

# Completing the Square

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The process of rewriting a quadratic function

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

in the form

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

is called **completing the square**. We'll complete the square on  $f(x) = 4x^2 + 24x + 29$  to illustrate the steps involved.

**Step 1:** Factor the leading coefficient from the first **two** terms.

$$f(x) = 4x^2 + 24x + 29$$

$$f(x) = 4(x^2 + 6x) + 29$$

**Step 2:** Looking **inside the parentheses** find the coefficient of  $x$ . Divide this by two and square the result.

$$\left(\frac{6}{2}\right)^2 = 9$$

**Step 3:** Add the number from Step 2 **inside** the parentheses. However, to make sure that we haven't changed the equation, you'll need to subtract off that same number (9 in this case) multiplied times the leading coefficient from Step 1 (4 in this case) **outside** the parentheses.

$$f(x) = 4(x^2 + 6x) + 29$$

$$f(x) = 4(x^2 + 6x + 9) + 29 - 4 \cdot 9$$

**Step 4:** Factor the quadratic in the parentheses (it will be a perfect square) and simplify outside the parentheses.

$$f(x) = 4(x^2 + 6x + 9) + 29 - 4 \cdot 9$$

$$f(x) = 4(x + 3)^2 - 7$$