

Chapter 3  
Quadratic Equations and Complex Numbers

Section 3-3  
Completing the Square

**Square-Root Property**

| WORDS  | NUMBERS   | ALGEBRA  |
|--|---|--|
| To solve a quadratic equation, you can take the square root of both sides. Be sure to consider the positive and negative square roots. | $x^2 = 15$<br>$\sqrt{x^2} = \pm\sqrt{15}$<br>$x = \pm\sqrt{15}$ | If $x^2 = a$ and $a$ is a nonnegative real number, then<br>$x = \pm\sqrt{a}$ . |

**Reading Math**

**Equations by Using the Square Root Property**

Read  $\pm\sqrt{a}$  as "plus or minus square root of  $a$ ."

**Solving Quadratic Equation Examples before completing the square:**

1)  $(2x-3)^2 = 25$

2)  $(3x-1)^2 = -12$

3)

$$4x^2 + 11 = 59$$

4)

$$x^2 + 12x + 36 = 28$$

5)

$$x^2 + 8x + 16 = 49$$

If a quadratic expression of the form  $x^2 + bx$  cannot model a square, you can add a term to form a perfect square trinomial. This is called **completing the square**.

## **IMPORTANT!**

To Complete the Square  $a=1$  (a must be equal to one).

You can complete the square to solve quadratic equations.

### **Solving Quadratic Equations $ax^2 + bx + c = 0$ by Completing the Square**

1. Collect variable terms on one side of the equation and constants on the other.
2. As needed, divide both sides by  $a$  to make the coefficient of the  $x^2$ -term 1.
3. Complete the square by adding  $\left(\frac{b}{2}\right)^2$  to both sides of the equation.
4. Factor the variable expression as a perfect square.
5. Take the square root of both sides of the equation.
6. Solve for the values of the variable.

#### **Example: Solving a Quadratic Equation by Completing the Square**

**Solve the equation by completing the square.**

$$x^2 = 12x - 20$$

### **Example: Solving a Quadratic Equation by Completing the Square**

**Solve the equation by completing the square.**

$$18x + 3x^2 = 45$$

### **Writing Quadratic Functions in Vertex Form**

Recall that the vertex form of a quadratic function is  $y = a(x - h)^2 + k$ , where  $(h, k)$  is the vertex of the graph of the function. You can write a quadratic function in vertex form by completing the square.

#### **EXAMPLE 5**

#### **Writing a Quadratic Function in Vertex Form**

Write  $y = x^2 - 12x + 18$  in vertex form. Then identify the vertex.