

I Do

$$\mathbf{a} = \begin{pmatrix} 4 \\ -3 \end{pmatrix} \text{ and } \mathbf{b} = \begin{pmatrix} -2 \\ 5 \end{pmatrix}$$

(a) Work out $3\mathbf{a} + 2\mathbf{b}$ as a column vector.

The vector $\mathbf{c} = \begin{pmatrix} 10 \\ k \end{pmatrix}$, where k is an integer.

(b) Given that $2\mathbf{a} - \mathbf{b} = \mathbf{c}$, work out the value of k .

(c) Point P has coordinates $(3, -1)$.

The translation vector from P to Q is $\begin{pmatrix} -5 \\ 4 \end{pmatrix}$.

Write down the coordinates of point Q .

We Do

$$\mathbf{u} = \begin{pmatrix} 5 \\ 2 \end{pmatrix} \text{ and } \mathbf{v} = \begin{pmatrix} -3 \\ -4 \end{pmatrix}$$

(a) Work out $2\mathbf{u} - 3\mathbf{v}$ as a column vector.

The vector $\mathbf{w} = \begin{pmatrix} 11 \\ m \end{pmatrix}$, where m is an integer.

(b) Given that $\mathbf{u} - 2\mathbf{v} = \mathbf{w}$, work out the value of m .

(c) Point A has coordinates $(-2, 5)$.

The translation vector from A to B is $\begin{pmatrix} 4 \\ -7 \end{pmatrix}$.

Write down the coordinates of point B .

You Do

$$\mathbf{p} = \begin{pmatrix} -1 \\ 6 \end{pmatrix} \text{ and } \mathbf{q} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$$

(a) Work out $4\mathbf{p} + \mathbf{q}$ as a column vector.

The vector $\mathbf{r} = \begin{pmatrix} n \\ 24 \end{pmatrix}$, where n is an integer.

(b) Given that $3\mathbf{p} - 2\mathbf{q} = \mathbf{r}$, work out the value of n .

(c) Point M has coordinates $(4, 0)$.

The translation vector from M to N is $\begin{pmatrix} -6 \\ 2 \end{pmatrix}$.

Write down the coordinates of point N .

Challenge

Vectors $\mathbf{x}$ and $\mathbf{y}$ are given by $\mathbf{x} = \begin{pmatrix} 3 \\ a \end{pmatrix}$ and $\mathbf{y} = \begin{pmatrix} b \\ -2 \end{pmatrix}$.

(a) Given that $2\mathbf{x} + 3\mathbf{y} = \begin{pmatrix} 12 \\ 2 \end{pmatrix}$, find the values of a and b .

(b) Point R is translated to point $S(5, 1)$ by the vector $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$.

Find the coordinates of point R .

Answers & Worked Solutions

• I Do:

$$(a) 3 \begin{pmatrix} 4 \\ -3 \end{pmatrix} + 2 \begin{pmatrix} -2 \\ 5 \end{pmatrix} = \begin{pmatrix} 12 \\ -9 \end{pmatrix} + \begin{pmatrix} -4 \\ 10 \end{pmatrix} = \begin{pmatrix} 8 \\ 1 \end{pmatrix}.$$

$$(b) 2 \begin{pmatrix} 4 \\ -3 \end{pmatrix} - \begin{pmatrix} -2 \\ 5 \end{pmatrix} = \begin{pmatrix} 8 \\ -6 \end{pmatrix} - \begin{pmatrix} -2 \\ 5 \end{pmatrix} = \begin{pmatrix} 10 \\ -11 \end{pmatrix}. \text{ Therefore, } k = -11.$$

$$(c) Q = P + PQ = \begin{pmatrix} 3 \\ -1 \end{pmatrix} + \begin{pmatrix} -5 \\ 4 \end{pmatrix} = \begin{pmatrix} -2 \\ 3 \end{pmatrix}. \text{ Coordinates: } (-2, 3).$$

• We Do:

$$(a) 2 \begin{pmatrix} 5 \\ 2 \end{pmatrix} - 3 \begin{pmatrix} -3 \\ -4 \end{pmatrix} = \begin{pmatrix} 10 \\ 4 \end{pmatrix} - \begin{pmatrix} -9 \\ -12 \end{pmatrix} = \begin{pmatrix} 19 \\ 16 \end{pmatrix}.$$

$$(b) \begin{pmatrix} 5 \\ 2 \end{pmatrix} - 2 \begin{pmatrix} -3 \\ -4 \end{pmatrix} = \begin{pmatrix} 5 \\ 2 \end{pmatrix} - \begin{pmatrix} -6 \\ -8 \end{pmatrix} = \begin{pmatrix} 11 \\ 10 \end{pmatrix}. \text{ Therefore, } m = 10.$$

$$(c) B = A + AB = \begin{pmatrix} -2 \\ 5 \end{pmatrix} + \begin{pmatrix} 4 \\ -7 \end{pmatrix} = \begin{pmatrix} 2 \\ -2 \end{pmatrix}. \text{ Coordinates: } (2, -2).$$

• You Do:

$$(a) 4 \begin{pmatrix} -1 \\ 6 \end{pmatrix} + \begin{pmatrix} 2 \\ -3 \end{pmatrix} = \begin{pmatrix} -4 \\ 24 \end{pmatrix} + \begin{pmatrix} 2 \\ -3 \end{pmatrix} = \begin{pmatrix} -2 \\ 21 \end{pmatrix}.$$

$$(b) 3 \begin{pmatrix} -1 \\ 6 \end{pmatrix} - 2 \begin{pmatrix} 2 \\ -3 \end{pmatrix} = \begin{pmatrix} -3 \\ 18 \end{pmatrix} - \begin{pmatrix} 4 \\ -6 \end{pmatrix} = \begin{pmatrix} -7 \\ 24 \end{pmatrix}. \text{ Therefore, } n = -7.$$

$$(c) N = M + MN = \begin{pmatrix} 4 \\ 0 \end{pmatrix} + \begin{pmatrix} -6 \\ 2 \end{pmatrix} = \begin{pmatrix} -2 \\ 2 \end{pmatrix}. \text{ Coordinates: } (-2, 2).$$

• Challenge:

$$(a) 2 \begin{pmatrix} 3 \\ a \end{pmatrix} + 3 \begin{pmatrix} b \\ -2 \end{pmatrix} = \begin{pmatrix} 6 \\ 2a \end{pmatrix} + \begin{pmatrix} 3b \\ -6 \end{pmatrix} = \begin{pmatrix} 6 + 3b \\ 2a - 6 \end{pmatrix}.$$

$$\text{Equating rows: } 6 + 3b = 12 \rightarrow 3b = 6 \rightarrow b = 2.$$

$$2a - 6 = 2 \rightarrow 2a = 8 \rightarrow a = 4.$$

$$(b) R + RS = S \rightarrow R = S - RS = \begin{pmatrix} 5 \\ 1 \end{pmatrix} - \begin{pmatrix} 2 \\ -3 \end{pmatrix} = \begin{pmatrix} 3 \\ 4 \end{pmatrix}. \text{ Coordinates: } (3, 4).$$