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9.2 Solving Quadratic Equations by Graphing

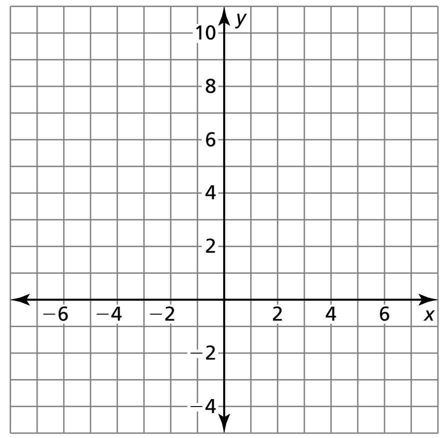
For use with Exploration 9.2

Essential Question How can you use a graph to solve a quadratic equation in one variable?

1 EXPLORATION: Solving a Quadratic Equation by Graphing

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

Work with a partner.



a. Sketch the graph of $y = x^2 - 2x$.

b. What is the definition of an x-intercept of a graph? How many x-intercepts does this graph have? What are they?

c. What is the definition of a solution of an equation in x? How many solutions does the equation $x^2 - 2x = 0$ have? What are they?

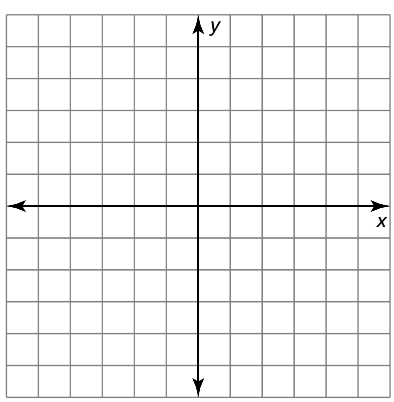
d. Explain how you can verify the solutions you found in part (c).

2 EXPLORATION: Solving Quadratic Equations by Graphing

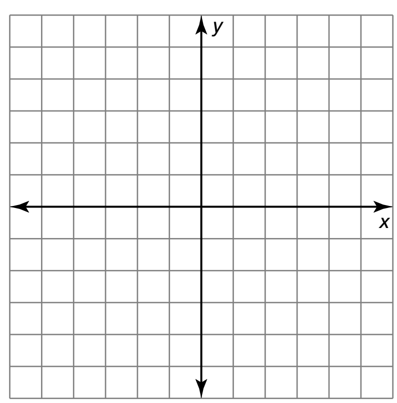
Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Solve each equation by graphing.

a. $x^2 - 4 = 0$



b. $x^2 + 3x = 0$



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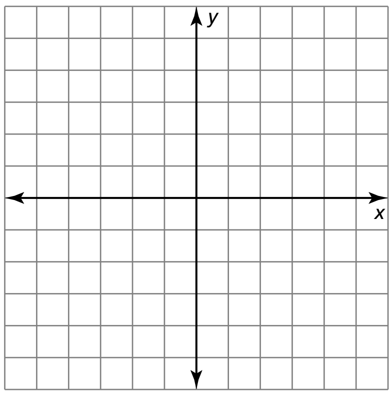
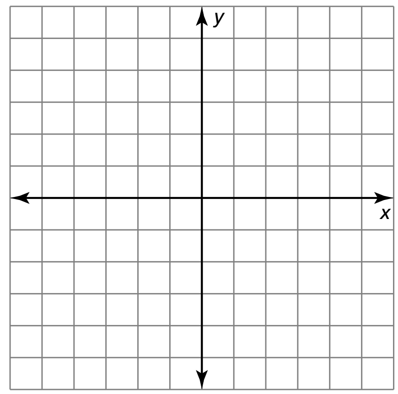
2 EXPLORATION: Solving Quadratic Equations by Graphing (continued)

