



THIRD SPACE
LEARNING

GCSE Maths Intervention Pack

Performing Transformations
of Shapes

Grade 3

Teacher Notes

Question Sets

Set 1: Reflecting Shapes

Reflect 2D polygons in a set of coordinate axes.

Key words: Horizontal, line of reflection, perpendicular, reflect, reflection, vertical, x -axis, y -axis

Set 2: Rotating Shapes

Rotate 2D polygons in a set of coordinate axes.

Key words: Angle of rotation, anticlockwise, centre of rotation, clockwise, degrees, direction

Set 3: Enlarging Shapes

Enlarge 2D polygons in a set of coordinate axes.

Key words: centre of enlargement, projection lines, scale factor

Set 4: Translating Shapes

Translate 2D polygons in a set of coordinate axes.

Key words: Column vector, direction, movement, negative, positive



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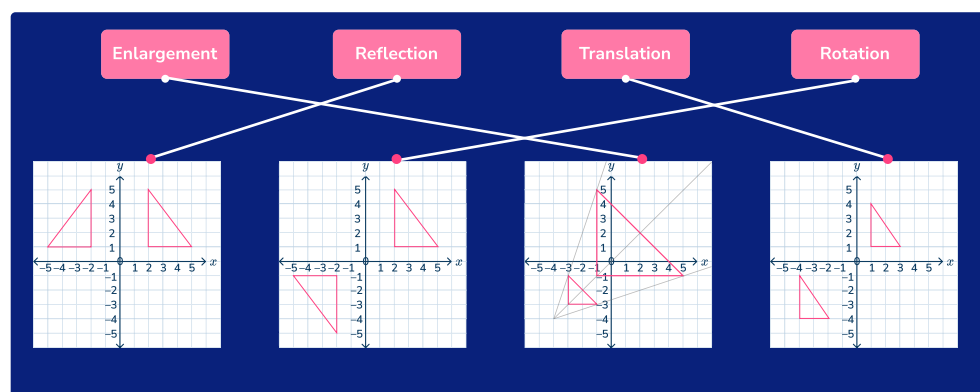
Gabriel Ogbeifun,
Head of Mathematics, Regent High School

Slide 1: Cover Slide

Teaching Prompts

- Which shape has changed in size?
- Which shape has been flipped in a mirror line?
- Which shape has been moved without changing the size or orientation of the shape?
- Which shape has been turned around a fixed point?

Answers



Teacher Reference Only

Common Misconceptions

- Students reflect the shape in the wrong line of reflection.
- The reflected shape is bigger or smaller than the original shape.
- Students rotate the shape around the wrong centre of rotation.
- The rotated shape is bigger or smaller than the original shape.
- Some students only enlarge a shape by a scale factor of 2.
- The shape is not enlarged from the centre of enlargement.
- Students do not enlarge each projected vertex correctly.
- Students think an enlargement can only make a shape bigger.
- The shape is in the correct orientation and size but is in the incorrect location.
- Students confuse the top and bottom numbers of a column vector resulting in an incorrect movement.
- Students forget to use a centre of rotation to rotate a shape or a centre of enlargement to enlarge a shape.
- Students mix up the transformations.

Slide 1: Cover Slide

Terminology

- **Reflection:** A shape is reflected in a line of reflection to produce a mirror image of the original.
- **Rotation:** A shape is turned a certain angle about the centre of rotation in a given direction.
- **Enlargement:** A shape's size is altered given a scale factor and the location of the centre of enlargement. An enlargement can be smaller than the original.
- **Translation:** A shape is moved left / right / up / or down given the column vector.

Slide 2: Try this exam-style question...

Set 1: Reflecting shapes.

Teaching Prompts

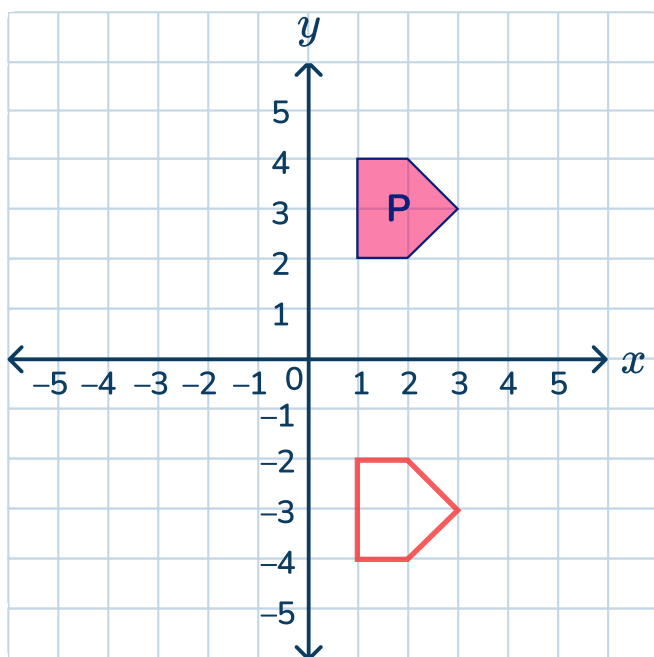
- Can you answer this question by yourself?
-

If stuck

- Move on to the next slide.
-

Mark Scheme

- (1 mark) Correct reflection of the shape: (1,-2) (2,-2) (3,-3) (2, -4) (1,-4)



Watch out for

- Students reflect the shape in a line that is not the x -axis.
- The reflected shape is bigger or smaller than the original shape.
- Students mix up reflection with other transformations.

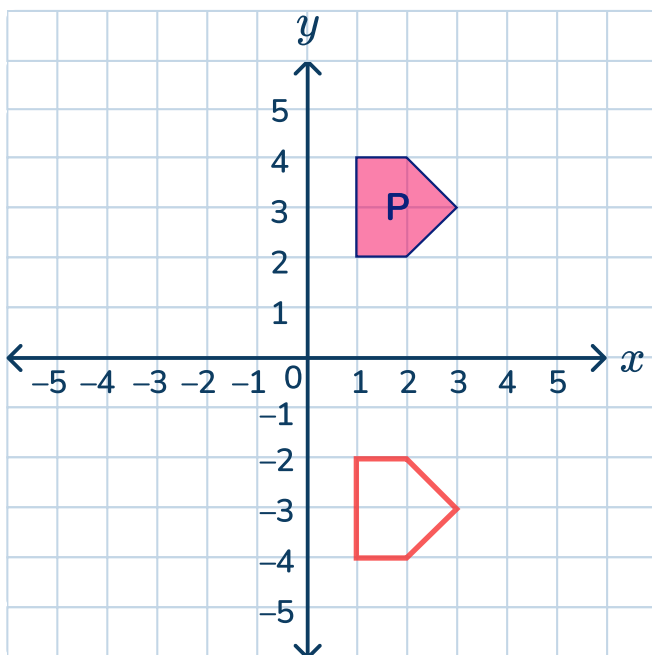
Slide 3: Let's go through it together...

Set 1: Reflecting shapes.

Teaching Prompts

- 1) Which line is the x -axis?
 - 2) It does not matter which vertex (corner) of shape P you choose.
 - 3) Be careful to count the number of units (squares) not the number of points.
 - 4) Carefully count the perpendicular units (squares) from each of the other vertices to the line of reflection.
 - 5) Make sure you join the points together with straight lines.
-

Answers



Mark Scheme

- (1 mark) Correct reflection of the shape: (1, -2) (2, -2) (3, -3) (2, -4) (1, -4)

Slide 4: Your turn...

