

Translations and Column Vectors

Solutions

For AQA GCSE Mathematics (8300) • Foundation tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (1 mark)

A point moves 3 squares down.

Circle the column vector for this translation.

Options: $\begin{pmatrix} 3 \\ 0 \end{pmatrix}$, $\begin{pmatrix} 0 \\ 3 \end{pmatrix}$, $\begin{pmatrix} -3 \\ 0 \end{pmatrix}$, $\begin{pmatrix} 0 \\ -3 \end{pmatrix}$

The top number is the movement across. The point does not move across, so it is 0.

The bottom number is the movement up or down.

Down is negative, so it is -3 .

Answer: $\begin{pmatrix} 0 \\ -3 \end{pmatrix}$

Tip: Top number: left or right. Bottom number: up or down. A common mistake is to put the 3 on top.

2 (1 mark)

A shape is translated 6 squares to the left and 2 squares up.

Write this translation as a column vector.

Top number: movement across. Left is negative, so it is -6 .

Bottom number: movement up or down. Up is positive, so it is 2.

Answer: $\begin{pmatrix} -6 \\ 2 \end{pmatrix}$

Tip: A column vector has no line in the middle. It is not a fraction, so never draw a fraction line or “simplify” it.

3 (1 mark)

The point $(-2, 3)$ is translated by the vector $\begin{pmatrix} 5 \\ -4 \end{pmatrix}$

Write down the coordinates of the image.

Add the top number to the x -coordinate: $-2 + 5 = 3$

Add the bottom number to the y -coordinate: $3 + (-4) = -1$

Answer: $(3, -1)$

4 (3 marks)

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

Write as a column vector

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

Add the top numbers: $2 + (-1) = 1$

Add the bottom numbers: $5 + 3 = 8$

Answer: $\begin{pmatrix} 1 \\ 8 \end{pmatrix}$

(b) $2\mathbf{a}$

Multiply both numbers by 2.

$$2 \times 2 = 4$$

$$2 \times 5 = 10$$

Answer: $\begin{pmatrix} 4 \\ 10 \end{pmatrix}$

(c) $\mathbf{a} - \mathbf{b}$

Subtract the top numbers: $2 - (-1) = 2 + 1 = 3$

Subtract the bottom numbers: $5 - 3 = 2$

Answer: $\begin{pmatrix} 3 \\ 2 \end{pmatrix}$

5 (2 marks)

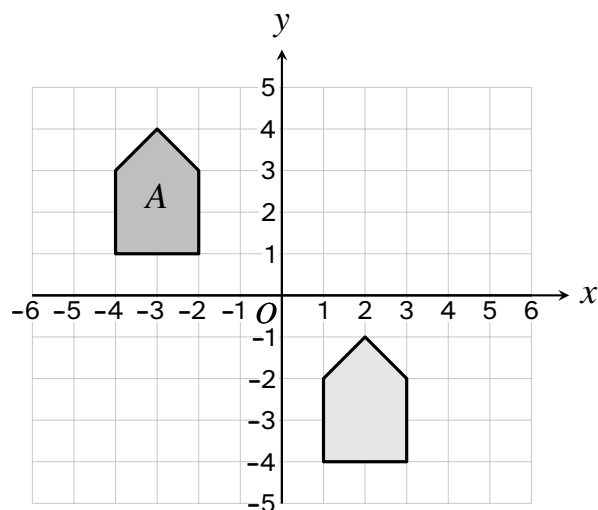
Translate shape A by the vector $\begin{pmatrix} 5 \\ -5 \end{pmatrix}$

The vector means 5 right and 5 down.

Move every vertex 5 squares right and 5 squares down.

For example, $(-4, 1) \rightarrow (1, -4)$

The image has vertices $(1, -4), (3, -4), (3, -2), (2, -1), (1, -2)$



Answer: $(1, -4), (3, -4), (3, -2), (2, -1), (1, -2)$

Marks: 2 marks for the correct image. 1 mark for a translation with one of the two movements correct.

