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

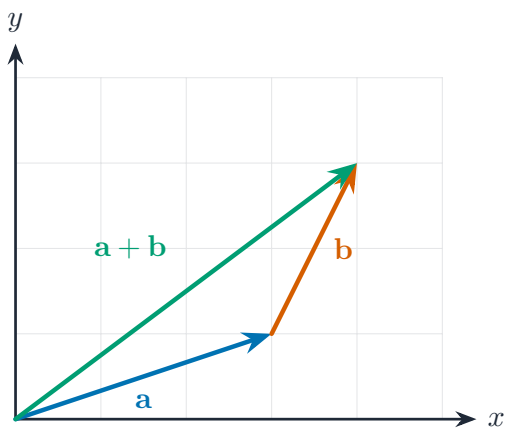
Build the skills to answer Extended exam questions on **vectors in two dimensions** – adding, subtracting and scaling **column vectors**, the **magnitude**, and **position vectors**.

You must be able to:

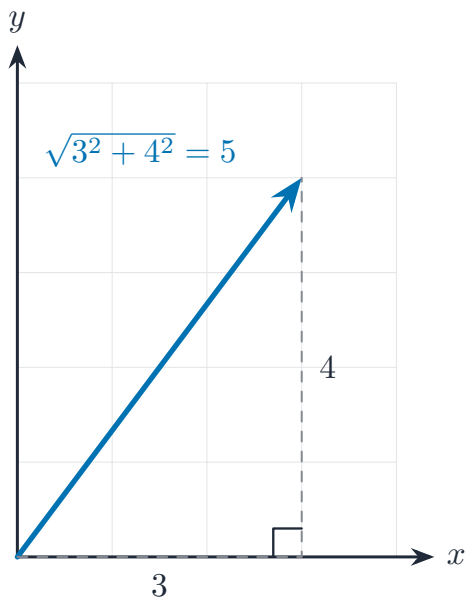
- add, subtract and multiply column vectors by a scalar
- find the magnitude of a vector
- use $\overrightarrow{AB} = \mathbf{b} - \mathbf{a}$

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]