# Translations

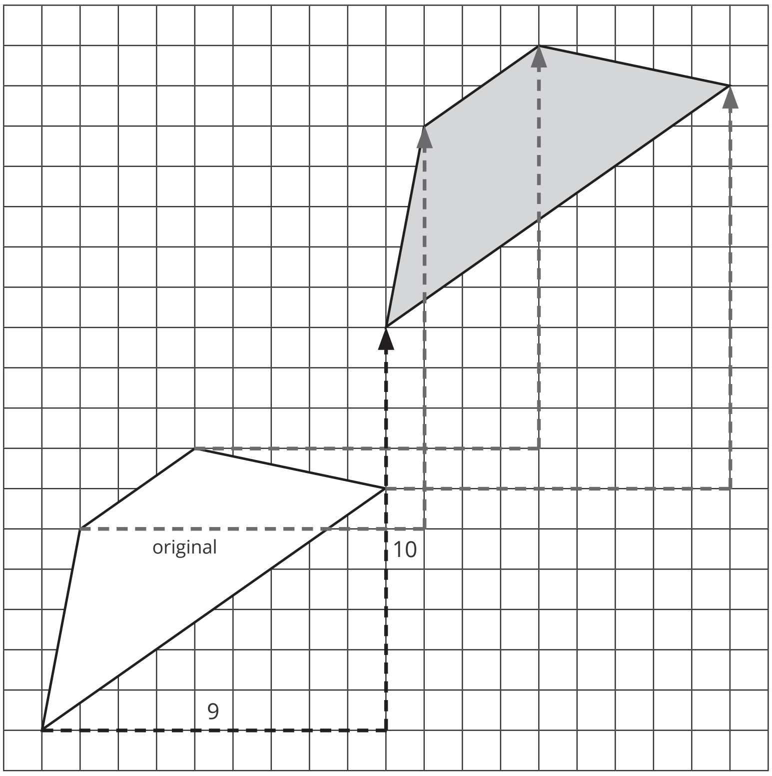
**Prior Knowledge:**

- How to read and write coordinates in 4 quadrants.

**Translation** is a type of transformation (along with reflection, rotation and enlargement).

If an object is **translated**, all the points are moved the **same distance** in the **same direction**.

Look at the diagram below. The original trapezium (in white) has been translated 9 spaces right and 10 spaces up.

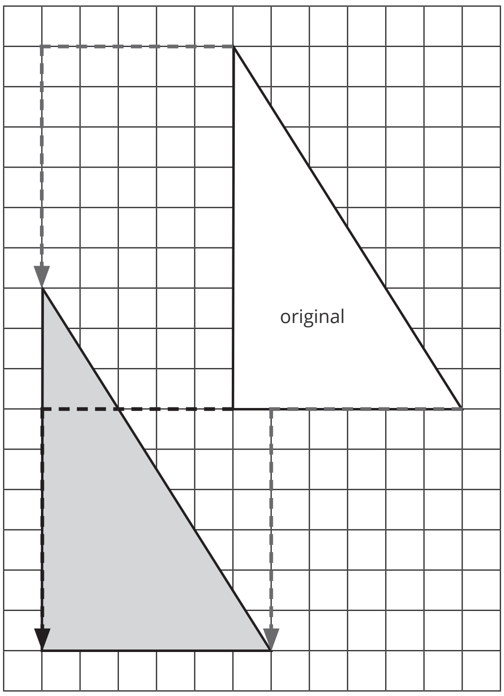



All points have moved 9 → 10 ↑

This translation is $\begin{pmatrix} 9 \\ 10 \end{pmatrix}$.

Translations are specified by distance and direction in a **vector**.

$\begin{pmatrix} \text{Units Right (+) or Left (–)} \\ \text{Units Up (+) or Down (–)} \end{pmatrix}$




The translated image is congruent to the orignal. This means the lengths of the sides and the angles have not changed.