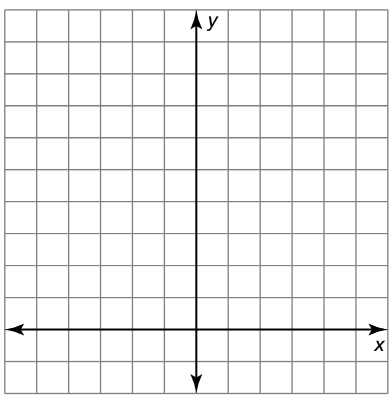
c. $-x^2 + 2x = 0$



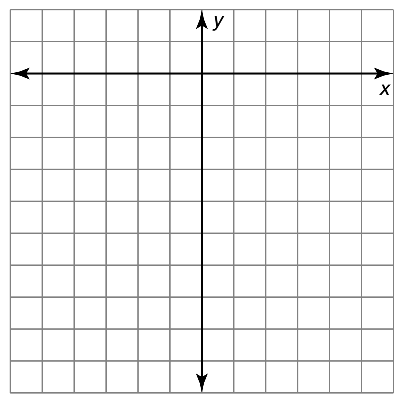
d. $x^2 - 2x + 1 = 0$



e. $x^2 - 3x + 5 = 0$



f. $-x^2 + 3x - 6 = 0$



Communicate Your Answer

3. How can you use a graph to solve a quadratic equation in one variable?

4. After you find a solution graphically, how can you check your result algebraically? Check your solutions for parts (a)–(d) in Exploration 2 algebraically.

5. How can you determine graphically that a quadratic equation has no solution?

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9.2 Practice
For use after Lesson 9.2

Core Concepts

Solving Quadratic Equations by Graphing

Step 1 Write the equation in standard form, $ax^2 + bx + c = 0$.

Step 2 Graph the related function $y = ax^2 + bx + c$.

Step 3 Find the x-intercepts, if any.

The solutions, or *roots*, of $ax^2 + bx + c = 0$ are the x-intercepts of the graph.

Notes:

Number of Solutions of a Quadratic Equation

A quadratic equation has:

- two real solutions when the graph of its related function has two x-intercepts.
- one real solution when the graph of its related function has one x-intercept.
- no real solutions when the graph of its related function has no x-intercepts.

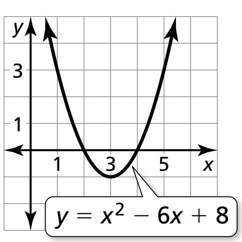
Notes:

Worked-Out Examples

Example #1

Use the graph to solve the equation.

$x^2 - 6x + 8 = 0$



The graph crosses the x-axis at (2, 0) and (4, 0). So, the solutions are $x = 2$ and $x = 4$.

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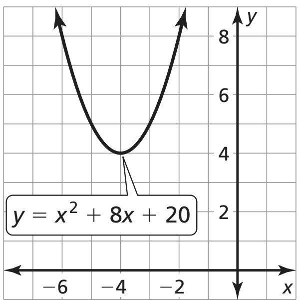
9.2 **Practice (continued)**

Example #2

Solve the equation by graphing.

$$-x^2 = 8x + 20$$
$$-x^2 + x^2 = 8x + 20 + x^2$$
$$0 = x^2 + 8x + 20$$

Graph $y = x^2 + 8x + 20$.

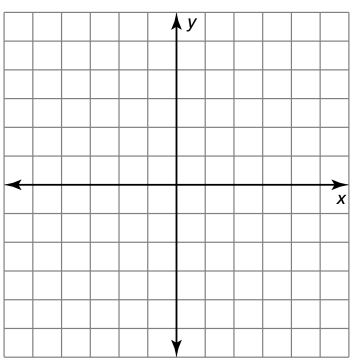


There are no x-intercepts. So, $-x^2 = 8x + 20$ has no real solutions.

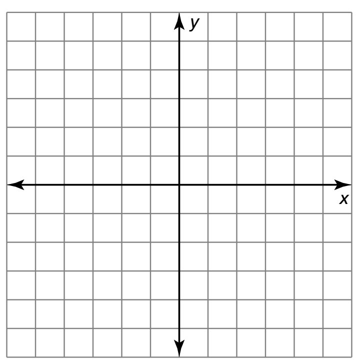
Practice A

In Exercises 1–9, solve the equation by graphing.

