Summer Block 2

Position and direction

White Rose MATHS

Small steps

Step 1	The first quadrant
Step 2	Read and plot points in four quadrants
Step 3	Solve problems with coordinates
Step 4	Translations
Step 5	Reflections

The first quadrant

Notes and guidance

Children were first introduced to a coordinate grid in Year 4. That learning is revisited in this small step, with children looking at the first quadrant, where both the x- and y-coordinates are positive.

Begin by recapping what the coordinate grid is and the names of the two axes, x and y. Then consider points on the grid. Discuss how children can find the coordinates for a given point, reading the first value on the x-axis and the second value on the y-axis. Children then move on to plotting points with given coordinates. Ensure that children understand the importance of the order of the values.

Children draw shapes on a coordinate grid, suggesting possible coordinates for vertices of different shapes. Finally, they solve problems in the first quadrant without the support of grid lines, using given coordinate information to find the coordinates of other points.

Things to look out for

- Children may confuse the x- and y-values of the coordinates and read or plot them in the wrong order.
- Children may think a coordinate refers to a square on the grid rather than a single point.

Key questions

- What is a coordinate grid?
- What is the name of the horizontal/vertical axis?
- What are the coordinates of this point?
- Which axis do you look at first when finding the coordinates of a point?
- Where does the point _____ go on the grid?
- What do you notice about all the points that are on a horizontal/vertical line?
- How can you work out the missing coordinate(s)?

Possible sentence stems

- The first value in a pair of coordinates is for the _____-axis and the second value is for the _____-axis.
- The x-coordinate of the point is _____ and the y-coordinate is _____
  The point is (_____, _____).

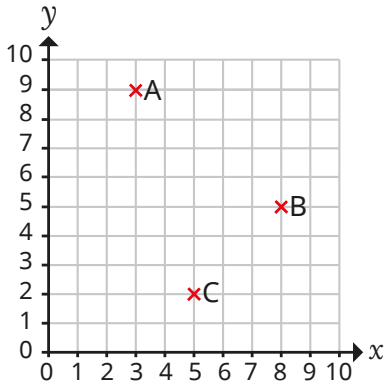
National Curriculum links

- Describe positions on the full coordinate grid (all four quadrants)

The first quadrant

Key learning

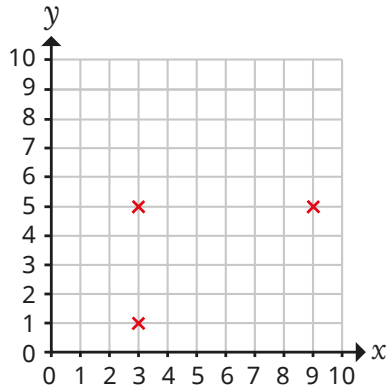
- Here is a coordinate grid.



  - What are the coordinates of the points A, B and C?
  - Plot points D, E and F on the grid.

D (1, 5)	E (5, 5)	F (0, 8)

- Tommy is drawing a rectangle on a coordinate grid.



Find the coordinates of the fourth vertex of the rectangle.

- Plot the points (7, 1), (7, 4) and (10, 1) on a coordinate grid.

  Join the points to form a polygon.

  What polygon have you drawn?

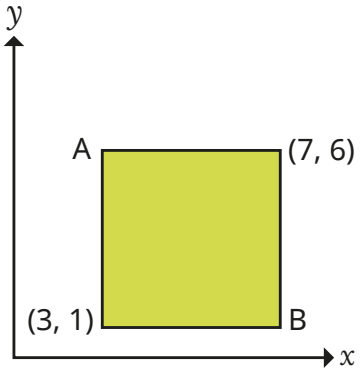
- Plot four points on a coordinate grid to make a square.

  What are the coordinates of the vertices?

  What patterns can you see?

  How do you know that the shape is a square?

- The diagram shows the coordinates of two vertices of a rectangle.