All points have moved 5 ← 6 ↓

This translation is $\begin{pmatrix} -5 \\ -6 \end{pmatrix}$.

BEYOND MATHS

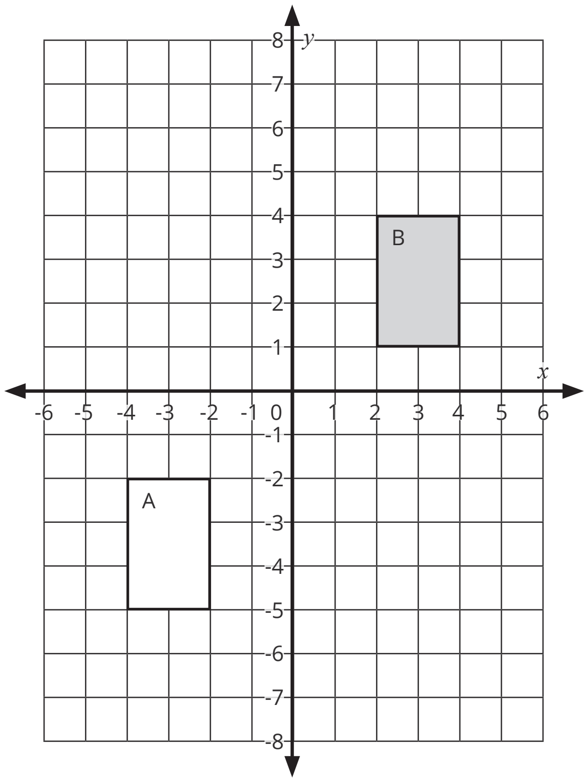
After your translation, a shape will be:

- the same shape and size;
- the same way around (orientation);
- in a different position.

Sometimes, you might be asked to fully describe a translation. This means you will need to write down the column vector which shows how one shape has moved (translated) to another.

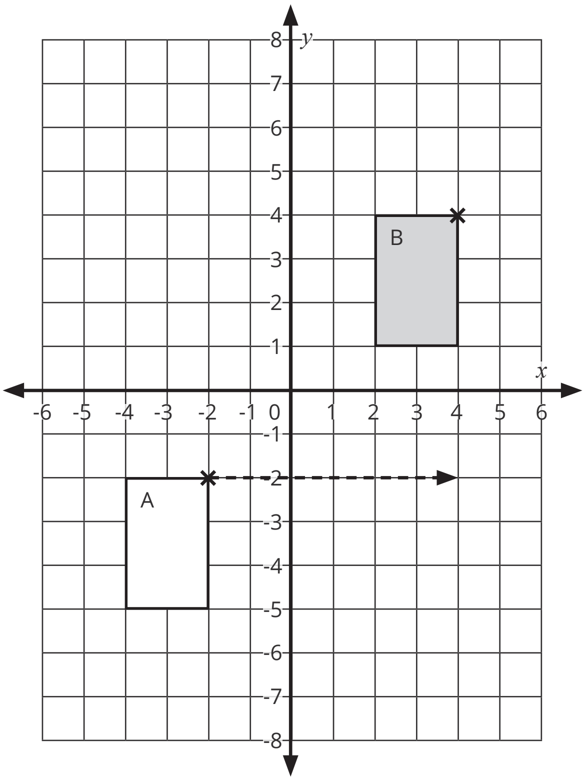
**Example 1**

Fully describe the translation that maps shape A onto shape B.

