



# Quadratic Equations: What They Are and How to Solve Them

KS4 MATHEMATICS

ALGEBRA

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## What is a Quadratic Equation?

A **quadratic equation** is a mathematical sentence that includes a letter (usually  $x$ ) raised to the power of **2**. The word 'quadratic' comes from 'quad', meaning four, because the shape these equations make on a graph has four main features.

A quadratic equation always looks like this:  $ax^2 + bx + c = 0$ . Here, **a**, **b**, and **c** are numbers (called **coefficients**), and **x** is the unknown number we're trying to find. The important thing is that  $x^2$  is the highest power—that's what makes it 'quadratic'.

Think of it like a treasure hunt: the equation gives you clues about where the treasure is buried, and solving it tells you the exact location. Sometimes there are two possible locations!

## Why Do We Need Quadratic Equations?

Quadratic equations are everywhere in real life! Engineers use them to design bridges and buildings. Scientists use them to predict how things move through the air, like a football kicked across a field or a rocket launched into space. Economists use them to work out the best price to sell something for maximum profit.

## Three Ways to Solve a Quadratic Equation

**Method 1: Factorising** means breaking the equation into smaller pieces that multiply together. If you can spot the pattern, this is the quickest method. For example,  $x^2 + 5x + 6 = 0$  can be factorised to  $(x + 2)(x + 3) = 0$ , which means  $x = -2$  or  $x = -3$ .

**Method 2: The Quadratic Formula** is a special recipe that always works. You plug your numbers into:  $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ . It looks complicated, but it's like following a cooking recipe—just substitute your numbers and calculate step by step.

Think of it like a GPS: the quadratic formula is like a universal sat nav that works for any quadratic equation, even ones that are really tricky to factorise by hand.

**Method 3: Completing the Square** is a clever technique where you rearrange the equation to make it easier to solve. It takes more steps than factorising, but it's useful when the other methods don't work easily.

## The Two Solutions

Most quadratic equations have **two solutions**—two different values of  $x$  that make the equation true. Sometimes there's only one solution, and occasionally there are no real solutions at all. When you draw a quadratic equation on a graph, it makes a U-shape called a **parabola**, and the solutions are where the U crosses the horizontal line.