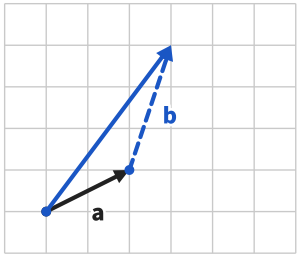
Calculating with column vectors

ANSWERS

1

$\mathbf{a} = \begin{pmatrix} 2 \\ 1 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$. Work out $\mathbf{a} + \mathbf{b}$.

Draw **b** from the end of **a**.



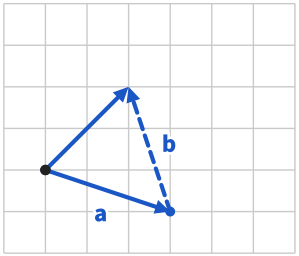
$\mathbf{a} + \mathbf{b} = \begin{pmatrix} 2+1 \\ 1+3 \end{pmatrix}$

$\mathbf{a} + \mathbf{b} = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$

2

$\mathbf{a} = \begin{pmatrix} 3 \\ -1 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} -1 \\ 3 \end{pmatrix}$. Work out $\mathbf{a} + \mathbf{b}$.

Draw it on the grid, starting at the dot.

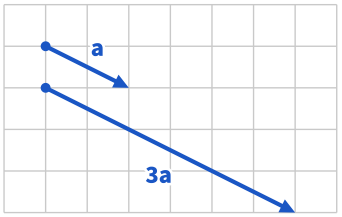


$\mathbf{a} + \mathbf{b} = \begin{pmatrix} 3 + (-1) \\ -1 + 3 \end{pmatrix}$

$\mathbf{a} + \mathbf{b} = \begin{pmatrix} 2 \\ 2 \end{pmatrix}$

3

$\mathbf{a} = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$. Work out $3\mathbf{a}$. Draw **a** and $3\mathbf{a}$ on the grid.



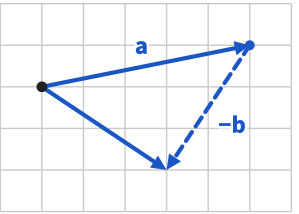
$3\mathbf{a} = \begin{pmatrix} 3 \times 2 \\ 3 \times (-1) \end{pmatrix}$

$3\mathbf{a} = \begin{pmatrix} 6 \\ -3 \end{pmatrix}$

4 *Notice the change!*

$\mathbf{a} = \begin{pmatrix} 5 \\ 1 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$. Work out $\mathbf{a} - \mathbf{b}$.

Draw it: **a**, then **b** backwards.



$\mathbf{a} - \mathbf{b} = \begin{pmatrix} 5 - 2 \\ 1 - 3 \end{pmatrix}$

$\mathbf{a} - \mathbf{b} = \begin{pmatrix} 3 \\ -2 \end{pmatrix}$

5

$\mathbf{a} = \begin{pmatrix} -3 \\ 2 \end{pmatrix}$. Work out $-2\mathbf{a}$.

$-2\mathbf{a} = \begin{pmatrix} -2 \times (-3) \\ -2 \times 2 \end{pmatrix}$

$-2\mathbf{a} = \begin{pmatrix} 6 \\ -4 \end{pmatrix}$

6

$\mathbf{a} = \begin{pmatrix} 6 \\ 1 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} 2 \\ -4 \end{pmatrix}$.

Jade says $\mathbf{a} - \mathbf{b} = \begin{pmatrix} 4 \\ -3 \end{pmatrix}$.

Explain her mistake. Work out $\mathbf{a} - \mathbf{b}$.

the bottom is $1 - (-4) = 1 + 4$

$\mathbf{a} - \mathbf{b} = \begin{pmatrix} 4 \\ 5 \end{pmatrix}$

7

$\mathbf{a} = \begin{pmatrix} 3 \\ -1 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} -4 \\ 5 \end{pmatrix}$. Work out $2\mathbf{a} + \mathbf{b}$.