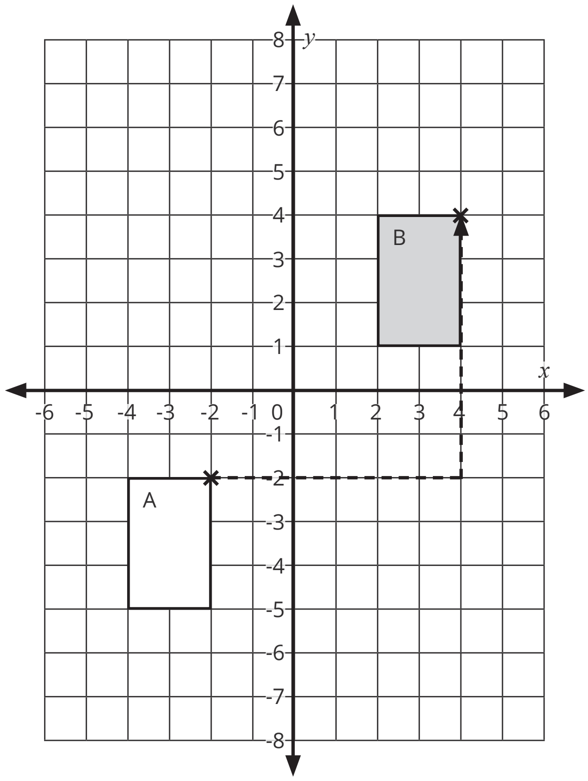



To answer this question, we need to work out how many units shape A has to move to get to shape B. We need to know how many units right (or left) and how many units up (or down). It helps to mark a corner to help our counting. Make sure you mark the same corner on each diagram.

BEYOND MATHS




In this case, the scale of the axes is in increments of 1. This means each space is worth 1, so shape A has moved 6 units to the right...




...and 6 units up.

For our final answer, we write this as a column vector.

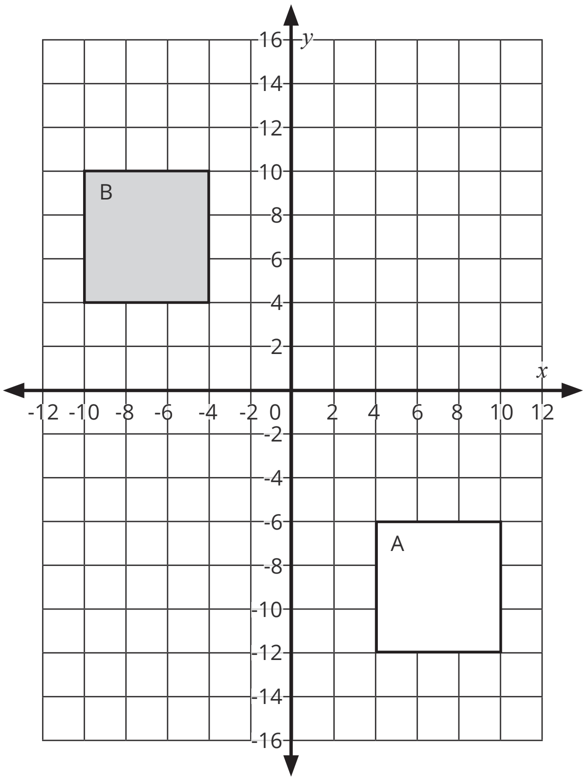
Remember: $\begin{pmatrix} \text{Units Right (+) or Left (–)} \\ \text{Units Up (+) or Down (–)} \end{pmatrix}$

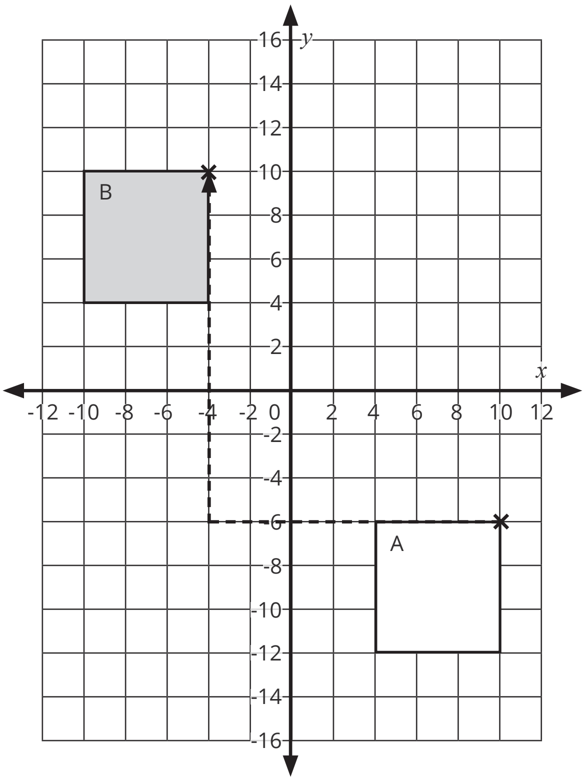
$$\begin{pmatrix} 6 \\ 6 \end{pmatrix}$$