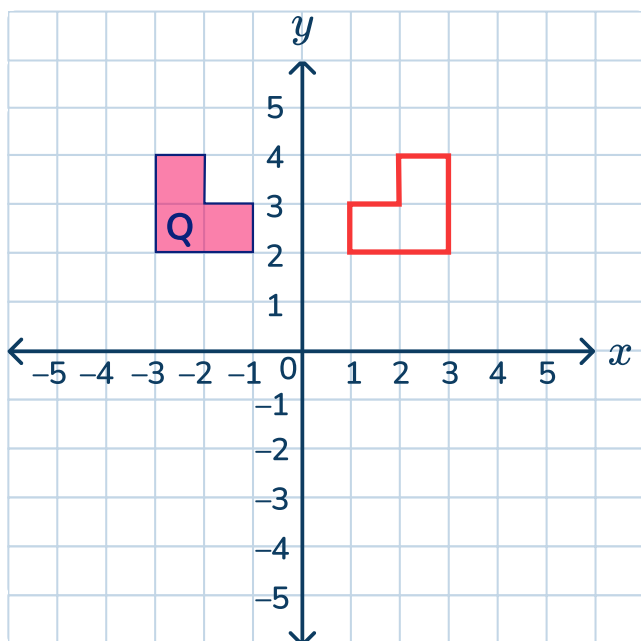
Set 1: Reflecting shapes.

Teaching Prompts

- Which line is the y -axis? (the vertical axes)
 - Choose a vertex of shape Q and count the number of units (squares) perpendicular to the y -axis, then count the same number on the other side.
 - Repeat this with each of the other vertices of shape Q.
 - Join the points together with straight lines.
-

Mark Scheme

- (1 mark) Correct reflection of the shape: (1, 2) (1, 3) (2, 3) (2, 4) (3, 4) (3, 2)



Slide 5: Try this exam-style question...

Set 2: Rotating shapes.

Teaching Prompts

- Can you try this question by yourself?
-

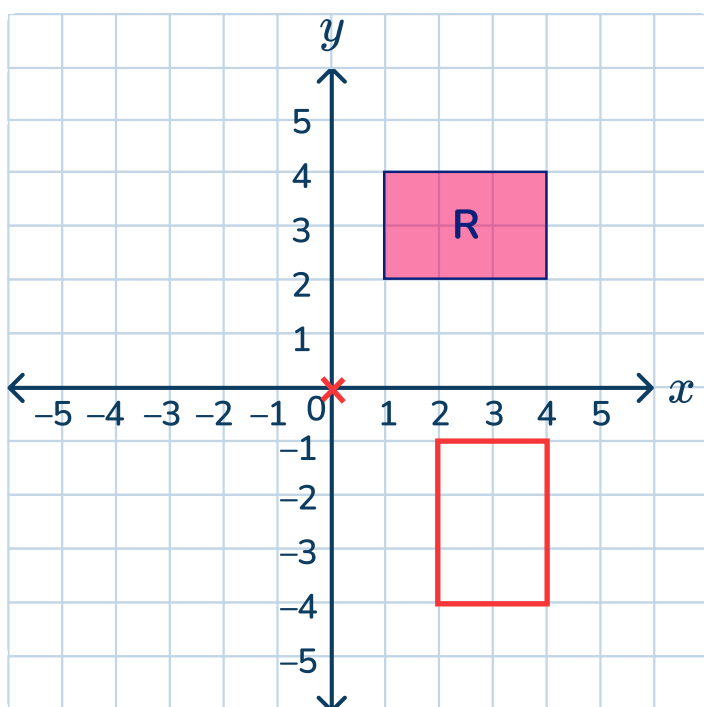
If stuck

- Move on to the next slide.
-

Mark Scheme

Award full marks for a correct rotation: (2, -1) (4, -1) (4, -4) (2, -4)

- (1 mark) correct orientation and size
- (1 mark) correct location



Watch out for

- Students rotate the shape around the wrong centre of rotation.
- The rotated shape is bigger or smaller than the original shape.
- Students mix up rotation with other transformations.

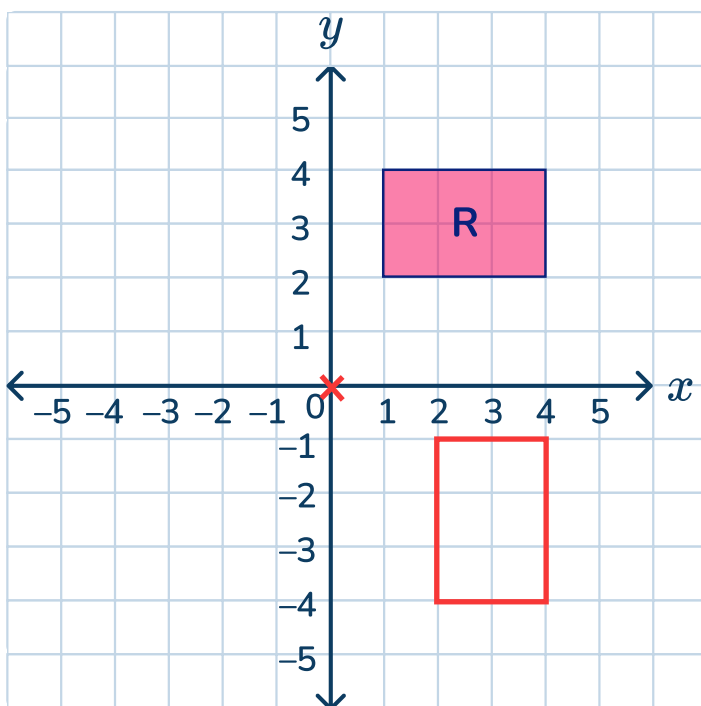
Slide 6: Let's go through it together...

Set 2: Rotating shapes.

Teaching Prompts

- 1) Be careful to keep the paper still when tracing over the shape.
 - 2) 90 degrees clockwise is the same as a quarter turn to the right.
 - 3) Carefully lift up the tracing paper and mark the vertices of the new shape, then draw the sides using a ruler.
-

Answers



Mark Scheme

Award full marks for a correct rotation: (2, -1) (4, -1) (4, -4) (2, -4)

- (1 mark) correct orientation and size
- (1 mark) correct location

Slide 7: Your turn...

Set 2: Rotating shapes.

