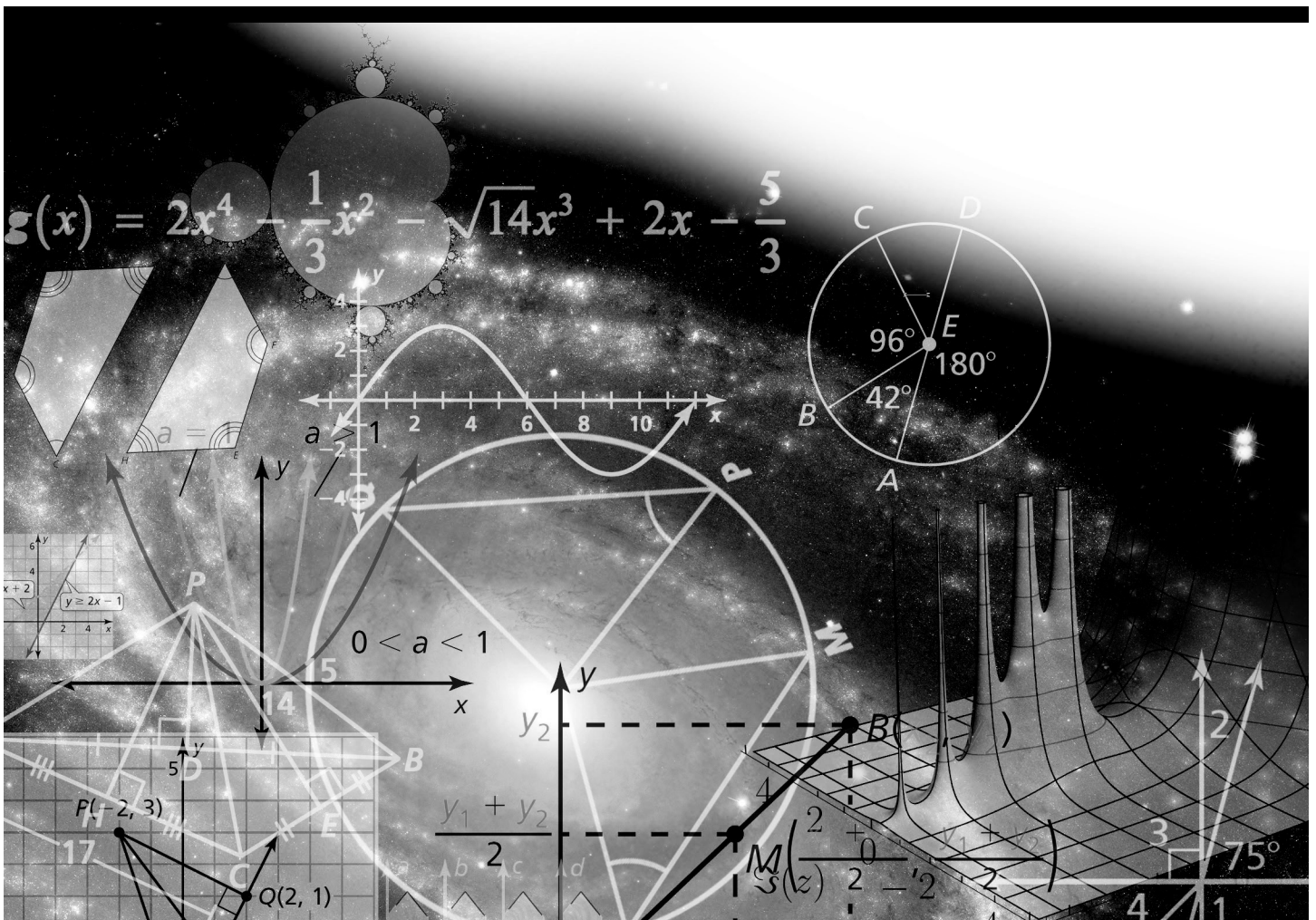
Factor the trinomial.

1. $x^2 - 6x + 9$

2. $x^2 + 4x + 4$

3. $x^2 - 14x + 49$

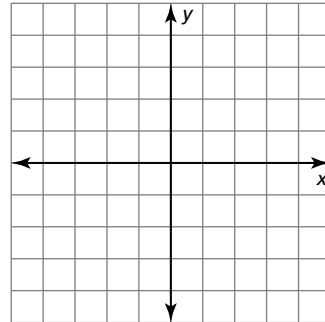**4.** $x^2 + 22x + 121$
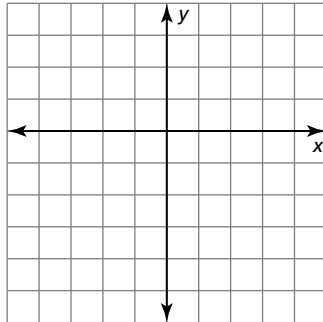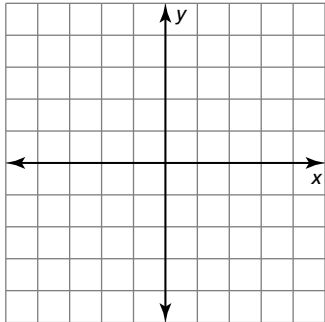
5. $x^2 - 24x + 144$

6. $x^2 + 26x + 169$

Solve the system of linear equations by graphing.

