

## What do I need to be able to do?

By the end of this unit you should be able to:

- Understand and represent vectors
- Use and read vector notation
- Draw and understand vectors multiplied by a scalar
- Draw and understand addition of vectors
- Draw and understand addition and subtraction of vectors

## Keywords

**Direction:** the line our course something is going

**Magnitude:** the magnitude of a vector is its length

**Scalar:** a single number used to represent the multiplier when working with vectors

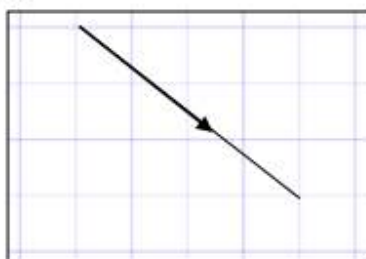
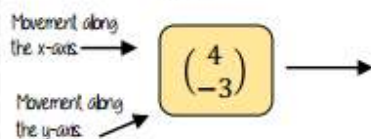
**Column vector:** a matrix of one column describing the movement from a point

**Resultant:** the vector that is the sum of two or more other vectors

**Parallel:** straight lines that never meet

## Understand and represent vectors

Column vectors have been seen in translations to describe the movement of one image onto another



Vectors show both direction and magnitude

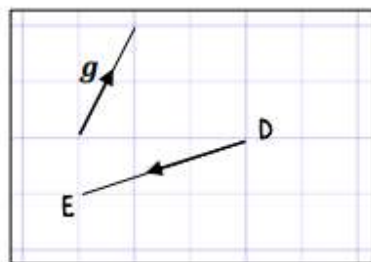
The arrow is pointing in the direction from starting point to end point of the vector.

The direction is important to correctly write the vector

The magnitude is the length of the vector (This is calculated using Pythagoras theorem and forming a right-angled triangle with auxiliary lines)

The magnitude stays the same even if the direction changes

## Understand and represent vectors



Vector notation  $\overrightarrow{DE}$  is another way to represent the vector joining the point D to the point E.

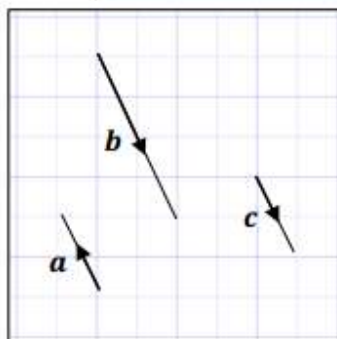
$$\overrightarrow{DE} = \begin{pmatrix} -3 \\ -1 \end{pmatrix}$$

The arrow also indicates the direction from point D to point E.

Vectors can also be written in bold lower case so  $\mathbf{g}$  represents the vector  $\mathbf{g} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$

## Vectors multiplied by a scalar

Parallel vectors are scalar multiples of each other



$$\mathbf{b} = 2 \times \mathbf{c} = 2\mathbf{c}$$

Multiply  $\mathbf{c}$  by 2 this becomes  $\mathbf{b}$ . The two lines are parallel

$$\mathbf{a} = -1 \times \mathbf{c} = -\mathbf{c}$$

The vectors  $\mathbf{a}$  and  $\mathbf{c}$  are also parallel. A negative scalar causes the vector to reverse direction.

$$\mathbf{b} = -2 \times \mathbf{a} = -2\mathbf{a}$$

$$\mathbf{a} = \begin{pmatrix} -1 \\ 2 \end{pmatrix} \quad \mathbf{b} = \begin{pmatrix} 2 \\ -4 \end{pmatrix} \quad \mathbf{c} = \begin{pmatrix} 1 \\ -2 \end{pmatrix}$$

## Addition of vectors

$$\overrightarrow{AB} = \begin{pmatrix} 3 \\ 1 \end{pmatrix}$$

$$\overrightarrow{BC} = \begin{pmatrix} 2 \\ -4 \end{pmatrix}$$

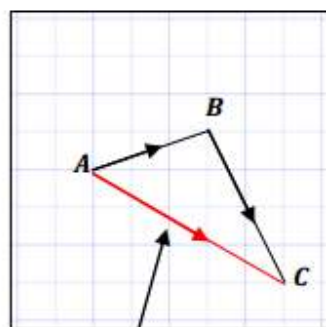
$$\overrightarrow{AB} + \overrightarrow{BC}$$

$$= \begin{pmatrix} 3 \\ 1 \end{pmatrix} + \begin{pmatrix} 2 \\ -4 \end{pmatrix}$$

$$= \begin{pmatrix} 3+2 \\ 1-4 \end{pmatrix}$$

$$\overrightarrow{AC} = \begin{pmatrix} 5 \\ -3 \end{pmatrix}$$

Look how this addition compares to the vector  $\overrightarrow{AC}$



The resultant

$$\overrightarrow{AB} + \overrightarrow{BC} = \overrightarrow{AC} = \begin{pmatrix} 5 \\ -3 \end{pmatrix}$$

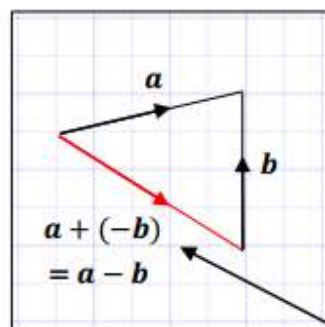
## Addition and subtraction of vectors

$$\mathbf{a} = \begin{pmatrix} 5 \\ 1 \end{pmatrix}$$

$$\mathbf{b} = \begin{pmatrix} 0 \\ 4 \end{pmatrix}$$

$$\mathbf{a} + (-\mathbf{b}) = \begin{pmatrix} 5 + -0 \\ 1 + -4 \end{pmatrix} = \begin{pmatrix} 5 \\ -4 \end{pmatrix}$$

$$\mathbf{a} + (-\mathbf{b}) = \mathbf{a} - \mathbf{b}$$



The resultant is  $\mathbf{a} - \mathbf{b}$  because the vector is in the opposite direction to  $\mathbf{b}$  which needs a scalar of  $-1$