Teaching Prompts

- Can you try this question by yourself?
-

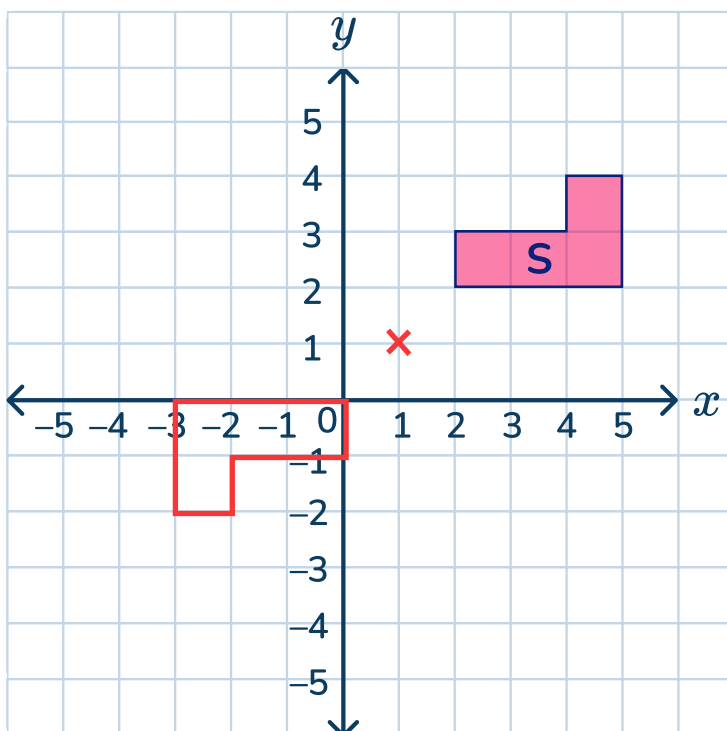
If Stuck

- Mark the centre of rotation on the grid.
 - When we rotate through 180° the direction of rotation does not matter.
-

Mark Scheme

Award full marks for the correct rotation: (0, 0) (0, -1) (-2, -1) (-2, -2) (-3, -2) (-3, 0)

- (1 mark) correct shape and correct orientation
- (1 mark) fully correct rotation



Slide 8: Try this exam-style question...

Set 3: Enlarging shapes.

Teaching Prompts

- Can you try this question by yourself?
-

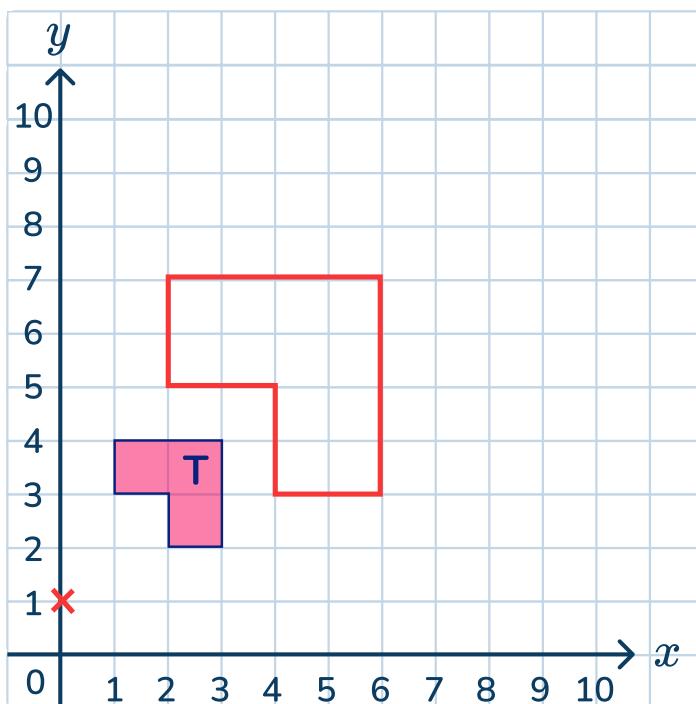
If Stuck

- Move on to the next slide.
-

Mark Scheme

Award full marks for a correct enlargement: (2, 5) (2, 7) (6, 7) (6, 3) (4, 3) (4, 5)

- (1 mark) correct orientation and size
- (1 mark) correct location



Watch out for

- The shape is enlarged by a scale factor other than 2.
- The shape is not enlarged from the centre of enlargement.
- Students mix up enlargement with other transformations.

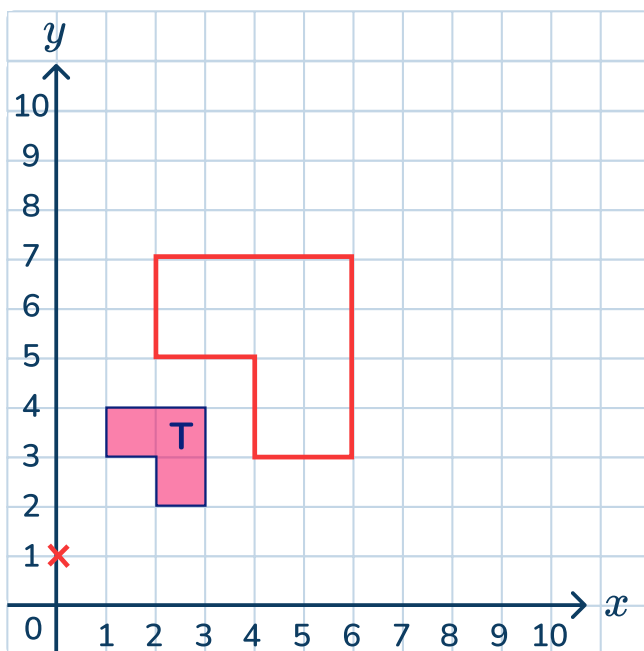
Slide 9: Let's go through it together...

Set 3: Enlarging shapes.

Teaching Prompts

- 1) Mark the centre of rotation with a cross or a point.
 - 2) It does not matter which vertex of shape T you start with.
 - 3) Make sure to count the units (squares) not the points from the vertex.
 - 4) Carefully multiply each length counted by the scale factor, 2.
 - 5) Make sure to count the units (squares) not the points from the other vertices.
 - 6) Use a ruler to join the points.
-

Answers



Mark Scheme

Award full marks for the correct enlargement: (2, 5) (2, 7) (4, 5) (4, 3) (6, 7) (6, 3)

- (1 mark) correct orientation and size
- (1 mark) correct location

Slide 10: Your turn...

Set 3: Enlarging shapes.

Teaching Prompts

- Can you answer this question by yourself?

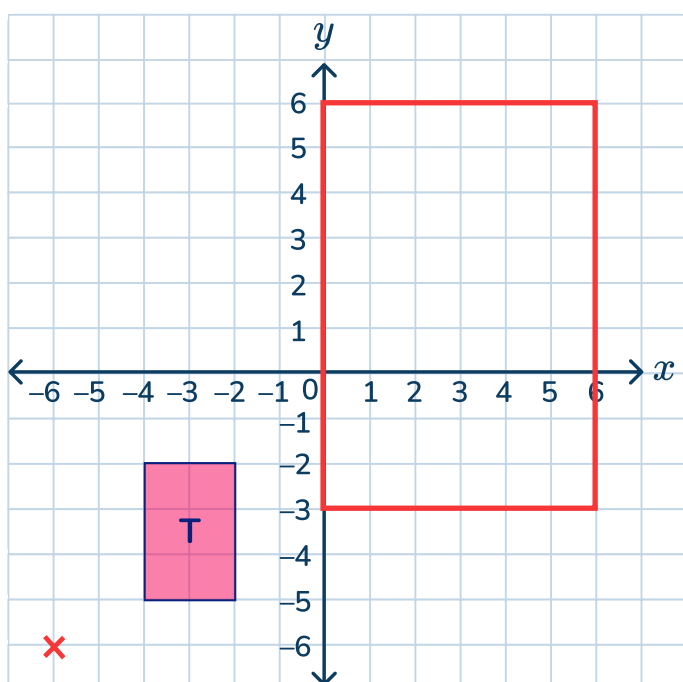
If stuck

- Mark the centre of enlargement on the grid.
- Carefully count the number of units (squares) right and the number of units (squares) up from the centre of enlargement to each of the vertices of shape T
- Multiply these lengths by 3.
- Count this new number of units (squares) right and up from the centre of enlargement and mark four new vertices.
- Join the new points with straight lines.