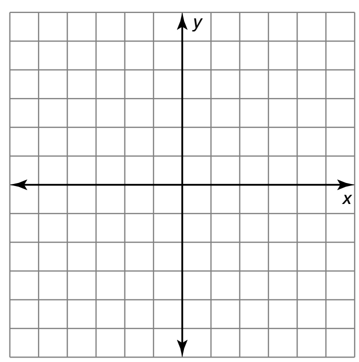
1. $x^2 + 4x = 0$



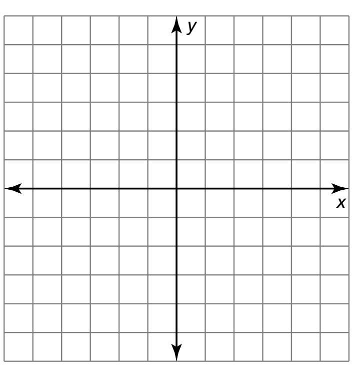
2. $-x^2 = -2x + 1$



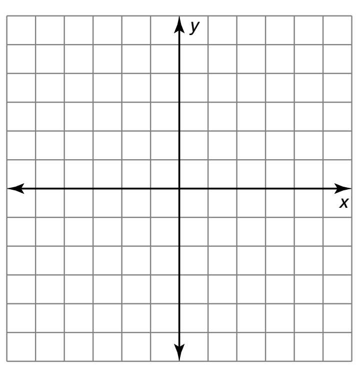
3. $x^2 + 2x + 4 = 0$



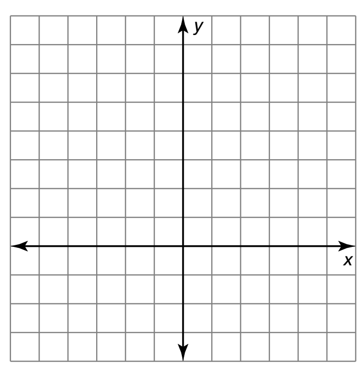
4. $x^2 - 5x + 4 = 0$



5. $x^2 + 6x + 9 = 0$



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



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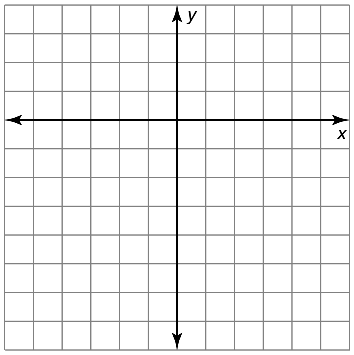
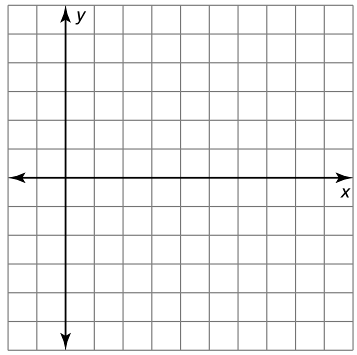
9.2 Practice (continued)

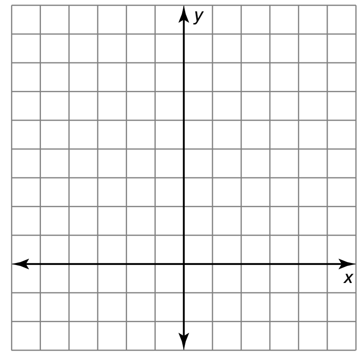
7. $x^2 - x - 12 = 0$



8. $x^2 - 10x + 25 = 0$

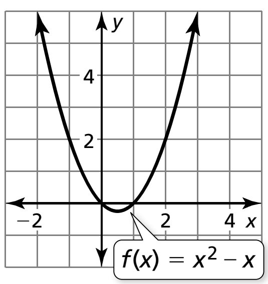


9. $x^2 + 4 = 0$



In Exercises 10–15, find the zero(s) of *f*.

10.