BEYOND MATHS

**Example 2**

Fully describe the translation that maps shape A onto shape B.




Just like before, we need to work out the direction as well as the number of units that shape A has moved to get to shape B. This time, we can see that the scale on each axis is in increments of 2.

This means that, although shape A has been moved 7 units to the left, this represents a move of 14 units left (7 × 2 = 14).

Similarly, shape A has been moved 8 units up. This represents a move of 16 units (8 × 2 = 16).

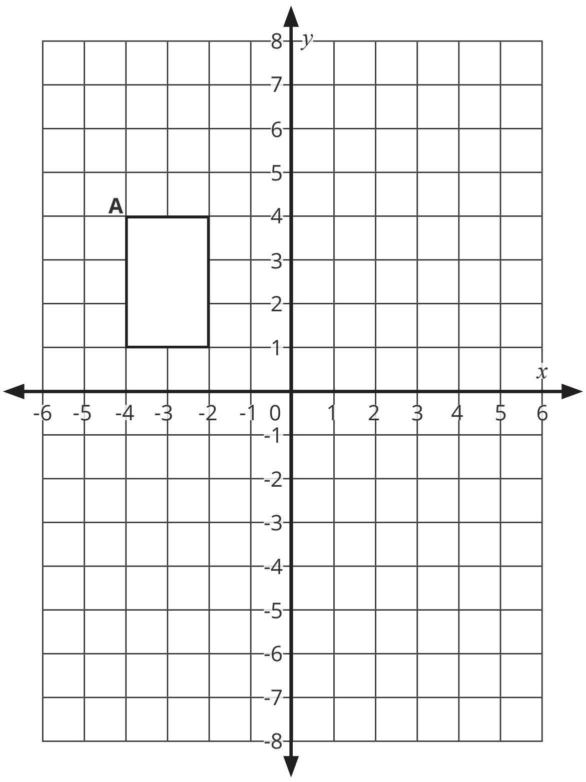
Remember: if a shape has moved to the left, we should place a - sign in front of the number.