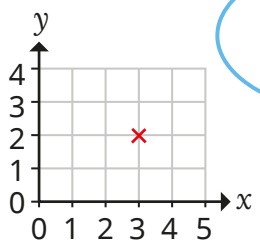


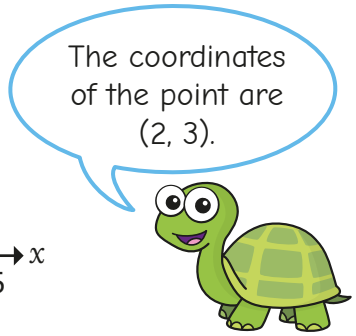
What are the coordinates of the other two vertices?

How did you work out the coordinates?

The first quadrant

Reasoning and problem solving



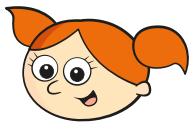


Do you agree with Tiny?

Explain your answer.

No

(2, 2) (3, 3) (7, 7)



Alex thinks that when she joins these points, they will make a straight line.

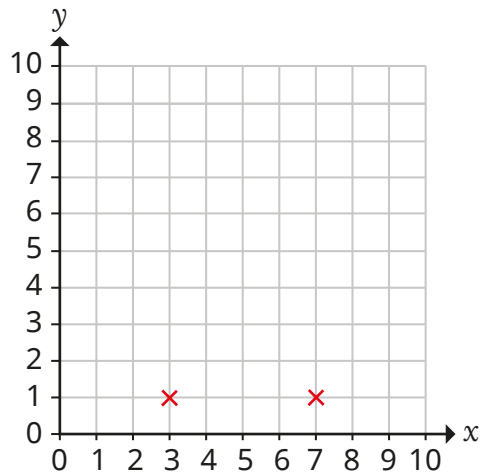
Do you agree with Alex?

Explain your answer.

Yes

Huan wants to draw an isosceles triangle on the coordinate grid.

He has already plotted the points for two of the vertices.



What could the coordinates of the third vertex be?

How many different answers can you find?

(5, a), where a is not equal to 1

(3, 5)

(7, 5)

Read and plot points in four quadrants

Notes and guidance

In this small step, children extend their understanding of the coordinate grid to include all four quadrants. It may be helpful to refer to these as the first (top-right), second (top-left), third (bottom-left) and fourth (bottom-right) quadrants.

Show children that the x- and y-axes can both be extended through zero into negative numbers. Children plot points in each of the "new" quadrants in turn. Model that the process is the same as for the first quadrant, and emphasise that the axes behave in the same way as number lines with positive and negative numbers, which children are already familiar with. Children should recognise the pattern of positive and negative coordinates that belong in each quadrant.

When children are comfortable with points in each of the quadrants, they move on to drawing shapes in the coordinate grid, using all of the quadrants. Finally, they determine which quadrant a point with given coordinates is in, without the use of a grid to support them.

Things to look out for

- Children may confuse the x- and y-values of the coordinates and read or plot them in the wrong order.
- Children may ignore or omit the negative sign.

Key questions

- Which axis do you look at first when finding the coordinates of a point?
- What are the coordinates of the point?
- What are the coordinates of the vertices of the shape?
- Where does the point _____ go on the grid?
- How do you know if the x-value/y-value is positive or negative?
- What do you notice about the coordinates in the first/second/third/fourth quadrant?

Possible sentence stems

- The first value in a pair of coordinates is for the _____-axis and the second value is for the _____-axis.
- The x-coordinate of the point is _____ and the y-coordinate is _____. The point is (_____, _____).
- The x-coordinate of a point in the _____ quadrant is _____
- The y-coordinate of a point in the _____ quadrant is _____

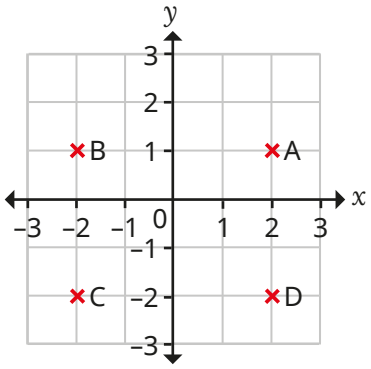
National Curriculum links

- Describe positions on the full coordinate grid (all four quadrants)

Read and plot points in four quadrants

Key learning

- What are the coordinates of the four points?



