

## Section 3.1 Quadratic Functions and Models

**DEFINITION:** A quadratic function is a function  $f$  of the form

$$f(x) = ax^2 + bx + c$$

where  $a, b$ , and  $c$  are real numbers and  $a \neq 0$ .

### Graphing Quadratic Functions Using the Standard Form

#### Standard Form of a Quadratic Function

A quadratic function  $f(x) = ax^2 + bx + c$  can be expressed in the **standard form**

$$f(x) = a(x - h)^2 + k$$

by completing the square. The graph of  $f$  is a parabola with **vertex**  $(h, k)$ ; the parabola opens upward if  $a > 0$  or downward if  $a < 0$ .



**EXAMPLE:** Let  $f(x) = x^2 + 10x - 1$ . Express  $f$  in standard form. Identify the vertex.

**Solution:** We have

$$\begin{aligned} f(x) &= x^2 + 10x - 1 \\ &= x^2 + 2x \cdot 5 - 1 \\ &= x^2 + 2x \cdot 5 + 5^2 - 5^2 - 1 \\ &= (x + 5)^2 - 26 \\ &= (x - (-5))^2 + (-26) \end{aligned}$$

The vertex is  $(-5, -26)$ .

**EXAMPLE:** Let  $f(x) = 2x^2 - 12x + 23$ .

(a) Express  $f$  in standard form.

(b) Sketch the graph of  $f$ .

# Section 3 1 Quadratic Functions

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## **Section 3.1 Quadratic Functions:**

## Reviewing **Section 3 1 Quadratic Functions**: Unlocking the Spellbinding Force of Linguistics

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