$$\begin{pmatrix} -14 \\ 16 \end{pmatrix}$$

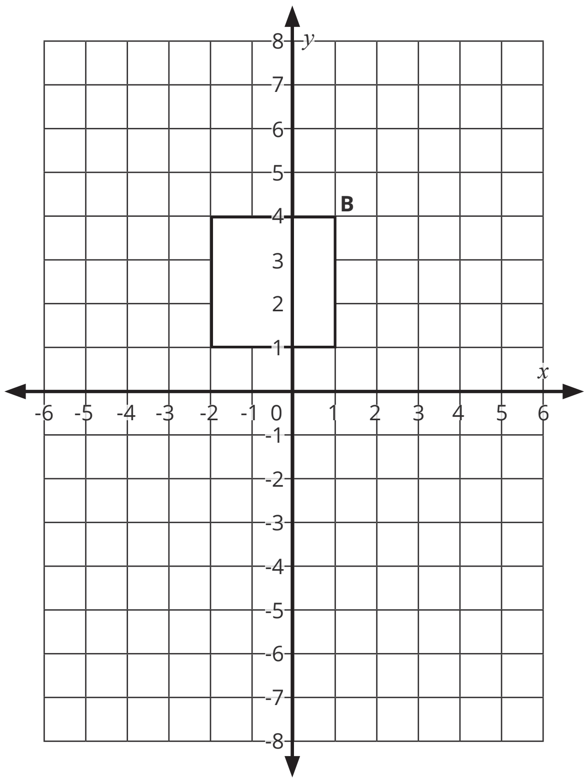
## Your Turn

1. Translate each shape by the given vector. Then, write down the new coordinates of the given point.

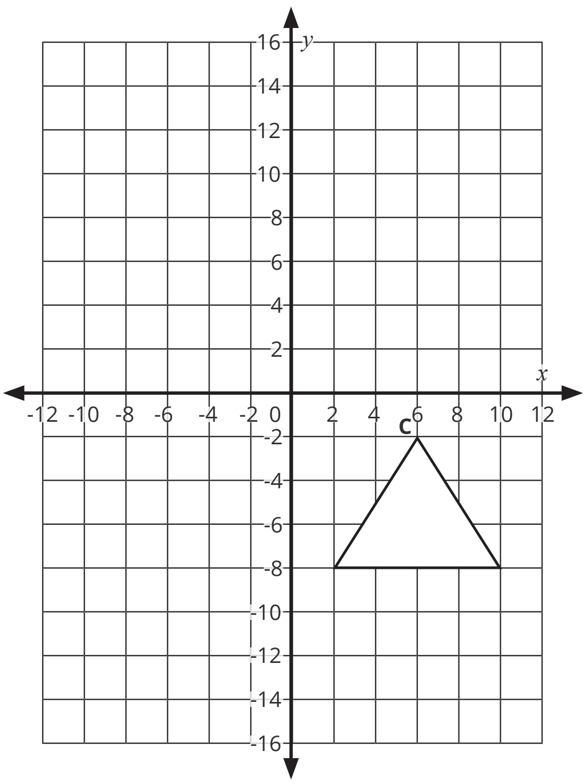
a. $\begin{pmatrix} 8 \\ -4 \end{pmatrix}$ ____________________