How did you work them out?

Compare answers with a partner.

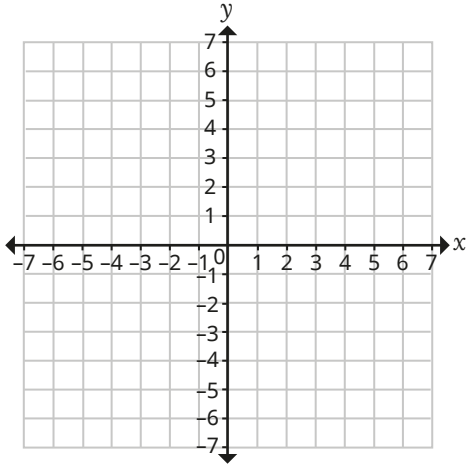
- Plot and label the points on the grid.

D (4, 5)

E (–3, 2)

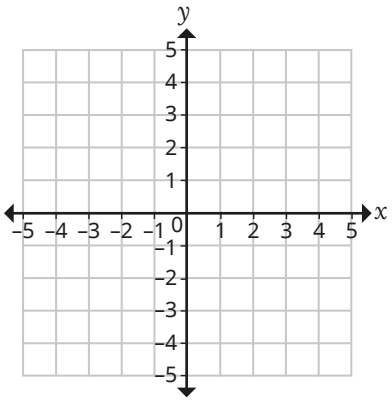
F (6, –5)

G (–1, –7)



- Draw a polygon with vertices at (–2, 2), (–4, 2), (–4, –2) and (–2, –3).

What is the mathematical name of the shape?

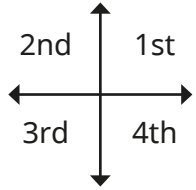


- Draw a coordinate grid with each axis from –5 to 5

Draw a square with a vertex in each quadrant.

Write the coordinates of the vertices.

- Write the coordinates of four points, one in each quadrant.



- Without plotting points P, Q, R and S, describe which quadrant each point is in.

P (–8, 3)

Q (8, –3)

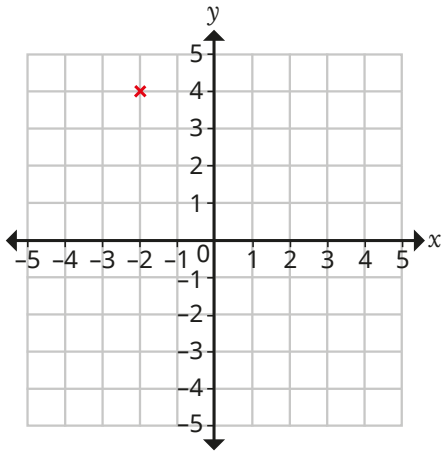
R (8, 3)

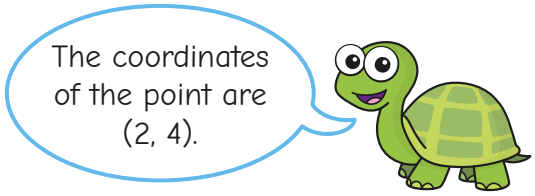
S (–8, –3)

Read and plot points in four quadrants

Reasoning and problem solving

A point is plotted on a coordinate grid.



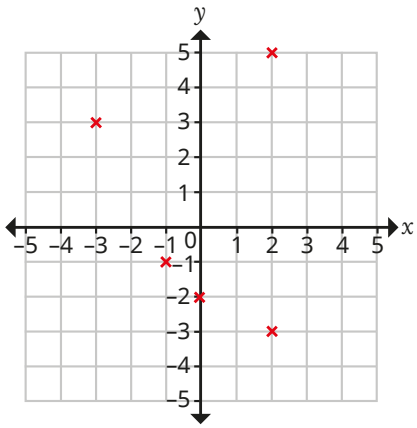


Do you agree with Tiny?