$2\mathbf{a} = \begin{pmatrix} 6 \\ -2 \end{pmatrix}$

$2\mathbf{a} + \mathbf{b} = \begin{pmatrix} 6 + (-4) \\ -2 + 5 \end{pmatrix}$

$2\mathbf{a} + \mathbf{b} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$

8

$\mathbf{a} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} 1 \\ -2 \end{pmatrix}$. Work out $3\mathbf{a} - 2\mathbf{b}$.

$3\mathbf{a} = \begin{pmatrix} 6 \\ 9 \end{pmatrix}$

$2\mathbf{b} = \begin{pmatrix} 2 \\ -4 \end{pmatrix}$

$3\mathbf{a} - 2\mathbf{b} = \begin{pmatrix} 6 - 2 \\ 9 - (-4) \end{pmatrix}$

$3\mathbf{a} - 2\mathbf{b} = \begin{pmatrix} 4 \\ 13 \end{pmatrix}$

Calculating with column vectors *further practice*

ANSWERS

9

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

Work out $2\mathbf{a} - \mathbf{b}$.

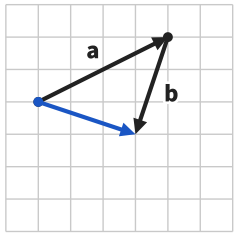
$\begin{pmatrix} 8 \\ -4 \end{pmatrix} - \begin{pmatrix} -1 \\ 3 \end{pmatrix}$

Answer $\begin{pmatrix} 9 \\ -7 \end{pmatrix}$

10

Write **a** and **b** as column vectors.

Then work out **a** + **b**.



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

a + b = $\begin{pmatrix} 3 \\ -1 \end{pmatrix}$

11

Find the vector **p**.

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

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

p = $\begin{pmatrix} -2 \\ 6 \end{pmatrix}$

12

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

$2\mathbf{a} - \mathbf{b} = \begin{pmatrix} 7 \\ 5 \end{pmatrix}$. Find k.

$2k - 3 = 7$

$2k = 10$

k = 5

13

A drone flies the vector $\begin{pmatrix} 4 \\ 1 \end{pmatrix}$ three times, then the vector $\begin{pmatrix} -5 \\ 2 \end{pmatrix}$.

Write its whole journey as one column vector.

$3\begin{pmatrix} 4 \\ 1 \end{pmatrix} + \begin{pmatrix} -5 \\ 2 \end{pmatrix}$

$\begin{pmatrix} 12 \\ 3 \end{pmatrix} + \begin{pmatrix} -5 \\ 2 \end{pmatrix}$

Answer $\begin{pmatrix} 7 \\ 5 \end{pmatrix}$

14

$\mathbf{a} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$ and $\mathbf{c} = \begin{pmatrix} 6 \\ -9 \end{pmatrix}$. Write **c** in terms of **a**.

$6 = 3 \times 2$ and $-9 = 3 \times (-3)$

Answer $\mathbf{c} = 3\mathbf{a}$

15

A ferry sails **p**, then **q**, then **−p**, where $\mathbf{p} = \begin{pmatrix} 6 \\ 1 \end{pmatrix}$ and $\mathbf{q} = \begin{pmatrix} -2 \\ 5 \end{pmatrix}$. Write its whole journey as one column vector.

$\begin{pmatrix} 6 \\ 1 \end{pmatrix} + \begin{pmatrix} -2 \\ 5 \end{pmatrix} + \begin{pmatrix} -6 \\ -1 \end{pmatrix}$

Answer $\begin{pmatrix} -2 \\ 5 \end{pmatrix}$

16

$\mathbf{a} = \begin{pmatrix} 4 \\ 1 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$. Mia says $2(\mathbf{a} - \mathbf{b})$ is the same as $2\mathbf{a} - \mathbf{b}$. Is Mia right? Show how you know.

$2(\mathbf{a} - \mathbf{b}) = \begin{pmatrix} 6 \\ -4 \end{pmatrix}$

$2\mathbf{a} - \mathbf{b} = \begin{pmatrix} 7 \\ -1 \end{pmatrix}$

Answer No