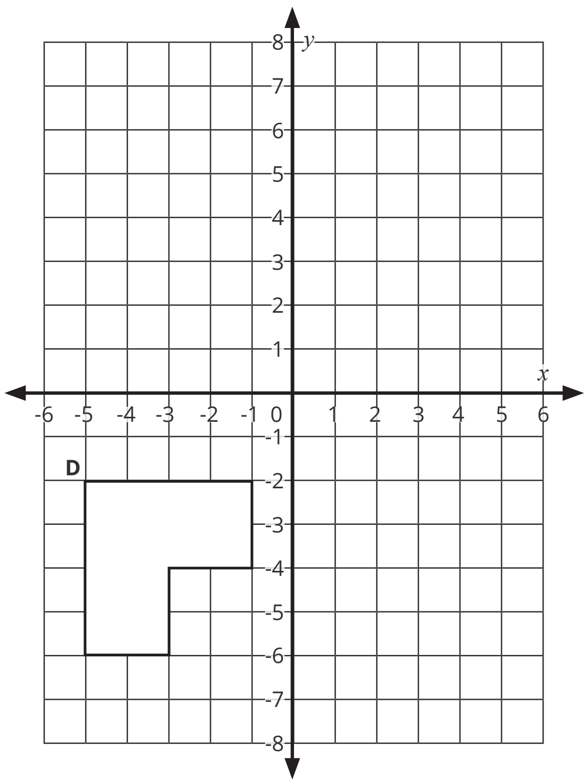

b. $\begin{pmatrix} -3 \\ -8 \end{pmatrix}$ ____________________




c. $\begin{pmatrix} -2 \\ 10 \end{pmatrix}$ ____________________

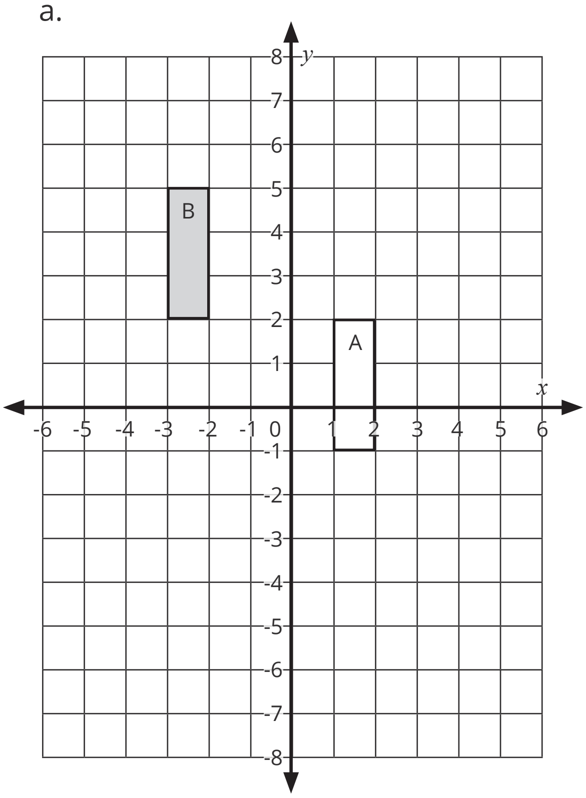