Explain your answer.

No

Amir plots five points on a grid and writes their coordinates.



(2, −5) (3, −3) (−1, −1)
(−2) (2, −3)

Mark Amir's work and make any corrections necessary.

Discuss with a partner what mistakes Amir might have made and why he might have made them.

(2, −5) ✘ (2, 5)

(3, −3) ✘ (−3, 3)

(−1, −1) ✔

(−2) ✘ (0, −2)

(2, −3) ✔

Solve problems with coordinates

Notes and guidance

In this small step, children use their knowledge of coordinates in four quadrants to solve problems, such as working out the coordinates of vertices of polygons.

Children need to be secure in reading and plotting coordinates in all four quadrants. They consider horizontal and vertical lines that go through a known coordinate, using the fact that if they know the x-coordinate of a point on a vertical line, then every point on that line will have the same x-coordinate. Similarly, every point on a horizontal line will have the same y-coordinate. Children then use this information to help find missing coordinates on shapes, both on grids with gridlines and on those without. Finally, they use the properties of shapes to solve problems on coordinate grids, for example using the fact that the opposite sides of a rectangle are equal in length.

Things to look out for

- Some children may need the support of gridlines to work out the coordinates of a point.
- If children confuse the x- and y-values of the coordinates of a point, then coordinates derived from this point will also be incorrect.

Key questions

- Which axis do you look at first when finding the coordinates of a point?
- What do you know about the coordinates of all points on the x-axis/y-axis?
- If you know the coordinates of a point, what do you know about the coordinates of a point that lies on the vertical/horizontal line that passes through the point?
- How can you use the coordinates of these two vertices to work out the coordinates of the other vertices?

Possible sentence stems

- On a horizonal line, the _____-value of the coordinates of any point will remain the same.
- On a vertical line, the _____-value of the coordinates of any point will remain the same.
- If the x-/y-coordinate of the vertex is _____, I know that the x-/y-coordinate of the other vertex must be _____

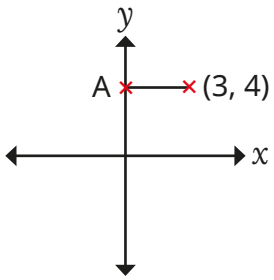
National Curriculum links

- Describe positions on the full coordinate grid (all four quadrants)

Solve problems with coordinates

Key learning

- A horizontal line is drawn between two coordinates on a grid.



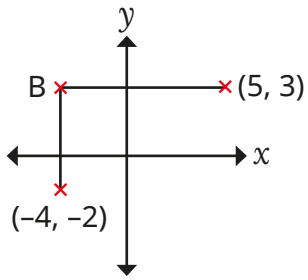
What are the coordinates of point A?

How do you know?

- A horizontal line goes through (5, 3).

A vertical line goes through (–4, –2).

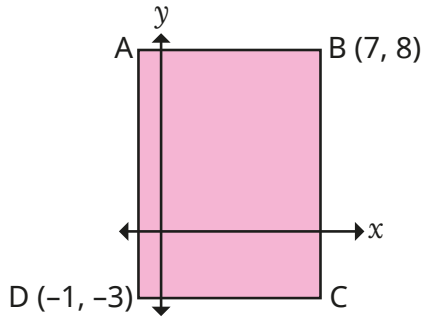
The horizontal line meets the vertical line at point B.



What are the coordinates of point B?

How did you find the coordinates?

- ABCD is a rectangle.

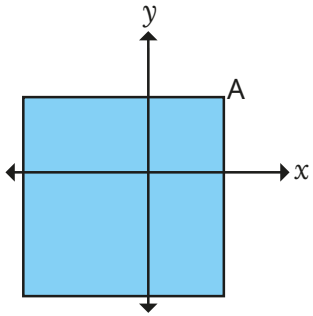


Work out the coordinates of A and C.

- A square has been drawn on a coordinate grid.

The square has a perimeter of 20 units.

Vertex A is at (2, 2).