Mark Scheme

Award full marks for the correct enlargement: (0, -3) (0, 6) (6, 6) (6, -3)

- (1 mark) correct shape and correct orientation
- (1 mark) fully correct rotation



Slide 11: Try this exam-style question...

Set 4: Translating shapes.

Teaching Prompts

- Can you answer this question by yourself?
-

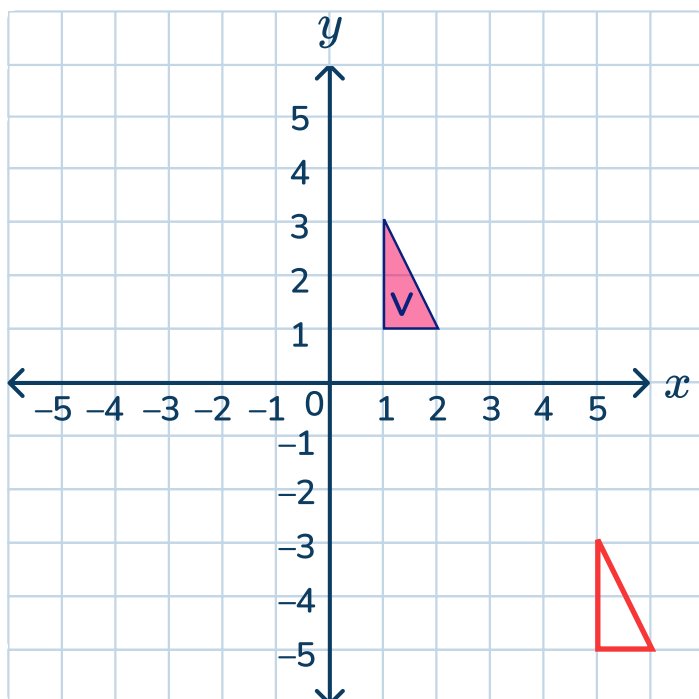
If stuck

- Move on to the next slide.
-

Mark Scheme

Award full marks for the correct translation: (5, -3) (5, -5) (6, -5)

- (1 mark) correct orientation and size
- (1 mark) correct location



Watch out for

- The shape is in the correct orientations and size but is in the incorrect location.
- Students move the shape 4 to the left and 6 up.
- Students move the shape 4 up and 6 to the left.
- Students mix up translation with other transformations.

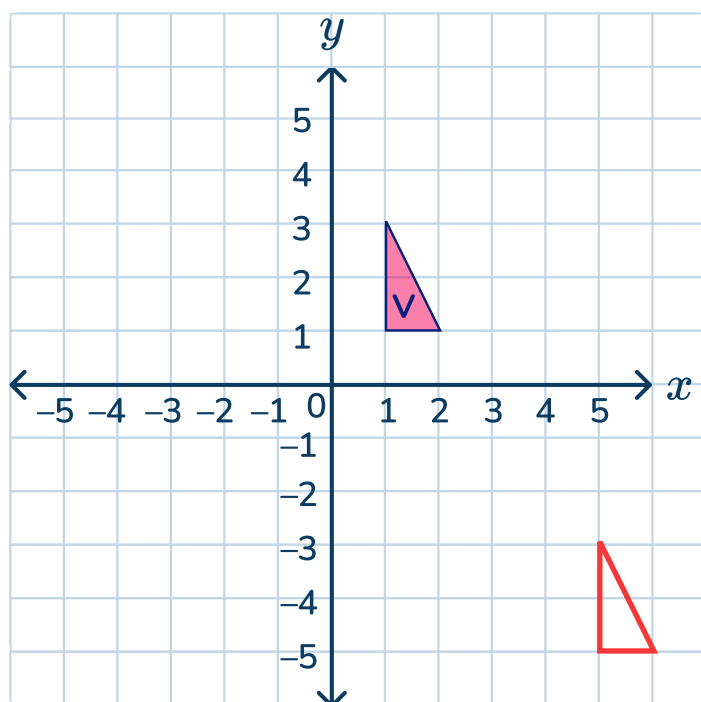
Slide 12: Let's go through it together...

Set 4: Translating shapes.

Teaching Prompts

- 1) It does not matter which vertex we choose.
 - 2 / 3) Be careful to count the number of units (squares) not the number of points.
 - 4) Use a ruler to draw straight lines between the points.
-

Answers



Mark Scheme

Award full marks for the correct translation: (5, -3) (5, -5) (6, -5)

- (1 mark) correct orientation and size
- (1 mark) correct location

Slide 13: Your turn...

Set 4: Translating shapes.

Teaching Prompts

- Can you answer this question by yourself?
-

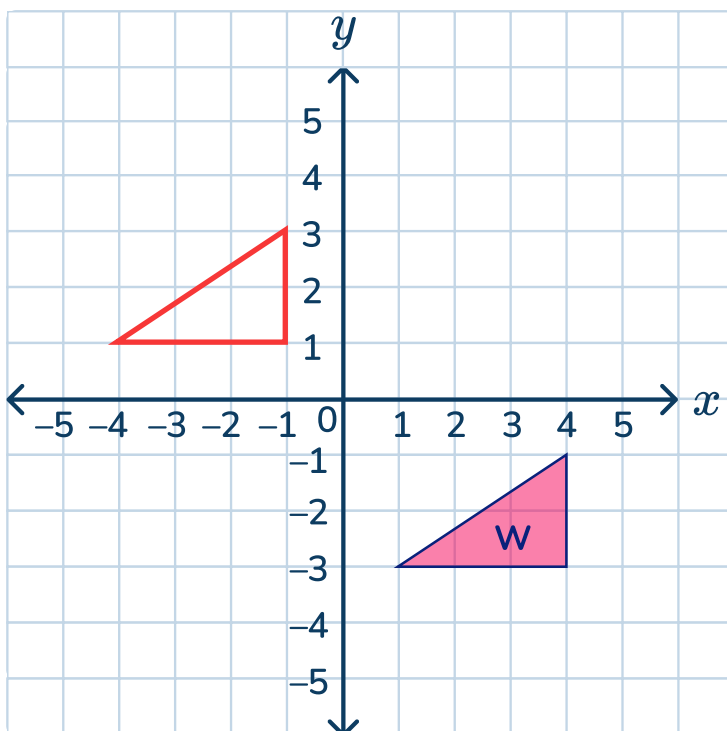
If Stuck

- Choose a vertex of the shape and count 5 units left and 4 units up and mark the new point.
 - Repeat this process for each vertex.
 - Join up the new points with straight lines.
-

Mark Scheme

Award full marks for a correct translation: $(-4, 1)$ $(-1, 1)$ $(-1, 3)$

- (1 mark) correct orientation and size
- (1 mark) correct location



Slide 14: Ready for a Challenge?

