

### 10.3- Solve Quadratic Equations by Graphing

A **quadratic equation** is an equation that can be written in the **standard form**  $ax^2 + bx + c = 0$  where  $a \neq 0$ .

In Chapter 9, you used factoring to solve a quadratic equation. You can also use graphing to solve a quadratic equation. Notice that the solutions of the equation  $ax^2 + bx + c = 0$  are the  $x$ -intercepts of the graph of the related function  $y = ax^2 + bx + c$ .

**Solve by Factoring**

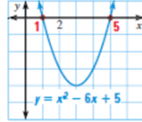
$$x^2 - 6x + 5 = 0$$

$$(x - 1)(x - 5) = 0$$

$$x = 1 \text{ or } x = 5$$

**Solve by Graphing**

To solve  $x^2 - 6x + 5 = 0$ , graph  $y = x^2 - 6x + 5$ . From the graph you can see that the  $x$ -intercepts are 1 and 5.



To solve a quadratic equation by graphing, first write the equation in standard form,  $ax^2 + bx + c = 0$ . Then graph the related function  $y = ax^2 + bx + c$ . The  $x$ -intercepts of the graph are the solutions, or roots, of  $ax^2 + bx + c = 0$ .

### Example 1

Determine whether the given value is a solution of the equation.

a.  $x^2 - 7x - 8 = 0$ ; 8

$$8^2 - 7(8) - 8 = 0$$

$$64 - 56 - 8 = 0$$

$$8 - 8 = 0$$

$$0 = 0 \checkmark$$

YES

b.  $3x^2 - 7x + 2 = 0$ ; -2

$$3(-2)^2 - 7(-2) + 2 = 0$$

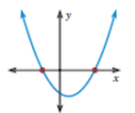
$$3(4) + 14 + 2 =$$

NO

**KEY CONCEPT**

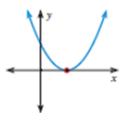
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**Number of Solutions of a Quadratic Equation**



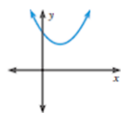
A quadratic equation has **two solutions** if the graph of its related function has **two x-intercepts**.

$$x = -2, 5$$



A quadratic equation has **one solution** if the graph of its related function has **one x-intercept**.

$$x = 2, 2$$



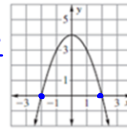
A quadratic equation has **no real solution** if the graph of its related function has **no x-intercepts**.

### Example 2

Use the Graph to find the solutions of the given equation

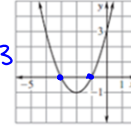
a.  $-x^2 + 4 = 0$

$$x = 2, -2$$



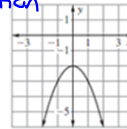
b.  $x^2 + 4x + 3 = 0$

$$x = -1, -3$$



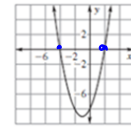
c.  $x^2 - 2 = 0$

No Solution



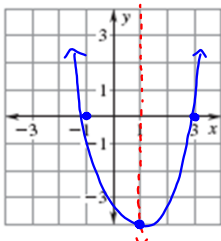
d.  $x^2 + 2x - 8 = 0$

$$x = 2, -4$$



### Example 3- Solve a quadratic equation having two solutions

Solve  $x^2 - 2x = 3$  by graphing



$$x^2 - 2x - 3 = 0$$

$$x = \frac{-b}{2a} = \frac{2}{2(1)} = 1$$

$$1^2 - 2(1) - 3 \quad V: (1, -4)$$

$$1 - 2 - 3 = -4$$

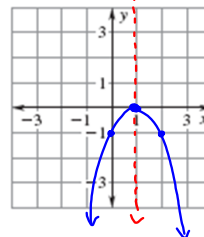
$$x^2 - 2x - 3 = 0$$

$$(x - 3)(x + 1) = 0$$

$$x = 3, -1$$

### Example 4- Solve a quadratic equation having one solution

Solve  $-x^2 + 2x = 1$  by graphing



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

$$-1(x^2 - 2x + 1) = 0$$

$$-1(x - 1)(x - 1) = 0$$

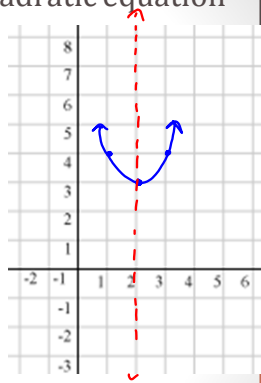
$$x = 1$$

**Example 5- Solve a quadratic equation having no solution**

Solve  $x^2 + 7 = 4x$  by graphing

$$x^2 - 4x + 7 = 0$$

$$x = \frac{-b}{2a} = 2$$



**Example 6- Find the zeros of a quadratic function**

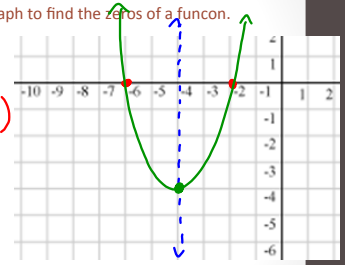
Finding Zeros Because a zero of a function is an x-intercept of the function's graph, you can use the function's graph to find the zeros of a function.

Find the zeros of:  $f(x) = x^2 + 8x + 12$

$$f(x) = (x+2)(x+6)$$

$$x = -6, -2$$

$$f(x) = (-4)^2 + 8(-4) + 12$$



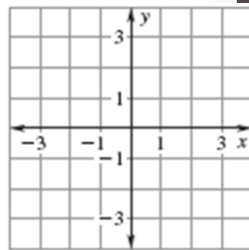
**Example 7- Approximate the zeros of a quadratic function**

Approximate the zeros of  $f(x) = x^2 + 4x + 1$

$$f(x) = x^2 + 4x + 1$$

$$f(x) = (x \quad)(x \quad)$$

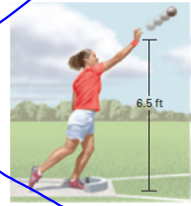
No Solution



**Example 8- Solve a multi-step problem**

**SPORTS** An athlete throws a shot put with an initial vertical velocity of 29 feet per second as shown.

- Write an equation that models the height  $h$  (in feet) of the shot put as a function of time  $t$  (in seconds) after it is thrown.
- Use the equation to find the time that the shot put is in the air.



**CONCEPT SUMMARY** *For Your Notebook*

**Relating Solutions of Equations, x-Intercepts of Graphs, and Zeros of Functions**

- Solutions of an Equation**  
The solutions of the equation  $-x^2 + 8x - 12 = 0$  are 2 and 6.
- x-Intercepts of a Graph**  
The x-intercepts of the graph of  $y = -x^2 + 8x - 12$  occur where  $y = 0$ , so the x-intercepts are 2 and 6, as shown.
- Zeros of a Function**  
The zeros of the function  $f(x) = -x^2 + 8x - 12$  are the values of  $x$  for which  $f(x) = 0$ , so the zeros are 2 and 6.

**Homework**

**10.3 Pracce B**

**Worksheet**

SKIP #15, #16