d. $\begin{pmatrix} 4 \\ 4 \end{pmatrix}$ ____________________

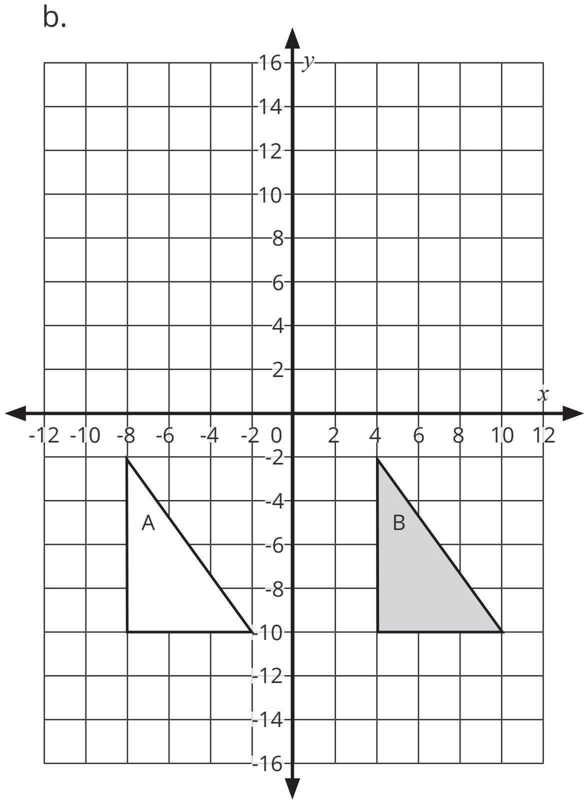


2. Fully describe each translation that maps shape A onto shape B.

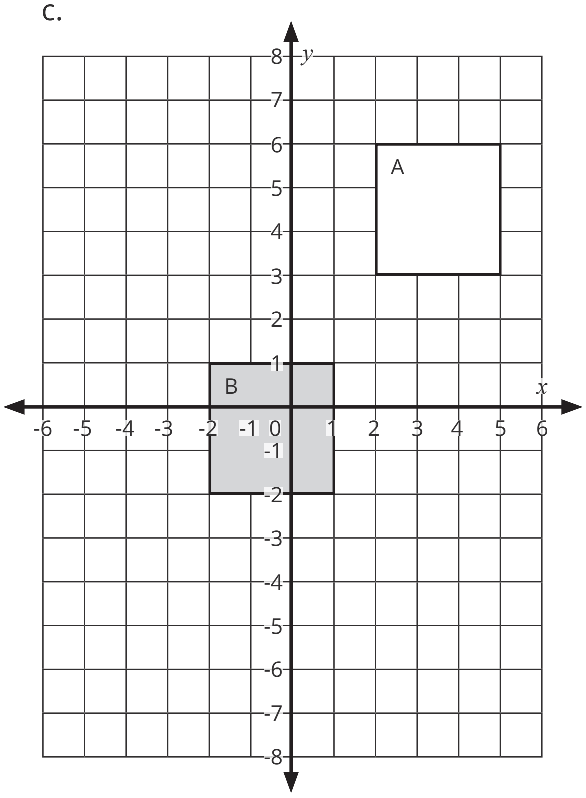
a.



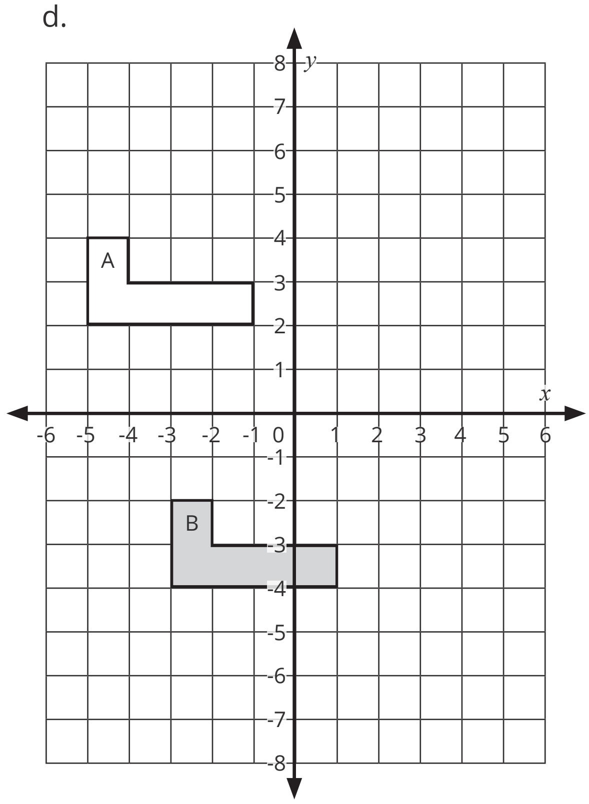

b.