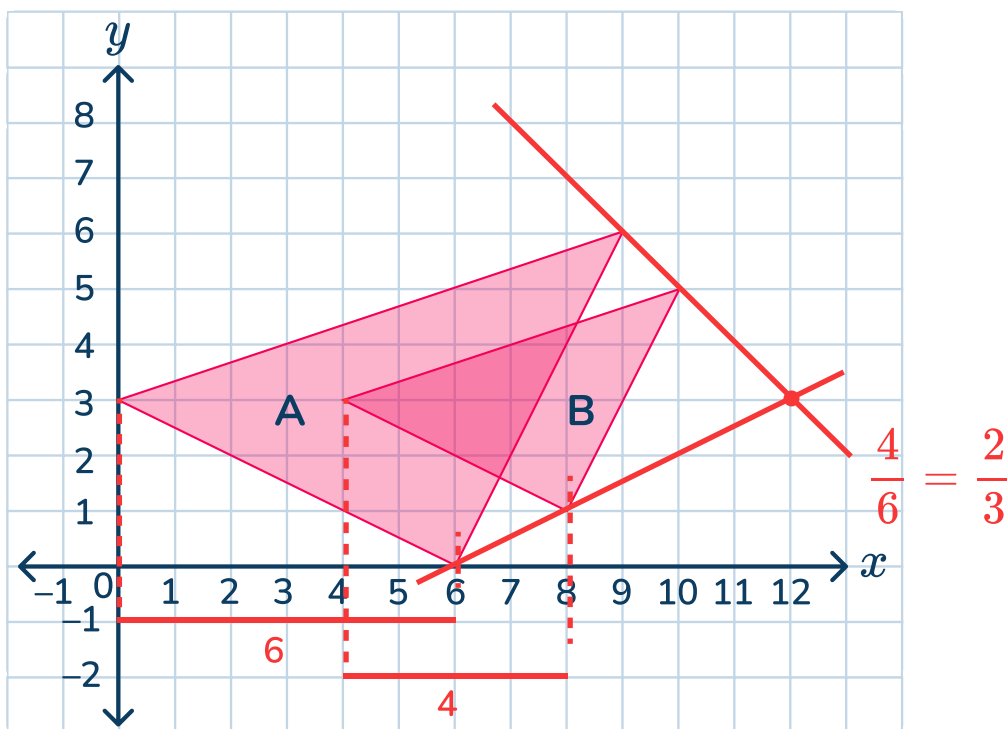
Teaching Prompts

- How can we find the centre of enlargement? (draw straight projection lines from corresponding vertices, the lines will intersect at the centre of enlargement).
- How can we find the scale factor? (use corresponding dimensions for each shape and divide).
- Is shape A getting larger or smaller? (smaller, so the scale factor will be between 0 and 1).

Answers

Centre of enlargement is (12, 3)

Scale factor is $\frac{2}{3}$



Mark Scheme

- (1 mark) centre of enlargement of (12, 3)
- (1 mark) dividing corresponding dimensions to get $\frac{3}{2}$ or $\frac{2}{3}$
- (1 mark) scale factor of $\frac{2}{3}$

Slide 15: What have we learnt?

Teaching Prompts

a) Can you see where the student has gone wrong? (they have not identified the correct line of reflection).

a) What should they have done instead?

a) Find what line the shape has been reflected in.

b) Can you see where the student has gone wrong? (they have identified it as a translation).

b) What should they have done instead?

b) The shape has changed in size so it must be an enlargement.

Answers

a) Reflection in the line $x = -1$

b) Enlargement, centre $(-1, 0)$, scale factor 2

Performing Transformations of Shapes

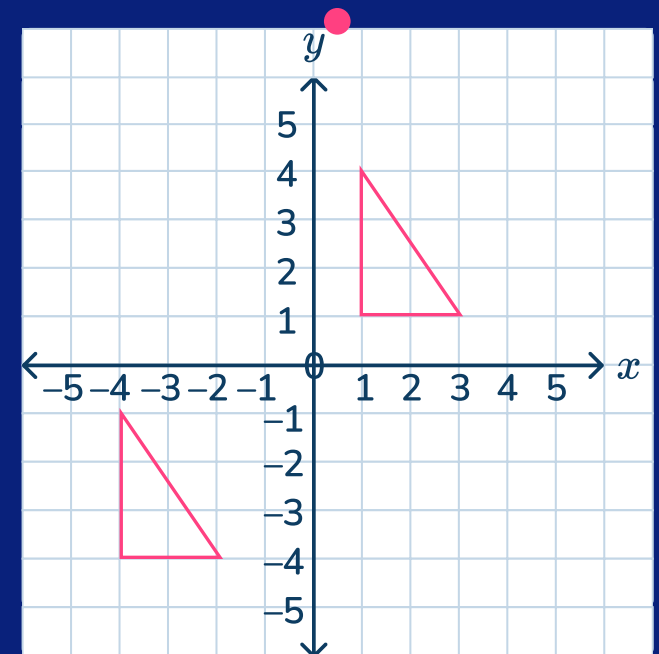
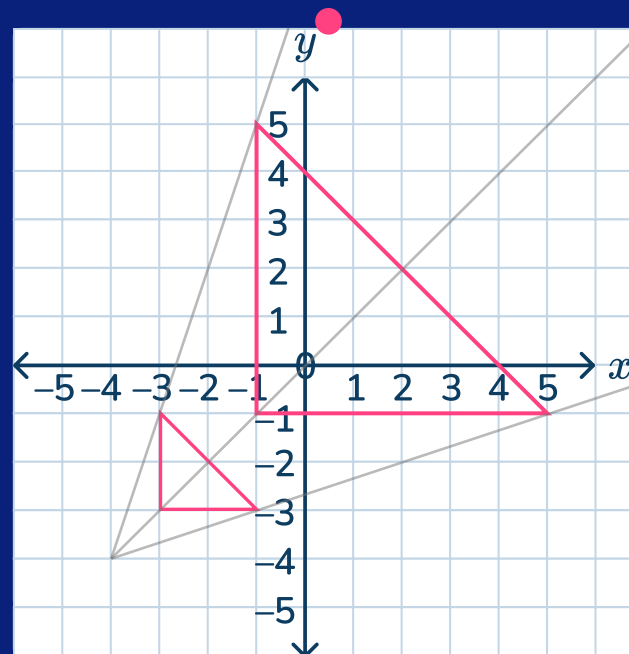
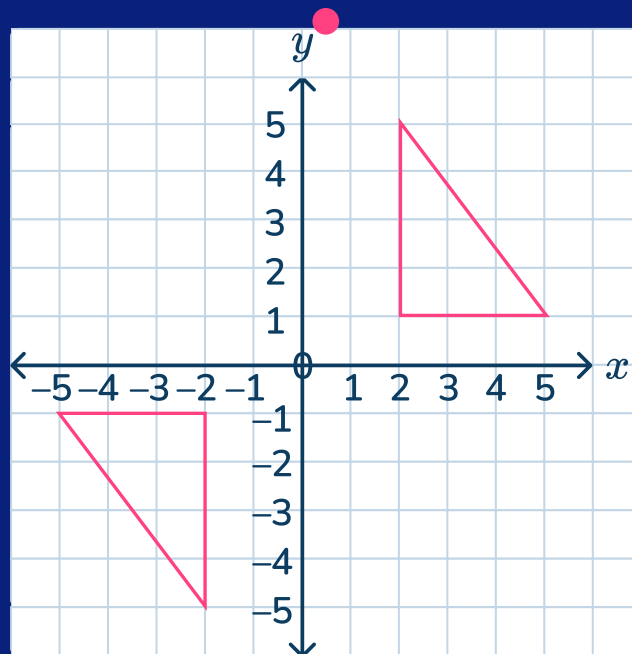
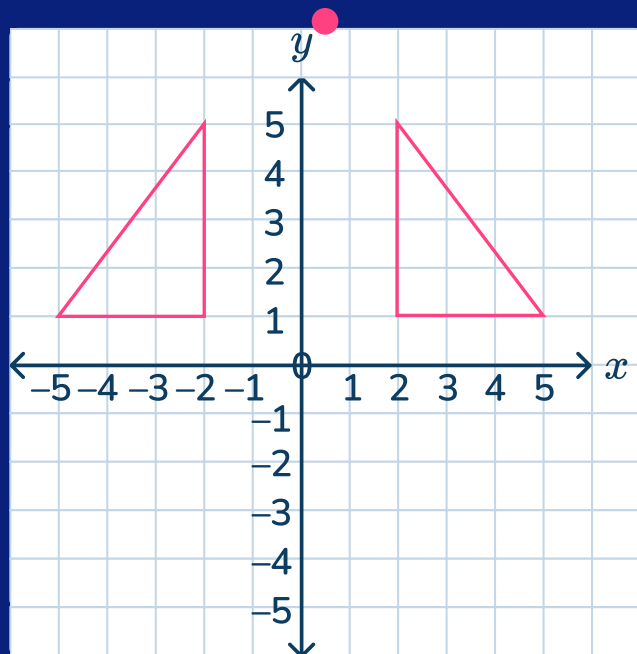
Match the type of transformation to the graph.

