

## Translations

### Starter

Reminder of **column vectors**:  $\begin{pmatrix} a \\ b \end{pmatrix}$

**Top** number is **horizontal** movement: if +ve  $\Rightarrow$  to the right if -ve  $\Rightarrow$  to the left.  
**Bottom** number is **vertical** movement: if +ve  $\Rightarrow$  up if -ve  $\Rightarrow$  down.

### 1. (Review of previous material)

State the new coordinates of the point  $P(3, -2)$  after it is translated under the vectors:

(a)  $\begin{pmatrix} 4 \\ 10 \end{pmatrix}$

(b)  $\begin{pmatrix} -5 \\ 8 \end{pmatrix}$

### 2. (Review of previous lesson)

State the vector that takes (a)  $(-6, 1)$  to  $(2, 7)$  (b)  $(5, 1)$  to  $(12, -8)$

### Notes

There are 4 types of transformations that change the size, position and/or orientation (any type of flipping over or rotation) of a shape.

What changes for each transformation?

Translation — changes position

Reflection — changes position and orientation

Rotation — changes position and orientation

Enlargement — changes position, size and possible orientation

**N.B.** The **original shape** is called the **object**  
The **transformed shape** is called the **image**.

### Translations

Translations are described by **column vectors**:  $\begin{pmatrix} a \\ b \end{pmatrix}$ .

$\begin{pmatrix} -3 \\ 2 \end{pmatrix}$  means “3 units **left** (because it is **negative**) and 2 units **up** (because it is **positive**)”

### How to translate shapes

Each point on the shape is translated by the stated column vector to its new position.

1. Select a vertex (corner) of the shape and translate it by the given column vector.
2. Repeat step 1 for the other vertices of the shape
3. Join up the new vertices to form the image.

### How to describe a translation

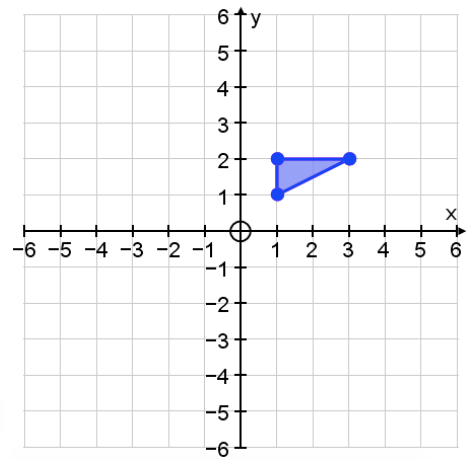
We describe a translation by stating the column vector.

1. Draw a line from one point on the object to the **corresponding** point (i.e. the same point) on the image — make sure you put an arrow on the line to show direction from object to image. This is the vector we need to describe.
2. Describe the drawn vector from 1 using a column vector.

**E.g. 1** Translating a shape: draw the translation of the blue triangle under these vectors

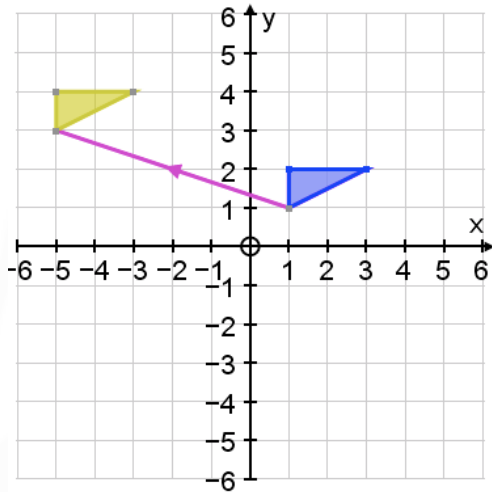
(a)  $\begin{pmatrix} -6 \\ 2 \end{pmatrix}$

(b)  $\begin{pmatrix} 3 \\ -4 \end{pmatrix}$



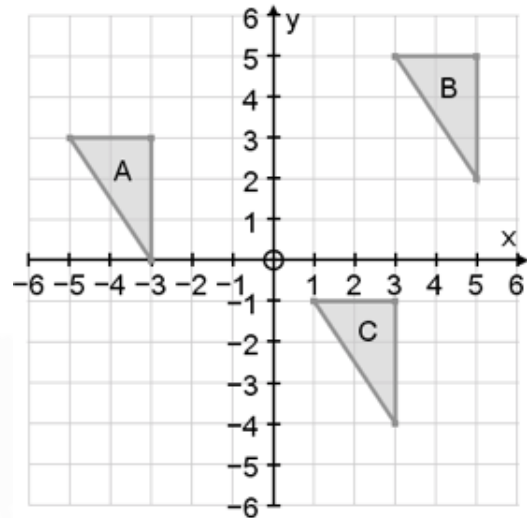
**Working:** Make sure you include the direction of the vector.  
The blue triangle is the object and the yellow triangle is the image.

(a) The pink line is the vector  $\begin{pmatrix} -6 \\ 2 \end{pmatrix}$



**E.g. 2** Write down the column vector that transforms:

- (a)  $A$  to  $B$
- (b)  $C$  to  $B$
- (c)  $A$  to  $C$
- (d)  $C$  to  $A$



What do you notice about your answers to (c) and (d)?

**Working:** (a) Draw a line between corresponding points on  $A$  and  $B$ , say  $(-3, 0)$  and  $(5, 2)$ .  
 Draw an arrow on the line to show direction — in this case, the arrow should point from  $A$  to  $B$ .  
 Describe the vector using a column vector.

Answer =  $\begin{pmatrix} 8 \\ 2 \end{pmatrix}$  i.e. the vector goes 8 to the right and 2 up.

**Video:** [Translations 1](#)  
**Video:** [Translations 2](#)

[Solutions to Starter and E.g.s](#)

**Exercise**

- 9-1 class textbook: p278 M9.3 Qu 1-2
- A\*-G class textbook: p237 M9.3 Qu 1-3
- 9-1 homework book: p95 M9.3 Qu 1-2
- A\*-G homework book: p67 M9.3 Qu 1-2

**Summary**

The **original shape** is called the **object**  
 The **transformed shape** is called the **image**.

Translations are described by **column vectors**:  $\begin{pmatrix} a \\ b \end{pmatrix}$ .

**Top** number is **horizontal** movement: if +ve  $\Rightarrow$  to the right if -ve  $\Rightarrow$  to the left.  
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**How to translate shapes**

1. Select a vertex (corner) of the shape and translate it by the given column vector.
2. Repeat step 1 for the other vertices of the shape
3. Join up the new vertices to form the image.

**How to describe a translation**

We describe a translation by stating the column vector.

1. Draw a line from one point on the object to the **corresponding** point (i.e. the same point) on the image — make sure you put an arrow on the line to show direction from object to image. This is the vector we need to describe.
2. Describe the drawn vector from 1 using a column vector.