

The Panda Math Tutor

Vectors and Transformations

IGCSE Mathematics

Prepared by

Nikolas Agisilaou

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1 Introduction

Note

Vectors describe quantities that have both a *size* and a *direction*, while **transformations** describe how shapes move, turn, flip, and resize on the coordinate plane. The two topics are deeply connected: a translation is nothing more than a vector telling a shape how far to slide.

These topics are heavily tested in IGCSE examinations, both as standalone questions and as part of longer geometry and coordinate-geometry problems.

In this chapter, we will explore:

- Vectors, notation and column vectors — [Section 2](#)
- Magnitude of a vector — [Section 3](#)
- Vector operations: adding, subtracting, scaling — [Section 4](#)
- Position vectors and vector geometry — [Section 5](#)
- The four transformations: translation, reflection, rotation, enlargement — [Section 6](#) onwards
- Combining and describing transformations — [Section 11](#)

2 Vectors and Column Vectors

Definition

A **vector** is a quantity that has both **magnitude** (size) and **direction**.

A **scalar** is a quantity that has magnitude only.

Scalars: distance, speed, mass, temperature, time

Vectors: displacement, velocity, force, acceleration

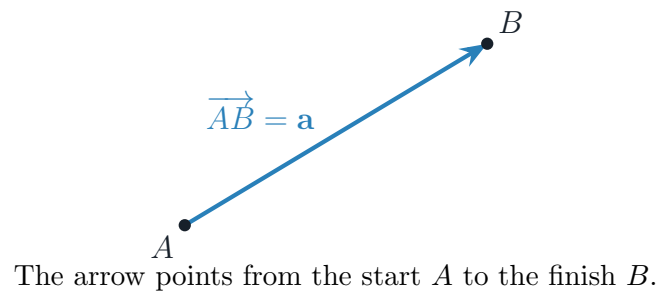
Note

How we write vectors:

- As a directed line segment from A to B : $\overrightarrow{AB}$
- As a single bold or underlined letter: $\mathbf{a}$ or $\underline{a}$ (handwritten)

- As a **column vector**: $\begin{pmatrix} x \\ y \end{pmatrix}$

A vector is drawn as an **arrow**: the length shows the magnitude, and the arrowhead shows the direction.



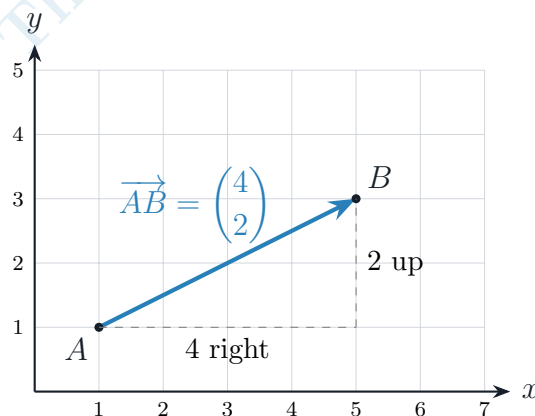
2.1 Column Vectors

Definition

A **column vector** describes a movement using two numbers:

$$\begin{pmatrix} x \\ y \end{pmatrix} \quad \begin{array}{l} x = \text{movement in the } x\text{-direction (right +, left -)} \\ y = \text{movement in the } y\text{-direction (up +, down -)} \end{array}$$

The **top** number is horizontal; the **bottom** number is vertical.



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