Enlargement

Reflection

Translation

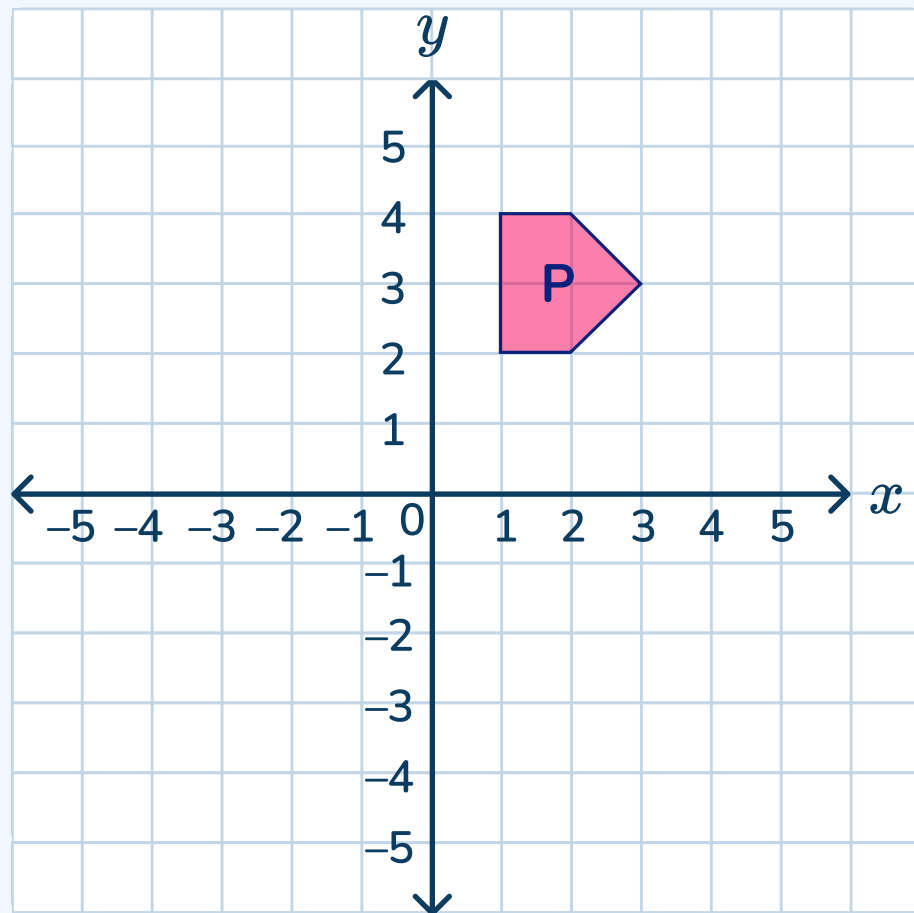
Rotation



THIRD SPACE
LEARNING

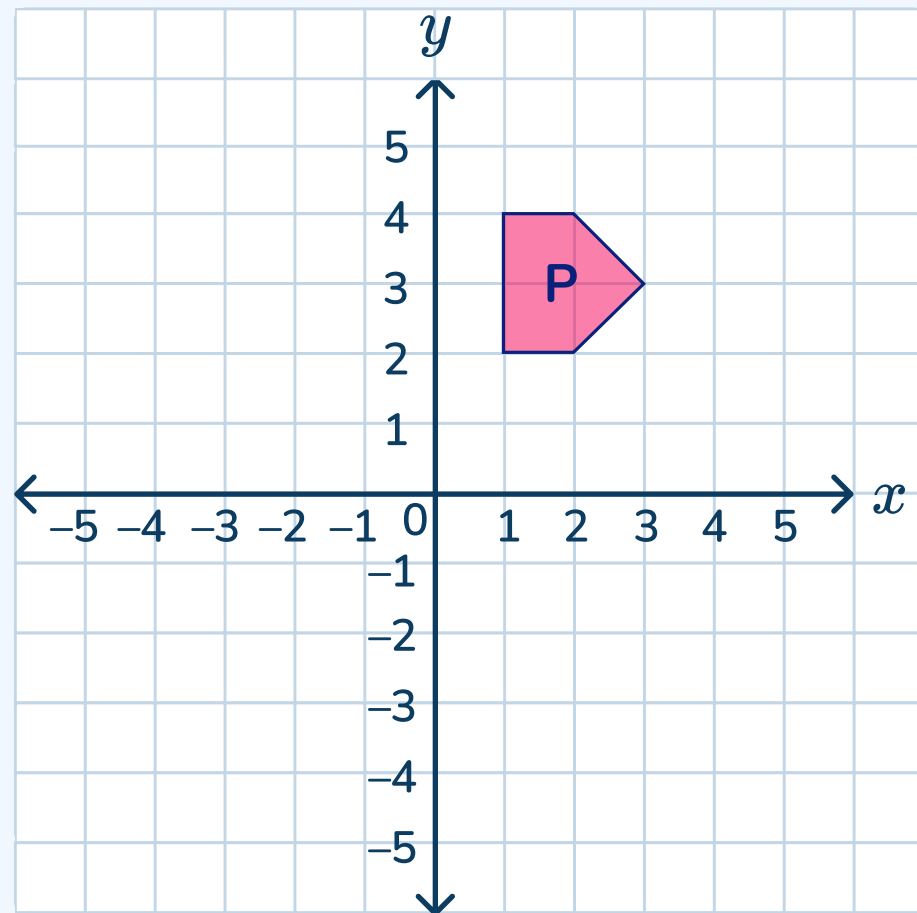
Try this exam-style question...

Reflect shape P in the x -axis.



(1)

Reflect shape P in the x -axis.