What are the coordinates of the other three vertices of the square?

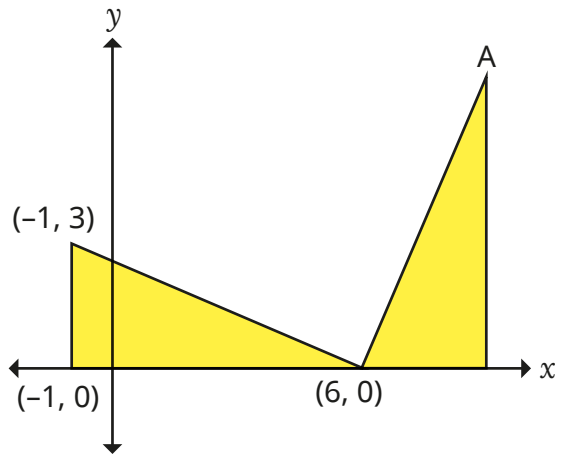
Solve problems with coordinates

Reasoning and problem solving

The diagram shows two identical triangles.

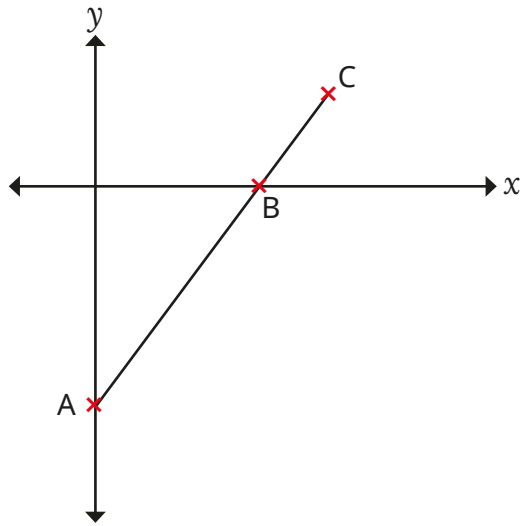
The coordinates of three points are shown.

Work out the coordinates of A.



(9, 7)

ABC is a straight line.



A is the point (0, –10).

B is the point (8, 0).

The distance from A to B is two-thirds of the distance from A to C.

Work out the coordinates of C.

(12, 5)

Translations

Notes and guidance

Now that children have a good understanding of coordinates in all four quadrants, in this small step they move on to translating points and shapes on a coordinate grid. They first experienced translation on a coordinate grid in Year 4, and that learning is now extended to translate in all four quadrants.

Begin by recapping that translating points means to move them. Look first at translations in one direction, either left/right or up/down, before moving on to translations in both directions. Once children have recapped translating single points on a grid, they explore translating shapes, applying the same translation to each vertex of the shape. They should see that the shape looks identical after being translated, but is in a different position on the coordinate grid. Give children opportunities to describe translations as well as perform them. Encourage children to explore the effect of translations on the coordinates.

Things to look out for

- Children may look at the gap between shapes, instead of how far a specific vertex has been translated.
- Children may not give the direction of the translation and/or confuse left and right.
- Children may confuse translation and reflection.

Key questions

- What does "translation" mean?
- How can you translate a point?
- What will the shape look like when it has been translated?
- Which point on the shape will you translate first?
- Will each vertex on a shape be translated in the same way?
- How can you describe the translation?

Possible sentence stems

- Shape A has been translated _____ squares to the right/left and _____ squares up/down.
- (_____, _____) translated _____ squares to the right/left is (_____, _____).
- (_____, _____) translated _____ squares up/down is (_____, _____).

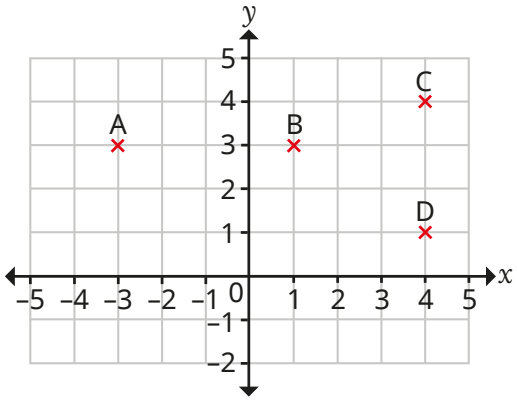
National Curriculum links

- Draw and translate simple shapes on the coordinate plane, and reflect them in the axes

Translations

Key learning

- Four points have been marked on a grid.



