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# The Quadratic Formula

IGCSE Mathematics

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# 1 Introduction to Quadratic Equations

**Note**

The quadratic formula is one of the most powerful and important tools in algebra. It allows us to solve *any* quadratic equation, even those that cannot be factorised easily. Mastering the quadratic formula is essential for IGCSE success and forms the foundation for more advanced mathematics.

**In this chapter, we will explore:**

- The standard form of a quadratic equation
- Deriving the quadratic formula by completing the square
- Using the quadratic formula to solve equations
- The discriminant and the nature of roots
- Interpreting solutions graphically
- Real-world applications

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# 2 Standard Form of a Quadratic Equation

**Definition**

A **quadratic equation** is a polynomial equation of degree 2. Its **standard form** is:

$$ax^2 + bx + c = 0$$

where:

- $a$, $b$, and $c$ are real number constants (called **coefficients**)
- $a \neq 0$ (if $a = 0$, the equation becomes linear)
- $x$ is the unknown variable

**Method**

**Identifying $a$, $b$, and $c$**
Before using the quadratic formula, always rearrange the equation into standard form $ax^2 + bx + c = 0$, then read off the values of $a$, $b$, and $c$.

**Step 1:** Move all terms to one side so the equation equals zero

**Step 2:** Write terms in descending powers of $x$

**Step 3:** Identify the coefficient of $x^2$ as $a$, the coefficient of $x$ as $b$, and the constant term as $c$

**Example**

Write each equation in standard form and state the values of $a$, $b$, and $c$.

**(a)** $5x^2 - 3x + 7 = 0$

Already in standard form: $a = 5, \quad b = -3, \quad c = 7$

**(b)** $x^2 - 9x = 0$

Already in standard form (with $c = 0$): $a = 1, \quad b = -9, \quad c = 0$

**(c)** $4x^2 = 7x - 2$

Rearrange: $4x^2 - 7x + 2 = 0$
$a = 4, \quad b = -7, \quad c = 2$

**(d)** $8x - 3x^2 = 5$

Rearrange: $-3x^2 + 8x - 5 = 0$, or equivalently $3x^2 - 8x + 5 = 0$
$a = 3, \quad b = -8, \quad c = 5$

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**Warning**

**Common Mistake:** Forgetting to include the negative sign!
If the equation is $3x^2 - 7x + 1 = 0$, then $b = -7$, NOT $b = 7$.
Carrying the wrong sign into the formula causes errors in every calculation that follows.

# Preview ends here

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