

UNIT 38 *Vectors*

Introduction to SIM

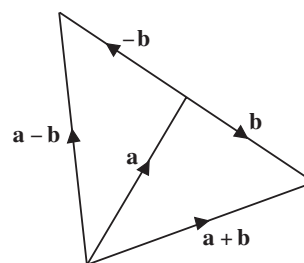
Learning objectives

This unit introduces the important topic of *vectors*. Vectors are used in many applications in more advanced studies in, for example, engineering and astrophysics; for example, fluid flow. After completing this unit of STUDENT INSTRUCTIONAL MATERIAL (SIM) you should

- be able to understand the concept of a vector and add and subtract vectors
- be able to use vectors in 2-dimensional geometry to prove geometric results.

Key points and principles

- Vector addition, i.e. $\begin{pmatrix} a \\ b \end{pmatrix} + \begin{pmatrix} c \\ d \end{pmatrix} = \begin{pmatrix} a + c \\ b + d \end{pmatrix}$ and geometric interpretation – see diagram.



- Multiplication of a vector by a scalar

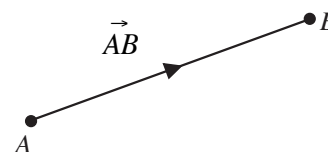
i.e.
$$k \begin{pmatrix} a \\ b \end{pmatrix} = \begin{pmatrix} ka \\ kb \end{pmatrix}$$

Facts to remember

- Any vector has both magnitude (modulus) and direction, whereas a scalar has only magnitude.
- Multiplying a vector by a scalar means multiplying all components of the vector by the scalar.

For example,
$$k \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} kx \\ ky \end{pmatrix}$$

- The vector $\vec{AB}$ starts at position A and finishes at position B .



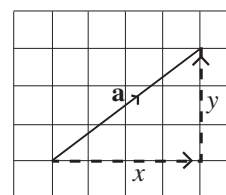
Glossary of terms

Scalar this means 'a number'

Vector a quantity that has magnitude and direction; for example, velocity

Magnitude (modulus) is the length of the vector, denoted by $|\mathbf{a}|$; if

$$\mathbf{a} = \begin{pmatrix} x \\ y \end{pmatrix}, \text{ then } |\mathbf{a}| = \sqrt{x^2 + y^2}$$



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Zero vector $\mathbf{0} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$

Parallel vectors vectors in the same direction but not necessarily of the same magnitude;
for example, $\mathbf{a}$ and $2\mathbf{a}$

Unit vector a vector that has magnitude 1; that is $|\mathbf{a}| = 1$

Position vector a vector that starts at the origin (O)