# E7.2 Vectors in two dimensions

Name: _____ Class: _____ Date: _____ **Total: 21 marks**

**KEY WORDS** magnitude • column vectors • position vectors • vectors in two dimensions • scalar

## Objective

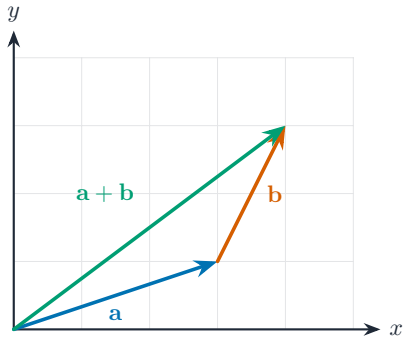
Build the skills to answer Extended exam questions on **vectors in two dimensions** – adding, subtracting and scaling **column vectors**, the **magnitude**, and **position vectors**.

**You must be able to:**

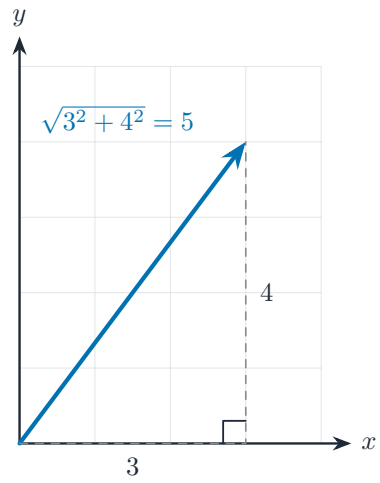
- add, subtract and multiply column vectors by a scalar
- find the magnitude of a vector
- use $\overrightarrow{AB} = \mathbf{b} - \mathbf{a}$

## 1 Key knowledge and worked examples

### Working with vectors




*Work on the top and bottom numbers separately*




*The magnitude (length) of a vector*

- **Add/scale:** $\mathbf{a} = \begin{pmatrix} 3 \\ 1 \end{pmatrix}$, $\mathbf{b} = \begin{pmatrix} 2 \\ -4 \end{pmatrix} \to \mathbf{a} + \mathbf{b} = \begin{pmatrix} 5 \\ -3 \end{pmatrix}$; $3\mathbf{a} = \begin{pmatrix} 9 \\ 3 \end{pmatrix}$.
- **Magnitude** : $\left|\begin{pmatrix} x \\ y \end{pmatrix}\right| = \sqrt{x^2 + y^2} \to \left|\begin{pmatrix} 3 \\ 4 \end{pmatrix}\right| = 5$.
- **Position vectors:** $\overrightarrow{AB} = \mathbf{b} - \mathbf{a}$.

**Answer shapes:** **M1** a correct method, **A1** the correct answer.

## 2 Practice

**2.1** $\mathbf{a} = \begin{pmatrix} 4 \\ 2 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} 1 \\ -3 \end{pmatrix}$. Find $\mathbf{a} + \mathbf{b}$. [1]

**2.2** Find $2\mathbf{a}$ for $\mathbf{a} = \begin{pmatrix} 3 \\ -1 \end{pmatrix}$. [1]

**2.3** Find the magnitude of $\begin{pmatrix} 6 \\ 8 \end{pmatrix}$. [2]

## 3 Exam-style questions

**3.1** $\mathbf{a} = \begin{pmatrix} 5 \\ 2 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} 1 \\ 6 \end{pmatrix}$. Find $\mathbf{a} - \mathbf{b}$. [2]

**3.2** The position vector of $A$ is $\begin{pmatrix} 1 \\ 3 \end{pmatrix}$ and of $B$ is $\begin{pmatrix} 7 \\ 11 \end{pmatrix}$. Find $\overrightarrow{AB}$ and its magnitude. [3]

**3.3** $\mathbf{a} = \begin{pmatrix} 3 \\ -1 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} -2 \\ 4 \end{pmatrix}$.

(a) Work out $2\mathbf{a} - \mathbf{b}$ as a column vector. [2]

(b) Find $|\mathbf{a}|$, giving your answer in surd form and to 2 decimal places. [3]

(c) $OABC$ is a parallelogram with $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OC} = \mathbf{b}$. Write $\overrightarrow{AC}$ and $\overrightarrow{OB}$ in terms of $\mathbf{a}$ and $\mathbf{b}$. [3]

(d) $M$ is the midpoint of $AB$. Show that $\overrightarrow{OM} = \mathbf{a} + \frac{1}{2}\mathbf{b}$, and hence write $\overrightarrow{OM}$ as a column vector. [4]