7. $y = 2x - 1$
$\quad\ y = -3x + 9$
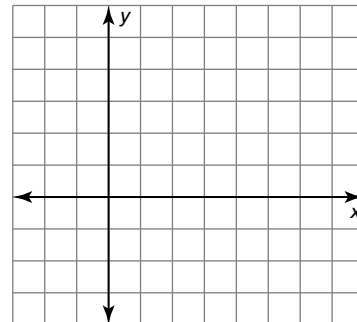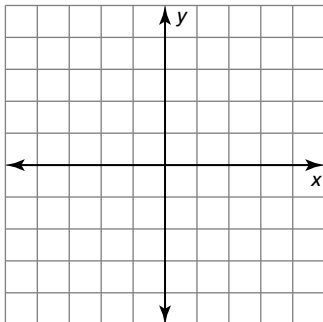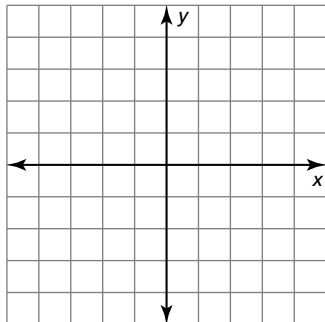
8. $y = -\dfrac{1}{2}x - 1$
$\quad\ y = \dfrac{1}{4}x - 4$

9. $y = 2x + 3$
$\quad\ y = -3x - 2$

10. $y = x + 3$
$\quad\ y = -\dfrac{1}{3}x - 1$

11. $y = x + 1$
$\quad\ y = 3x - 1$

12. $y = 2x - 3$
$\quad\ y = x + 1$

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Essential Question How can you solve a polynomial equation?

1 **EXPLORATION:** Matching Equivalent Forms of an Equation

Work with a partner. An equation is considered to be in *factored form* when the product of the factors is equal to 0. Match each factored form of the equation with its equivalent standard form and nonstandard form.

Factored Form	Standard Form	Nonstandard Form
a. $(x - 1)(x - 3) = 0$	**A.** $x^2 - x - 2 = 0$	**1.** $x^2 - 5x = -6$
b. $(x - 2)(x - 3) = 0$	**B.** $x^2 + x - 2 = 0$	**2.** $(x - 1)^2 = 4$
c. $(x + 1)(x - 2) = 0$	**C.** $x^2 - 4x + 3 = 0$	**3.** $x^2 - x = 2$
d. $(x - 1)(x + 2) = 0$	**D.** $x^2 - 5x + 6 = 0$	**4.** $x(x + 1) = 2$
e. $(x + 1)(x - 3) = 0$	**E.** $x^2 - 2x - 3 = 0$	**5.** $x^2 - 4x = -3$

2 **EXPLORATION:** Writing a Conjecture

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Substitute 1, 2, 3, 4, 5, and 6 for x in each equation and determine whether the equation is true. Organize your results in the table. Write a conjecture describing what you discovered.

	Equation	$x = 1$	$x = 2$	$x = 3$	$x = 4$	$x = 5$	$x = 6$
a.	$(x - 1)(x - 2) = 0$						
b.	$(x - 2)(x - 3) = 0$						
c.	$(x - 3)(x - 4) = 0$						
d.	$(x - 4)(x - 5) = 0$						
e.	$(x - 5)(x - 6) = 0$						
f.	$(x - 6)(x - 1) = 0$						

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3 **EXPLORATION:** Special Properties of 0 and 1

Work with a partner. The numbers 0 and 1 have special properties that are shared by no other numbers. For each of the following, decide whether the property is true for 0, 1, both, or neither. Explain your reasoning.

    a. When you add _____ to a number n, you get n.

    b. If the product of two numbers is _____, then at least one of the numbers is 0.

    c. The square of _____ is equal to itself.

    d. When you multiply a number n by _____, you get n.

    e. When you multiply a number n by _____, you get 0.

    f. The opposite of _____ is equal to itself.

Communicate Your Answer

    4. How can you solve a polynomial equation?

    5. One of the properties in Exploration 3 is called the Zero-Product Property. It is one of the most important properties in all of algebra. Which property is it? Why do you think it is called the Zero-Product Property? Explain how it is used in algebra and why it is so important.

9.1 Practice
For use after Lesson 9.1

Core Concepts

Zero-Product Property

Words   If the product of two real numbers is 0, then at least one of the numbers is 0.

