<u>Objectives</u>
- Solve quadratic equations by completing the square.
- Write quadratic equations in vertex form.

Vocabulary
    Completing the square.

Example 1
    Solving Equations by Using the Square Root Property
    Solve each equation.

    a) $3x^2 - 4 = 68$

    b) $x^2 - 10x + 25 = 27$

Try it!
    Solving Equations by Using the Square Root Property
    Solve each equation.

    a) $4x^2 - 20 = 5$

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

Completing the Square		
Words	**Numbers**	**Algebra**
To complete the square of $x^2 + bx$, add $\left(\dfrac{b}{2}\right)^2$	$x^2 + 6x + \,?$ $x^2 + 6x + \left(\dfrac{6}{2}\right)^2$ $x^2 + 6x + 9$ $(x-3)^2$	$x^2 + bx + \,?$ $x^2 + bx + \left(\dfrac{b}{2}\right)^2$ $\left(x - \dfrac{b}{2}\right)^2$

Example 2   **Completing the Square**
Complete the Square for each expression. Write the resulting expression as a binomial squared.

a) $x^2 - 2x + \,?$

Find $\left(\dfrac{b}{2}\right)^2 = \left(\dfrac{-2}{2}\right)^2 = (-1)^2 = 1$

Add $x^2 - 2x + 1$

Factor $(x-1)^2$

Check: **Find the square of the binomial**
$(x-1)^2 = (x-1)(x-1) = x^2 - 2x + 1$

b) $x^2 + 5x + \,?$

Find $\left(\dfrac{b}{2}\right)^2 = \left(\dfrac{5}{2}\right)^2 = \dfrac{25}{4}$

Add $x^2 + 5x + \dfrac{25}{4}$

Factor $\left(x + \dfrac{5}{2}\right)^2$

Check: **Find the square of the binomial**
$\left(x + \dfrac{5}{2}\right)^2 = \left(x + \dfrac{5}{2}\right)\left(x + \dfrac{5}{2}\right) = x^2 + 5x + \dfrac{25}{4}$

Try it!

Complete the Square for each expression. Write the resulting expression as a binomial squared.

a) $x^2 + 4x + ?$

Find $\left(\dfrac{b}{2}\right)^2 =$

Add

Factor

Check: **Find the square of the binomial**

b) $x^2 - 4x + ?$

c) $x^2 + 3x + ?$

Solving Quadratic Equations $ax^2 + bx + c$ by Completing the Square

1. **Collect the 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 term x^2 term 1.**

3. **Complete the square by adding $\left(\dfrac{b}{2}\right)^2$ 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 3   **Solving a Quadratic Equation by Completing the Square.**

      a) $x^2 = 27 - 6x$

               $x^2 + 6x = 27$ **Collect variable terms on one side.**

               $x^2 + 6x + [\;\;] = 27 + [\;\;]$ **Set up to complete the square.**

               $x^2 + 6x + \left(\dfrac{6}{2}\right)^2 = 27 + \left(\dfrac{6}{2}\right)^2$ **Add $\left(\dfrac{b}{2}\right)^2$ to both sides.**

               $x^2 + 6x + 9 = 27 + 9$ **Simplify.**

               $(x + 3)^2 = 36$ **Factor**

                    $x + 3 = \pm\sqrt{36}$ **Take the square root of both sides**

                    $x + 3 = \pm 6$ **Simplify.**

          $x + 3 = 6$ **or** $x + 3 = -6$ **Solve for _x_.**

          $x = 3$ **or** $x = -9$

      b) $2x^2 + 8x = 12$

Try it!   **Solving each equation by completing the square.**

a) $x^2 - 2 = 9x$

b) $3x^2 - 24x = 27$

Example 4   **Writing a Quadratic Function in Vertex Form.**

a) $f(x) = x^2 + 10x - 13$

b) $g(x) = 2x^2 - 8x + 3$

Try it!   a) $f(x) = x^2 + 24x + 145$

b) $g(x) = 5x^2 - 50x + 128$