6 (2 marks)

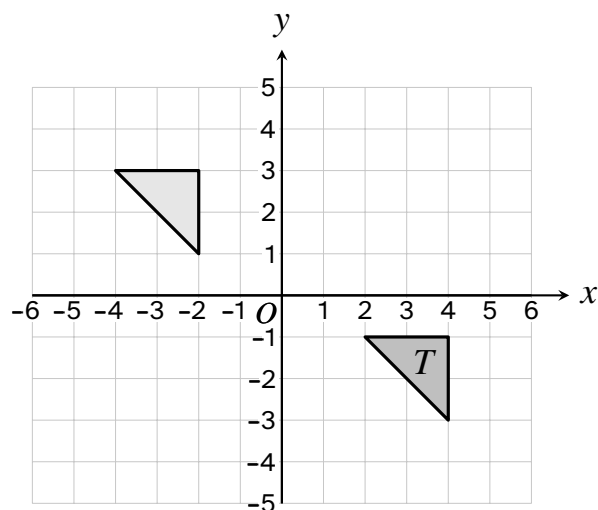
Translate triangle T by the vector $\begin{pmatrix} -6 \\ 4 \end{pmatrix}$

The vector means 6 left and 4 up.

Move every vertex 6 squares left and 4 squares up.

For example, $(4, -3) \rightarrow (-2, 1)$

The image has vertices $(-4, 3), (-2, 3), (-2, 1)$



Answer: $(-4, 3)$, $(-2, 3)$, $(-2, 1)$

Marks: 2 marks for the correct image. 1 mark for one of the two movements correct.

7 (2 marks)

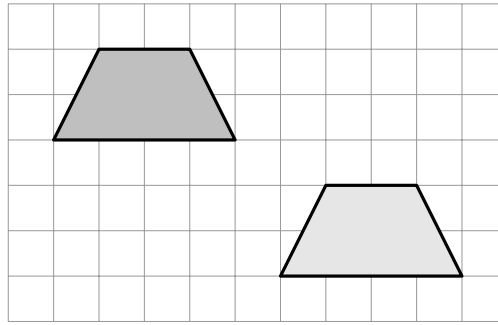
Here is a trapezium on a square grid.

Translate the trapezium 5 squares to the right and 3 squares down.

Move each corner 5 squares right and 3 squares down.

Join the new corners.

The shape must stay exactly the same size and the same way round.



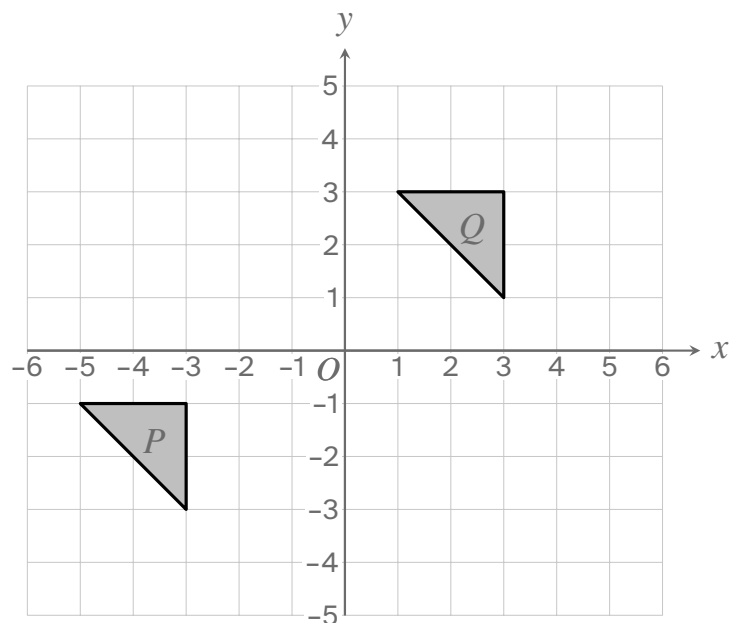
Answer: Trapezium drawn in the correct position

Tip: Count squares from a corner, not from the middle of the shape. A translation never changes the size or shape, so check the sloping sides still slope the same way.

Marks: 2 marks for the correct position. 1 mark for a correct move in one direction only, or for 3 right and 5 down.

8 (2 marks)

Work out the vector that translates triangle P to triangle Q .



Pick one vertex of P and find the matching vertex of Q .