Algebra   If a and b are real numbers and $ab = 0$, then $a = 0$ or $b = 0$.

Notes:

Worked-Out Examples

Example #1

Solve the equation.

$z(z + 2)(z - 1) = 0$

$z = 0 \quad or \quad z + 2 = 0 \quad or \quad z - 1 = 0$

$$\frac{-2 \quad -2}{z = -2} \qquad \frac{+1 \quad +1}{z = 1}$$

The roots are $z = 0$, $z = -2$, and $z = 1$.

Example #2

Solve the equation.

$6m^2 + 12m = 0$

$6m(m + 2) = 0$

$6m = 0 \quad or \quad m + 2 = 0$

$$\frac{6m}{6} = \frac{0}{6} \qquad \frac{-2 \quad -2}{m = -2}$$
$$m = 0$$

The roots are $m = 0$ and $m = -2$.

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Practice A

In Exercises 1–12, solve the equation.

1. $x(x + 5) = 0$

2. $a(a - 12) = 0$

3. $5p(p - 2) = 0$

4. $(c - 2)(c + 1) = 0$

5. $(2b - 6)(3b + 18) = 0$

6. $(3 - 5s)(-3 + 5s) = 0$

7. $(x - 3)^2 = 0$

8. $(3d + 7)(5d - 6) = 0$

9. $(2t + 8)(2t - 8) = 0$

10. $(w + 4)^2(w + 1) = 0$

11. $g(6 - 3g)(6 + 3g) = 0$

12. $(4 - m)\left(8 + \frac{2}{3}m\right)(-2 - 3m) = 0$

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In Exercises 13–18, factor the polynomial.

13. $6x^2 + 3x$

14. $4y^4 - 20y^3$

15. $18u^4 - 6u$

16. $7z^7 + 2z^6$

17. $24h^3 + 8h$

18. $15f^4 - 45f$

In Exercises 19–24, solve the equation.

19. $6k^2 + k = 0$

20. $35n - 49n^2 = 0$

21. $4z^2 + 52z = 0$

22. $6x^2 = -72x$

23. $22s = 11s^2$

24. $7p^2 = 21p$

25. A boy kicks a ball in the air. The height y (in feet) above the ground of the ball is modeled by the equation $y = -16x^2 + 80x$, where x is the time (in seconds) since the ball was kicked. Find the roots of the equation when $y = 0$. Explain what the roots mean in this situation.

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Practice B

In Exercises 1–9, solve the equation.

1. $-3y(y - 4) = 0$

2. $(d - 6)(d + 1) = 0$

3. $(w + 3)(w - 5) = 0$

4. $(2 - 3x)(2 + 3x) = 0$

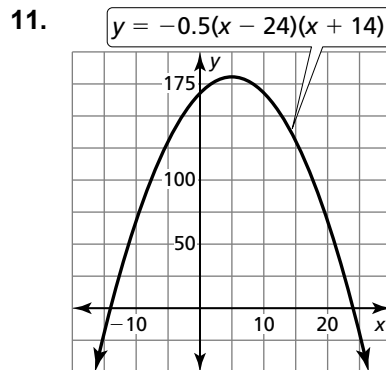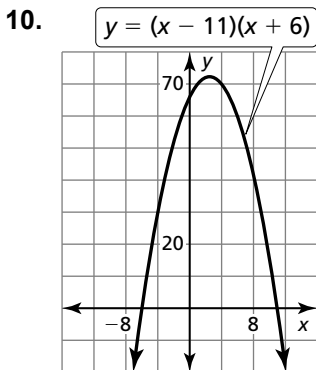**5.** $9h(h - 4)(3h + 2) = 0$

6. $k(k + 2)^2 = 0$

7. $(y - 7)^2(y + 9) = 0$

8. $(12 - 4n)(3n - 5)(-n + 2) = 0$

9. $(5 - n)\left(3 - \frac{1}{2}n\right)(n - 4) = 0$

In Exercises 10 and 11, find the *x*-coordinates of the points where the graph crosses the *x*-axis.

10.

$y = (x - 11)(x + 6)$

11.

$y = -0.5(x - 24)(x + 14)$

In Exercises 12–14, factor the polynomial.

12. $36v^2 + 24v$

13. $3r^6 - 2r^5$

14. $18a^5 + 12a$

In Exercises 15–17, solve the equation.

15. $16h^2 - 8h = 0$

16. $4w^2 = 12w$

17. $-32n = 8n^2$

18. Describe and correct the error in solving the equation.

$$\times \quad 15t^2 = 5t$$
$$3t = 1$$
$$t = \frac{1}{3}$$

The root is $t = \frac{1}{3}$.

19. Write a polynomial of degree 3 whose only roots are $x = 2$ and $x = \frac{2}{5}$. Is there another polynomial of degree 3 that has the same roots?