Angles and Shapes

Guidance for tutors

Outcome	SA8	Student can consistently:	Solve problems involving vectors, including geometrical and numerical examples.
How the topic is examined			

How the topic is examined	• Examined through test paper questions. • Questions are equally likely to appear on calculator and non-calculator papers. • Students could be asked to perform numerical calculations as well as solve geometrical problems using vectors.

Prior knowledge	• Students should be confident with:
	   ○ Four rules of number.
	   ○ Fractions (NF1)
	   ○ Basic shape and angle properties (SA2)
	• In addition questions involving this topic can have links to:
	   ○ Translations (SA4)

Suggested tuition approaches	• Students should understand and use vector notation. • They should be able to calculate and represent graphically the sum of two vectors, the difference of two vectors and a scalar multiple of a vector. • In addition they should know how to calculate the resultant of two vectors and be able to solve geometrical problems involving vectors. • Students are likely to have seen vectors before when doing translations (See SA2) • Column vectors looks like this $\begin{pmatrix} 5 \\ -2 \end{pmatrix}$. • The key difference between a scalar (a number) and a vector is that a vector has both direction and size. (e.g. $\begin{pmatrix} 5 \\ -2 \end{pmatrix}$ looks like this

This vector goes 5 units to the right and 2 units down.

The arrow on the vector points in the direction it is going. The arrow can be at the end or in the middle.

You could work out the length by using Pythagoras.

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- Vectors in an exam are represented by lower case letters in bold (e.g. **a,** or it can be shown by $\overrightarrow{AB}$, which means the vector that goes from A to B. To show that a letter represents a vector in their answer, a student should underline the letter.

- The vector **–a** is the same size as **a**, but the arrow just points in the opposite direction.
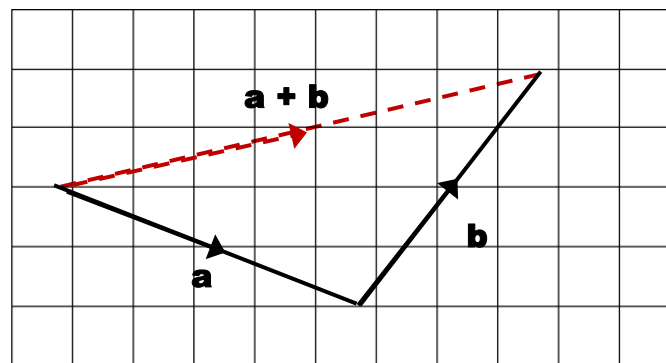
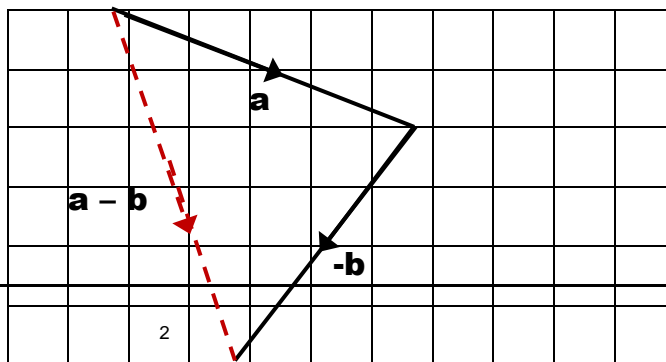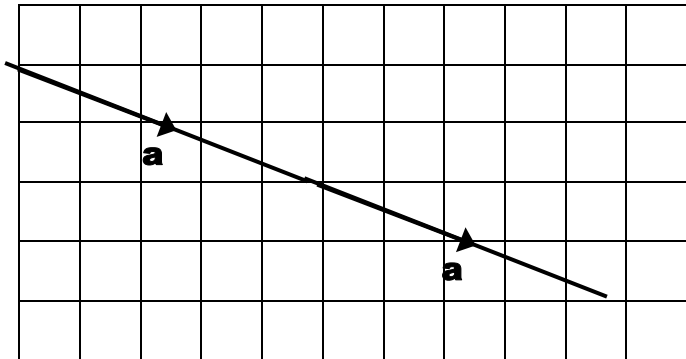| **Vector addition**	
Here are two vectors $$a = \begin{pmatrix} 5 \\ -2 \end{pmatrix} \qquad b = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$$ $$a + b = \begin{pmatrix} 5 \\ -2 \end{pmatrix} + \begin{pmatrix} 3 \\ 4 \end{pmatrix} = \begin{pmatrix} 8 \\ 2 \end{pmatrix}$$	On a diagram this would look like:
Vector subtraction	
Here are two vectors $$a = \begin{pmatrix} 5 \\ -2 \end{pmatrix} \qquad b = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$$ $$a - b = \begin{pmatrix} 5 \\ -2 \end{pmatrix} - \begin{pmatrix} 3 \\ 4 \end{pmatrix} = \begin{pmatrix} 2 \\ -6 \end{pmatrix}$$	

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Scalar multiplication

Here are two vectors

$$a = \begin{pmatrix} 5 \\ -2 \end{pmatrix} \qquad b = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$$

$$2a = 2 \times \begin{pmatrix} 5 \\ -2 \end{pmatrix} = \begin{pmatrix} 10 \\ -4 \end{pmatrix}$$

- Students may be given a diagram and asked to find a particular vector. Some worked examples are here. http://www.onlinemathlearning.com/vector-geometry.html
- Some teachers explain it as finding a pathway to get from one place to the other. You can only go along lines that they know the vector of.
- To show that two vectors are parallel you have to show that one vector is a multiple of the other.

Common errors and misconceptions

- Students struggle to solve problems involving geometrical representations of vectors. You could ask them to think about it as pathways.
- Students want to treat vectors as numbers. They are reluctant to use a different notation to show vectors. They see them solely as vectors like they see in translations.
- Students forget when going in the opposite direction to the arrow that this is the negative of the vector.
- Some students want to draw axes to show this.

Guidance for tutors

Suggested resources	- Questions - http://www.cimt.org.uk/projects/mepres/allgcse/bkc19.pdf - https://corbettmaths.files.wordpress.com/2013/02/vectors-pdf.pdf - Past GCSE Questions - https://keshgcsemaths.files.wordpress.com/2013/11/108_vectors.pdf - Video tutorial - https://www.youtube.com/watch?v=bLLBtAm197k