$(-5, -1)$ on P moves to $(1, 3)$ on Q .

Across: $1 - (-5) = 6$, so 6 right.

Up: $3 - (-1) = 4$, so 4 up.

Answer: $\begin{pmatrix} 6 \\ 4 \end{pmatrix}$

Tip: Use the **same** corner on both shapes (for example, the top right corner of each). Using different corners gives the wrong vector.

Marks: 1 mark for each correct number in the vector.

9 (1 mark)

The vector $\begin{pmatrix} -3 \\ 7 \end{pmatrix}$ translates shape A to shape B .

Write down the vector that translates shape B to shape A .

A to B is 3 left and 7 up.

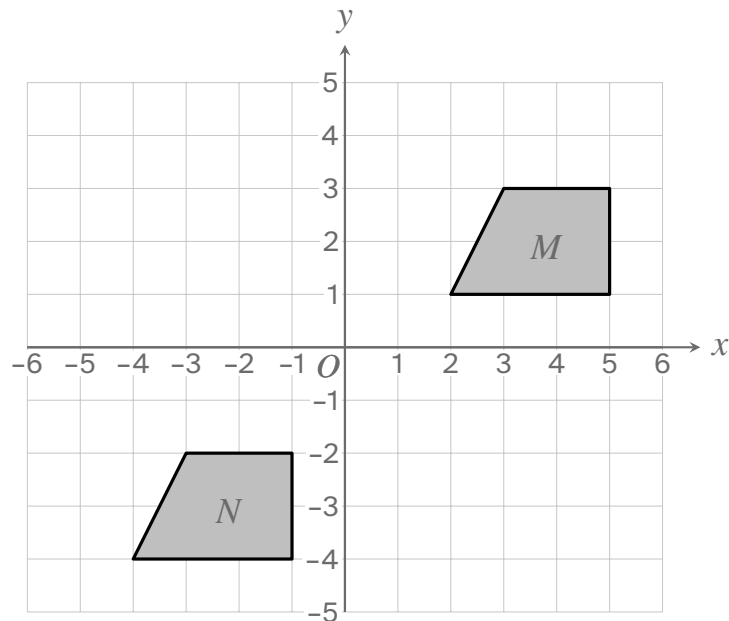
Going back from B to A reverses both movements: 3 right and 7 down.

Answer: $\begin{pmatrix} 3 \\ -7 \end{pmatrix}$

Tip: To reverse a vector, change the sign of **both** numbers. Do not swap the numbers round.

10 (2 marks)

Describe fully the single transformation that maps shape M onto shape N .



N is the same size, shape and way round as M , so it is a translation.

Follow one vertex: (2, 1) on M moves to (−4, −4) on N .

That is 6 left and 5 down.

Write this as a column vector.

Answer: Translation by the vector $\begin{pmatrix} -6 \\ -5 \end{pmatrix}$

Tip: Write the word “translation” as well as the vector. Give the movement as a column vector, not as coordinates or words like “moved across”.

Marks: 1 mark for the word translation. 1 mark for the vector $\begin{pmatrix} -6 \\ -5 \end{pmatrix}$. A vector on its own does not get the first mark.

11 (2 marks)

A triangle has a vertex at (2, 5)

The triangle is translated. The vertex moves to (−1, 7)

Write down the column vector of the translation.

Find the change in each coordinate: new minus old.

Across: $-1 - 2 = -3$

Up: $7 - 5 = 2$

Answer: $\begin{pmatrix} -3 \\ 2 \end{pmatrix}$

Marks: 1 mark for each correct number in the vector.

12 (2 marks)

Shape *A* is translated by the vector $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$ to give shape *B*.

Shape *B* is translated by the vector $\begin{pmatrix} -5 \\ 1 \end{pmatrix}$ to give shape *C*.

Write down the vector that translates shape *A* to shape *C*.

Doing one translation and then another is the same as adding the vectors.

Top: $2 + (-5) = -3$

Bottom: $-3 + 1 = -2$

Answer: $\begin{pmatrix} -3 \\ -2 \end{pmatrix}$

Marks: 1 mark for adding the two vectors, or for one correct number. 1 mark for the correct vector.