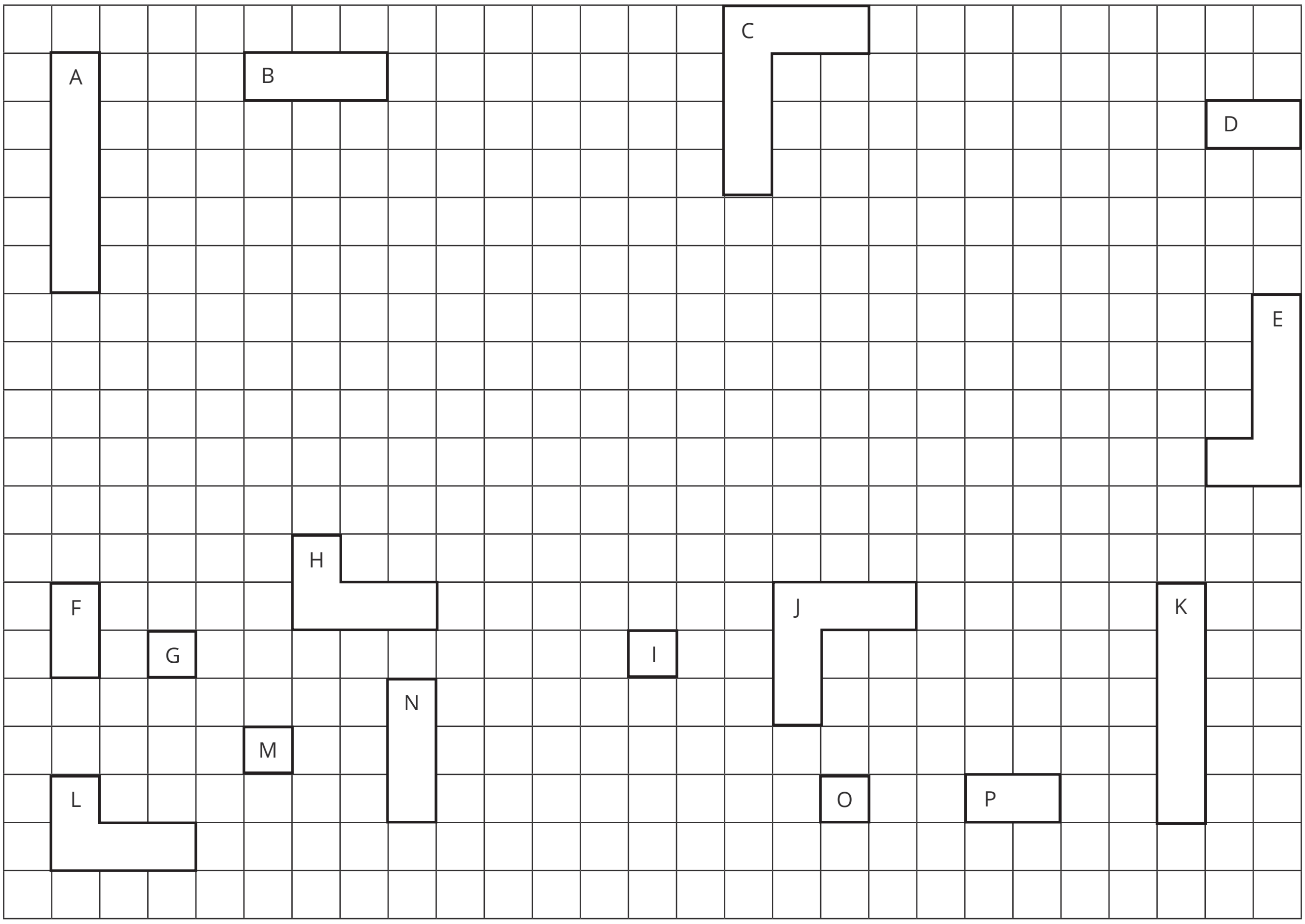

c.




d.



3. Translate each shape by the given vector. Once all the shapes have been translated, write down the word that the shapes have created.




a. $\begin{pmatrix} 12 \\ -3 \end{pmatrix}$

b. $\begin{pmatrix} -1 \\ -5 \end{pmatrix}$

c. $\begin{pmatrix} 6 \\ -4 \end{pmatrix}$

d. $\begin{pmatrix} -15 \\ -4 \end{pmatrix}$

e. $\begin{pmatrix} -3 \\ 1 \end{pmatrix}$

f. $\begin{pmatrix} 16 \\ 8 \end{pmatrix}$

g. $\begin{pmatrix} 0 \\ 9 \end{pmatrix}$

h. $\begin{pmatrix} 11 \\ 4 \end{pmatrix}$

i. $\begin{pmatrix} -10 \\ 5 \end{pmatrix}$

j. $\begin{pmatrix} -7 \\ 8 \end{pmatrix}$

k. $\begin{pmatrix} -17 \\ 8 \end{pmatrix}$

l. $\begin{pmatrix} 8 \\ 9 \end{pmatrix}$

m. $\begin{pmatrix} 12 \\ 9 \end{pmatrix}$

n. $\begin{pmatrix} -5 \\ 9 \end{pmatrix}$

o. $\begin{pmatrix} 4 \\ 8 \end{pmatrix}$

p. $\begin{pmatrix} -6 \\ 8 \end{pmatrix}$