The Panda Math Tutor

Vectors and Transformations

IGCSE Mathematics

The Panda Math Tutor

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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

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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

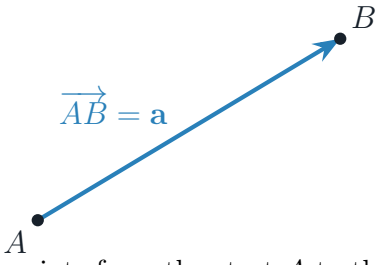
Note

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.



The arrow points from the start A to the finish B.

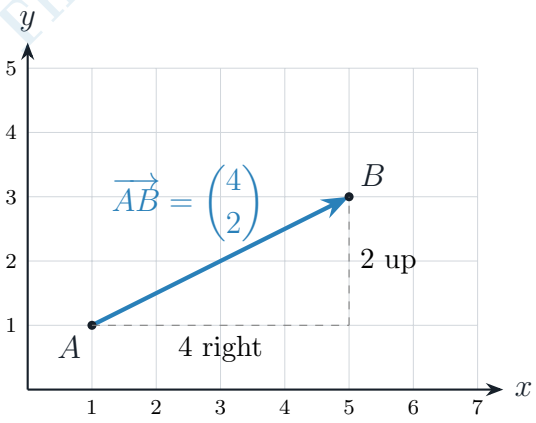
2.1 Column Vectors

Definition

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

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

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



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