The translation from point A to point B is 4 squares to the right.

What is the translation from point C to point D?

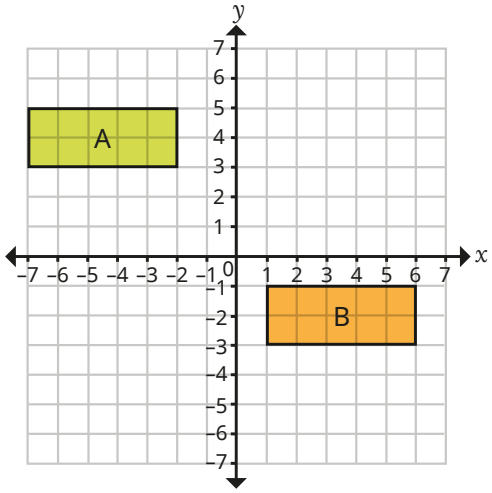
The translation from point B to point D is 3 squares to the right and 2 squares down.

What is the translation from point D to point A?

- Point C is translated 3 squares to the left and 2 squares down.

  What are the coordinates of the new point?

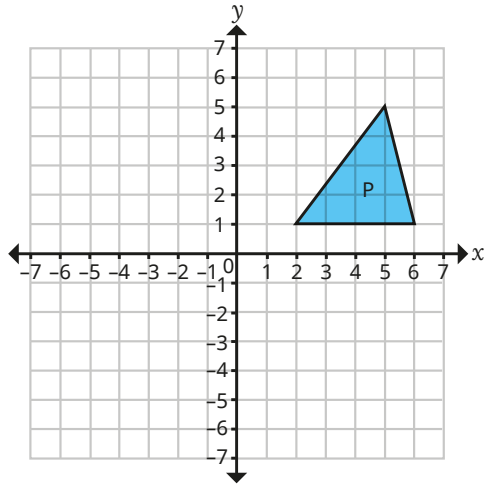
- Describe the translation from shape A to shape B.



What do you notice about shapes A and B?

- Triangle P is translated 6 squares to the left and 3 squares down.

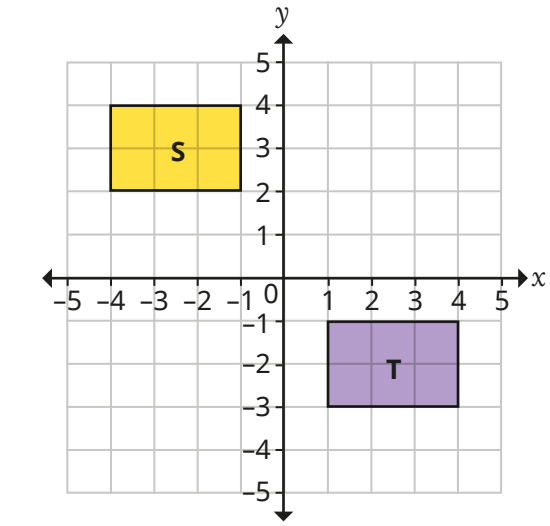
  Draw the new position of the triangle and label it Q.

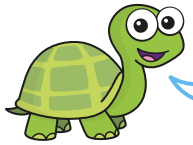


What do you notice about triangles P and Q?

Translations

Reasoning and problem solving





Rectangle S has been translated 2 squares to the right and 3 squares down to give rectangle T.