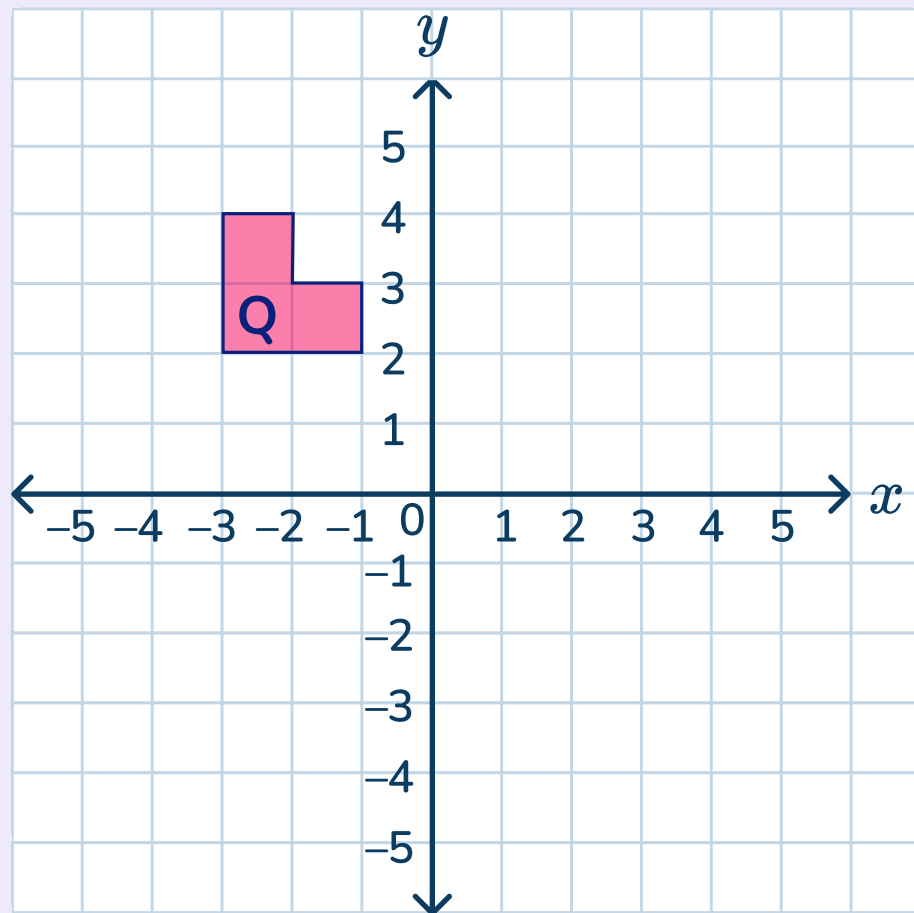


A **reflection** flips a shape in a mirror line (line of reflection) to create an **image**.

- 1 Identify and highlight the x -axis (the line of reflection).
- 2 Pick a vertex of shape P.
Find how many units this vertex is away from the x -axis.
- 3 Count the same number of units on the other side of the line of reflection and mark the vertex of the new reflected shape.
- 4 Repeat this for the other vertices.
- 5 Join the points together to draw the reflected image P'.

Your turn...

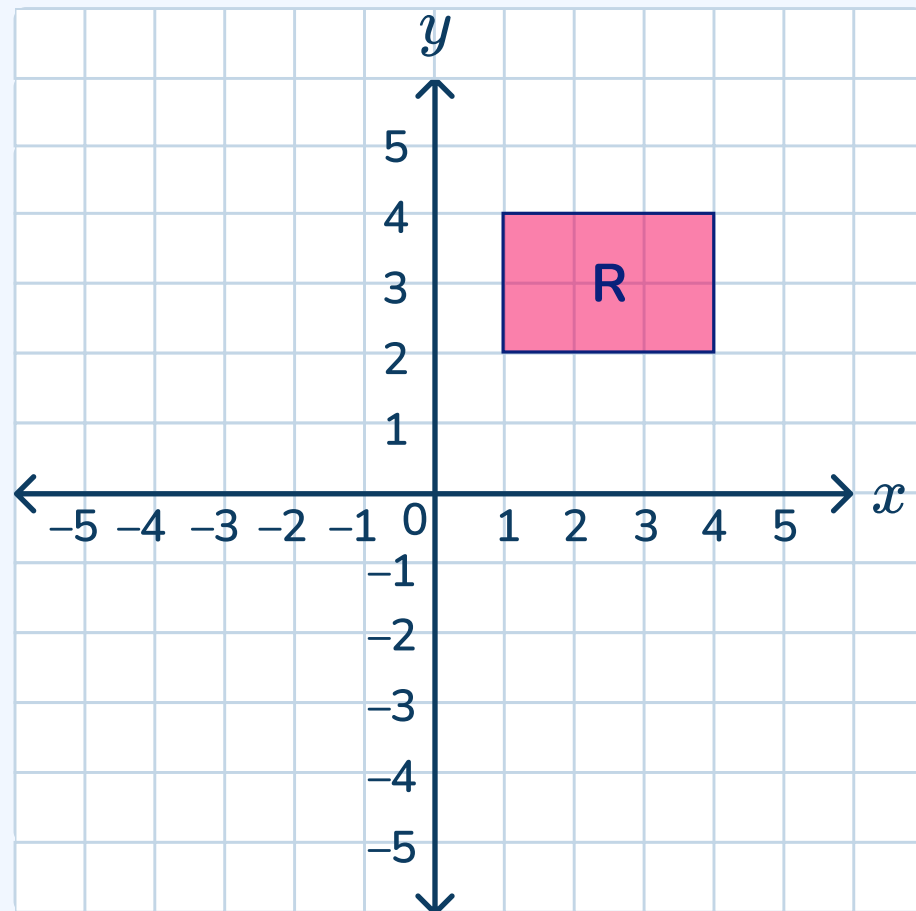
Reflect shape Q in the y -axis.



(1)

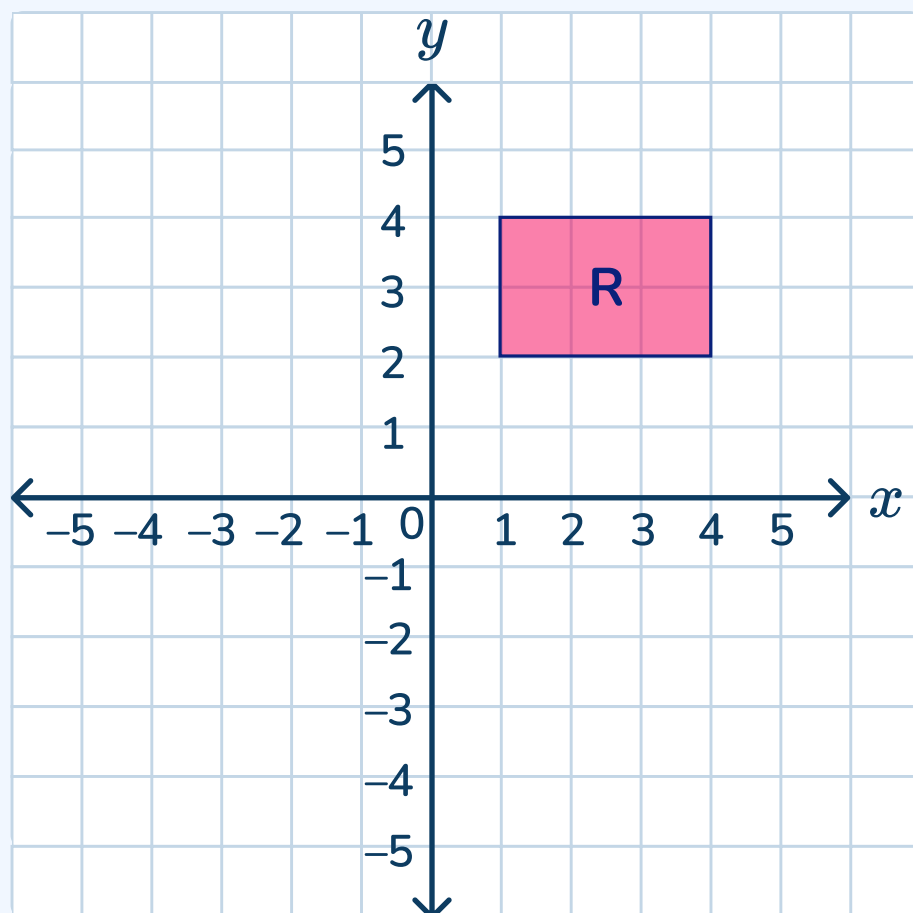
Try this exam-style question...

