

# LaTeX to PDF and MathJax: Example 1

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## Contents

|   |          |
|---|----------|
| <b>Using this document</b>                      | <b>1</b> |
| <b>1 Quadratic equations</b>                    | <b>2</b> |
| 1.1 Solutions to a quadratic equation . . . . . | 2        |
| 1.2 The discriminant . . . . .                  | 2        |

## List of Figures

|  |   |
|--|---|
| 1 Examples of quadratic functions with zero, one and two real roots. . . . | 3 |
|--|---|

## List of Tables

|  |   |
|--|---|
| 1 Number of real roots of a quadratic equation, given the discriminant . . | 3 |
|--|---|

## Using this document

This is an example of a document compiled from  $\text{\LaTeX}$  into multiple formats:

- Standard print PDF
- Clearer print PDF
- Accessible web format

The outputs can be used to test setups and as a first example for students to try out.

# 1 Quadratic equations

A quadratic equation is an equation with the form  $ax^2 + bx + c = 0$  where  $x$  represents an unknown and  $a$ ,  $b$  and  $c$  are known numbers with  $a \neq 0$ .

## 1.1 Solutions to a quadratic equation

A solution to a quadratic equation is a value of  $x$  such that the equation balances. The solutions to quadratic equations can be found by using the quadratic formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}. \quad (1)$$

### Example.

For instance, the solutions to  $x^2 + 2x - 3 = 0$  are:

$$\begin{aligned} x &= \frac{-2 \pm \sqrt{2^2 - 4 \times 1 \times -3}}{2 \times 1} \\ &= \frac{-2 \pm \sqrt{4 + 12}}{2} \\ &= \frac{-2 \pm \sqrt{16}}{2} \\ &= \frac{-2 \pm 4}{2} \end{aligned}$$

Hence,  $x = 1$  or  $x = -3$ .

## 1.2 The discriminant

### Definition (Discriminant).

The **discriminant** of a quadratic equation with coefficients  $a, b, c \in \mathbb{R}$  is:

$$\Delta = b^2 - 4ac.$$

### Remark.

Note that this is the expression beneath the square root symbol in the quadratic formula (1).

We can use the discriminant to determine the number of real roots of a quadratic equation. The number depends on the value of  $\Delta$  as in table 1.

| Value of $\Delta$ | Real roots    |
|-------------------|---------------|
| $\Delta > 0$      | Two, distinct |
| $\Delta = 0$      | One, repeated |
| $\Delta < 0$      | Zero          |

Table 1: Number of real roots of a quadratic equation, given the discriminant

Figure 1 shows an example of each possibility<sup>1</sup>.

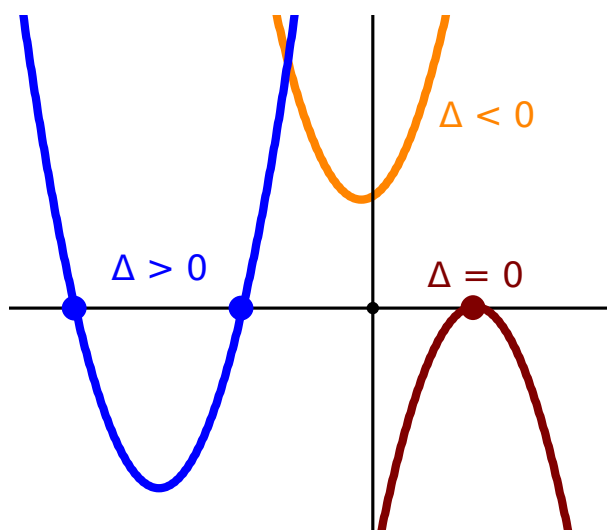


Figure 1: Examples of quadratic functions with zero, one and two real roots.

<sup>1</sup>The image is due to Olin, CC-BY-AS 3.0 downloaded from Wikimedia Commons