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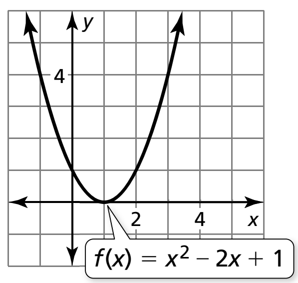

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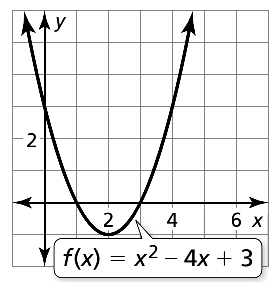

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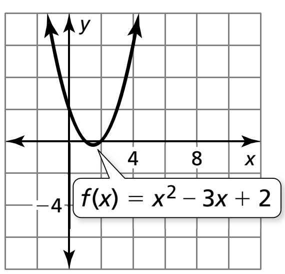

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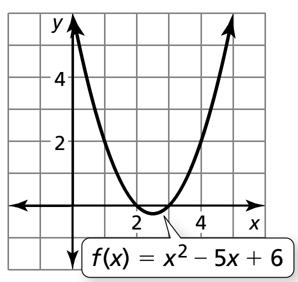

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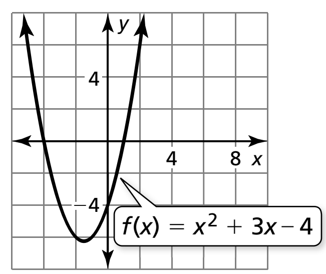
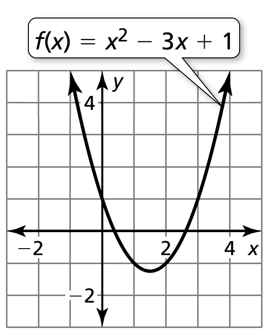
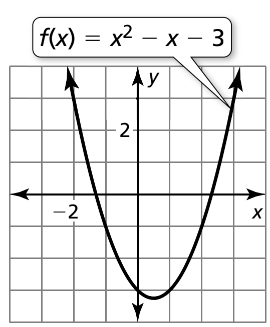


In Exercises 16–18, approximate the zeros of *f* to the nearest tenth.

16.



17.



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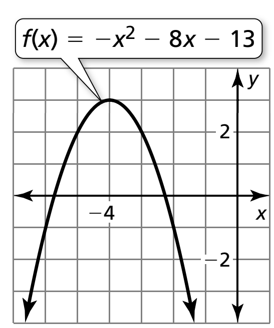

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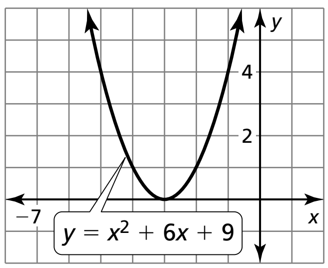
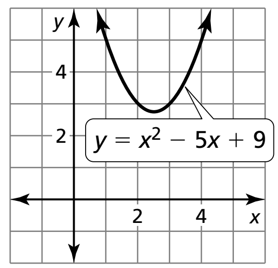
Practice B

In Exercises 1 and 2, use the graph to solve the equation.

1. $x^2 + 6x + 9 = 0$



2. $x^2 - 5x + 9 = 0$



In Exercises 3–5, write the equation in standard form.

3. $-x^2 = 23$ **4.** $3 - 5x^2 = 9x$ **5.** $6 - 2x = 7x^2$

In Exercises 6–11, solve the equation by graphing.

6. $-x^2 + 6x = 0$ **7.** $x^2 - 12x + 36 = 0$ **8.** $x^2 - 4x + 8 = 0$

9. $6x - 7 = -x^2$ **10.** $x^2 = -x - 1$ **11.** $9 - x^2 = -8x$

12. The height h (in feet) of a fly ball in a baseball game can be modeled by $h = -16t^2 + 28t + 8,$ where t is the time (in seconds).

a. Do both t-intercepts of the graph of the function have meaning in this situation? Explain.

b. No one caught the fly ball. After how many seconds did the ball hit the ground?

In Exercises 13–15, solve the equation by using Method 2 from Example 3.

13. $x^2 = 6x + 7$ **14.** $-20 = x^2 + 9x$ **15.** $x^2 - 24 = 10x$

In Exercises 16–19, graph the function. Approximate the zeros of the function to the nearest tenth when necessary.

16. $f(x) = x^2 + 5x + 2$ **17.** $f(x) = x^2 - 4x + 3$

18. $y = -x^2 + 3x - 5$ **19.** $y = \frac{1}{2}x^2 - 3x + 1$

20. The area (in square feet) of an x-foot-wide path can be modeled by $y = -0.003x^2 + 0.018x.$ Find the width of the path to the nearest foot.