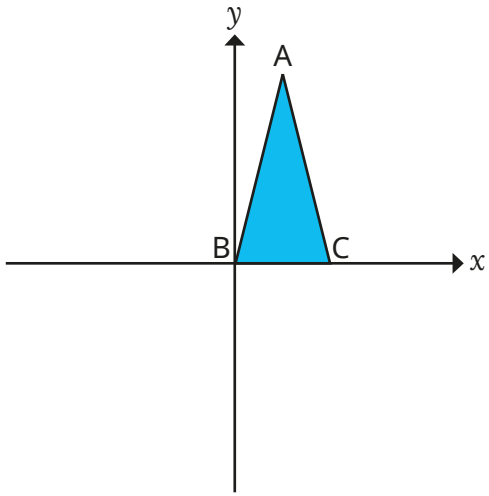
Do you agree with Tiny?

Explain your answer.

No

An isosceles triangle is drawn on a coordinate grid.

Vertex A has the coordinates (2, 5) and vertex B is at (0, 0).



The triangle is translated 4 to the right and 6 down.

What are the new coordinates of vertex C?

(8, −6)

Reflections

Notes and guidance

Children reflected shapes in the first quadrant of coordinate grids in Year 5, both with gridlines and without, using lines parallel to the x- or y-axis. In this small step, that learning is revisited and extended to include reflections across all four quadrants.

It can be useful to use mirrors to explore reflection and to see that a reflected image looks identical to the original image, but faces the opposite direction. Start with reflecting points and shapes on a coordinate grid in the x- or y-axis. Children should count how far away each vertex is from the axis and use this to work out the coordinates of each vertex in the reflected shape. They could then be stretched to reflect shapes in lines that are parallel to each axis. This should be done both with gridlines and without, giving children the opportunity to work out reflections both by counting squares and by calculation.

Things to look out for

- Children may confuse translation and reflection.
- Children may draw the reflection of a shape in the same orientation as the original shape.
- Children may miscount the distances to/from the mirror line.

Key questions

- How is reflecting similar to translating? How is it different?
- How does reflecting one vertex at a time make it easier to reflect the whole shape?
- How far away is the vertex from the mirror line? How far away does the corresponding vertex need to be from the mirror line?
- How can you check if the reflected shape looks like it is in the correct place?
- Does the reflection of a shape always, sometimes or never face the same way as the original shape?

Possible sentence stems

- Shape _____ has been reflected in the _____-axis.
- The vertex is _____ squares away from the mirror line, so the corresponding vertex also needs to be _____ squares away from the mirror line.

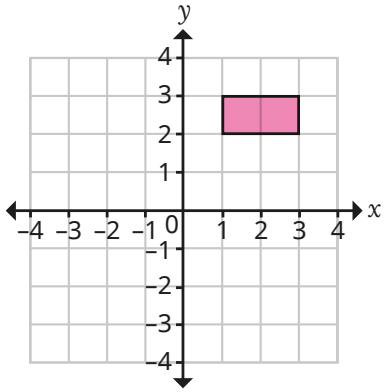
National Curriculum links

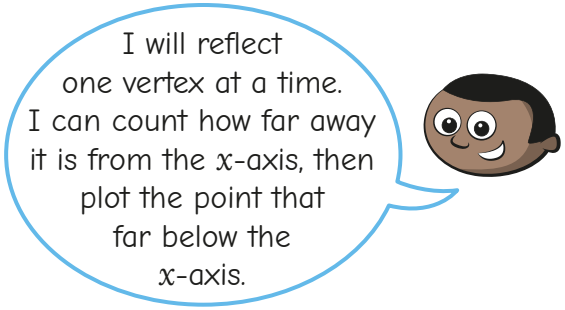
- Draw and translate simple shapes on the coordinate plane, and reflect them in the axes

Reflections

Key learning

- Mo is reflecting this rectangle in the x-axis.





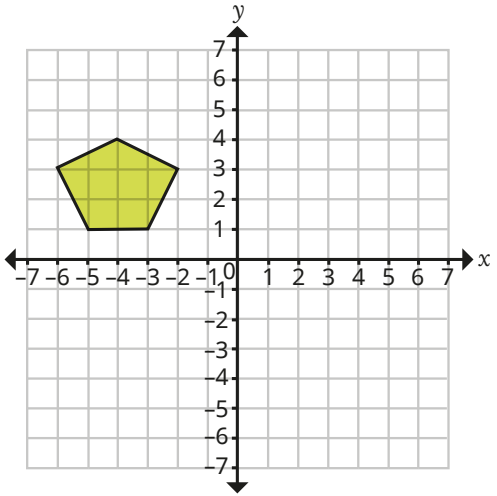
Use Mo's method to complete the reflection.

What are the coordinates of each vertex of the reflected rectangle?

What do you notice?

- Reflect this shape in the x-axis and in the y-axis.

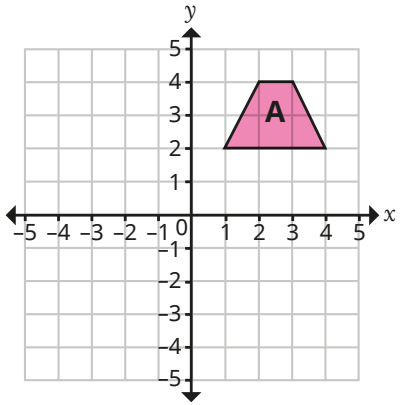
What do you notice about the reflections?



- Reflect trapezium A in the x-axis. Label the new trapezium B.

Reflect trapezium B in the y-axis. Label the new trapezium C.

Complete the table with the coordinates of the vertices of each shape.

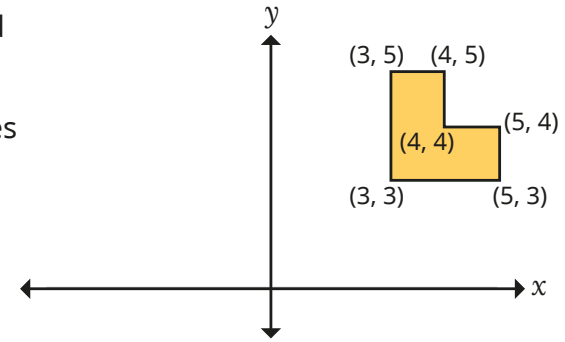


A	B	C
(1, 2)		
(4, 2)		
(3, 4)		
(2, 4)		

What do you notice?

- The hexagon is reflected in the y-axis.

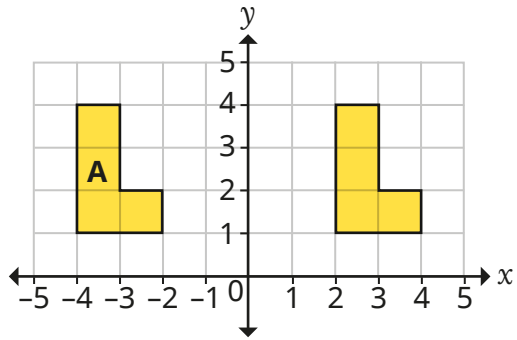
Work out the coordinates of the vertices of the reflected shape.



Reflections

Reasoning and problem solving

Tiny is reflecting shapes.

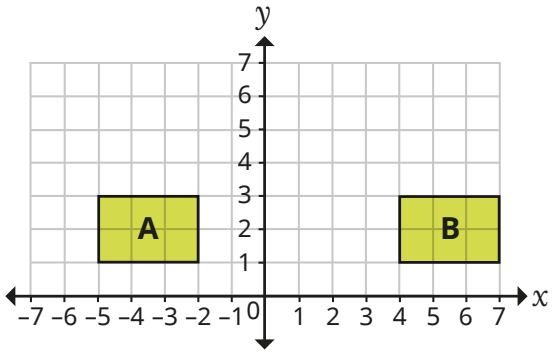


Do you agree with Tiny?

Explain your answer.

No

Shapes A and B are on a coordinate grid.



Whitney

Shape A has been translated.

Shape A has been reflected.

Teddy

Who is correct?

Explain your answer.

Both could be correct.

Shape A could have been reflected in the vertical line through (1, 0) or translated 9 squares to the right.