Rotate shape R 90° clockwise with centre of rotation $(0,0)$.



(2)

Rotate shape R 90° clockwise with centre of rotation $(0,0)$.



A rotation **turns** the shape around a fixed point.

To rotate a shape, we need:

- A **centre** of rotation (x,y) .
- An **angle** of rotation.

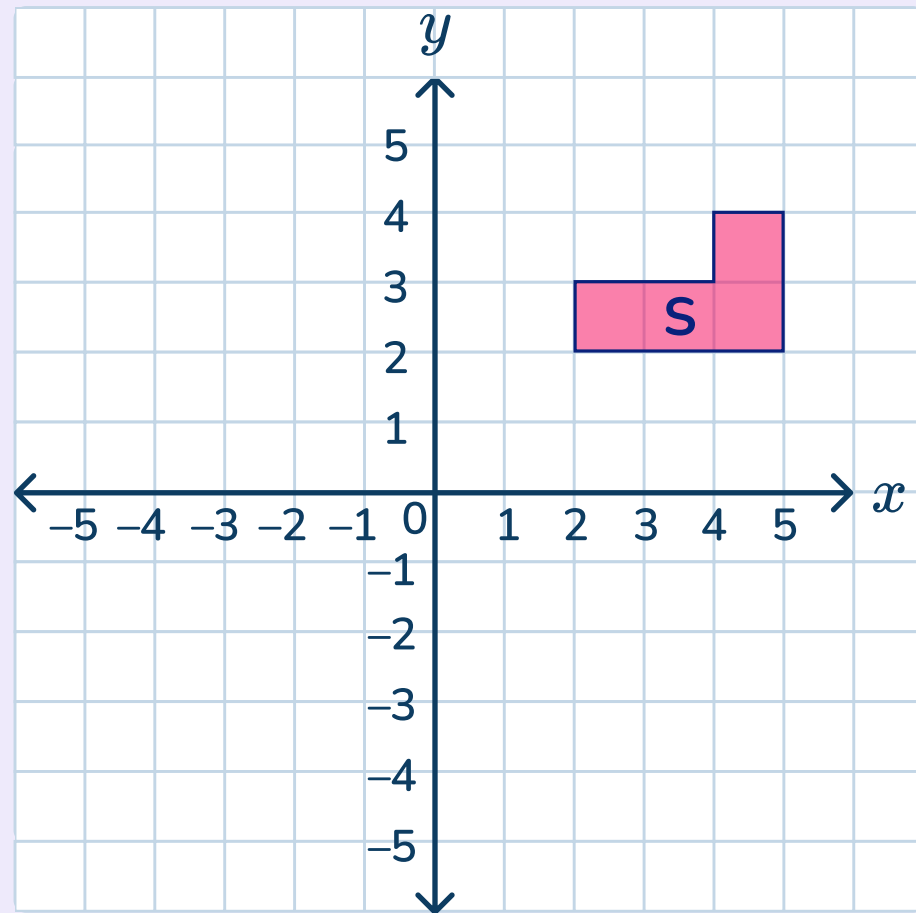


- A **direction** of rotation.



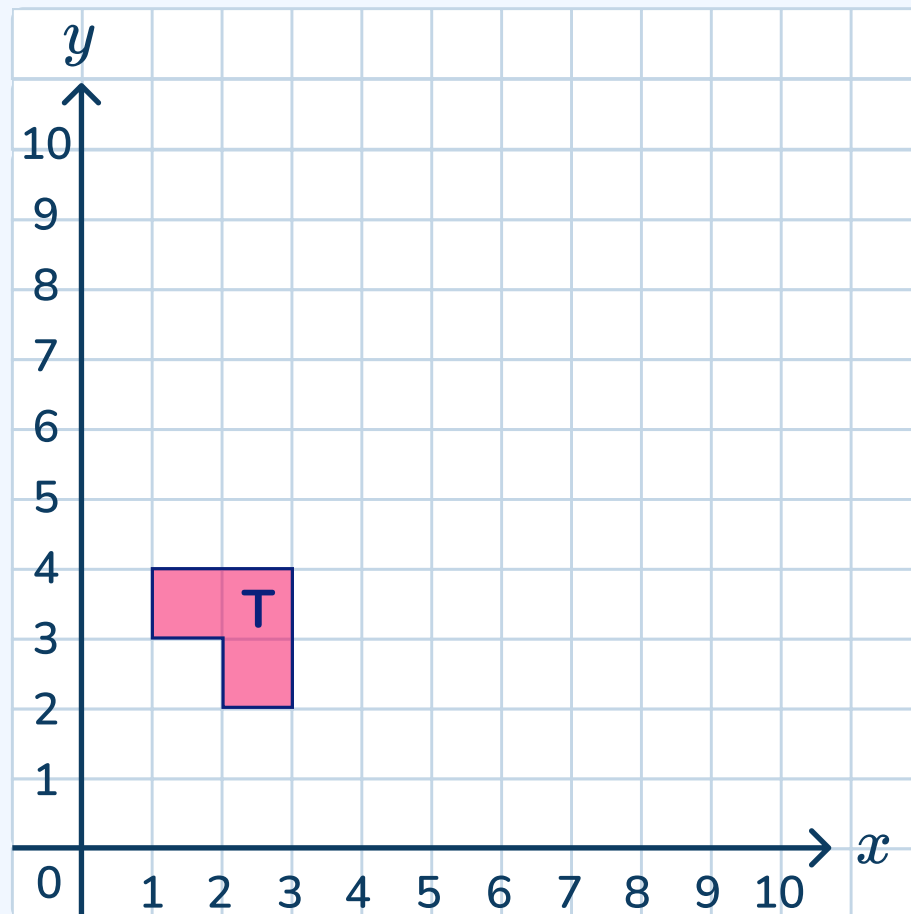
- 1 Place a piece of tracing paper over the grid and draw around the shape.
- 2 Place your pencil on the coordinate $(0,0)$ and turn the tracing paper 90° clockwise.
- 3 Draw the shape in the new position.
- 4 Label it R'.

Rotate shape S 180° with centre of rotation (1,1).



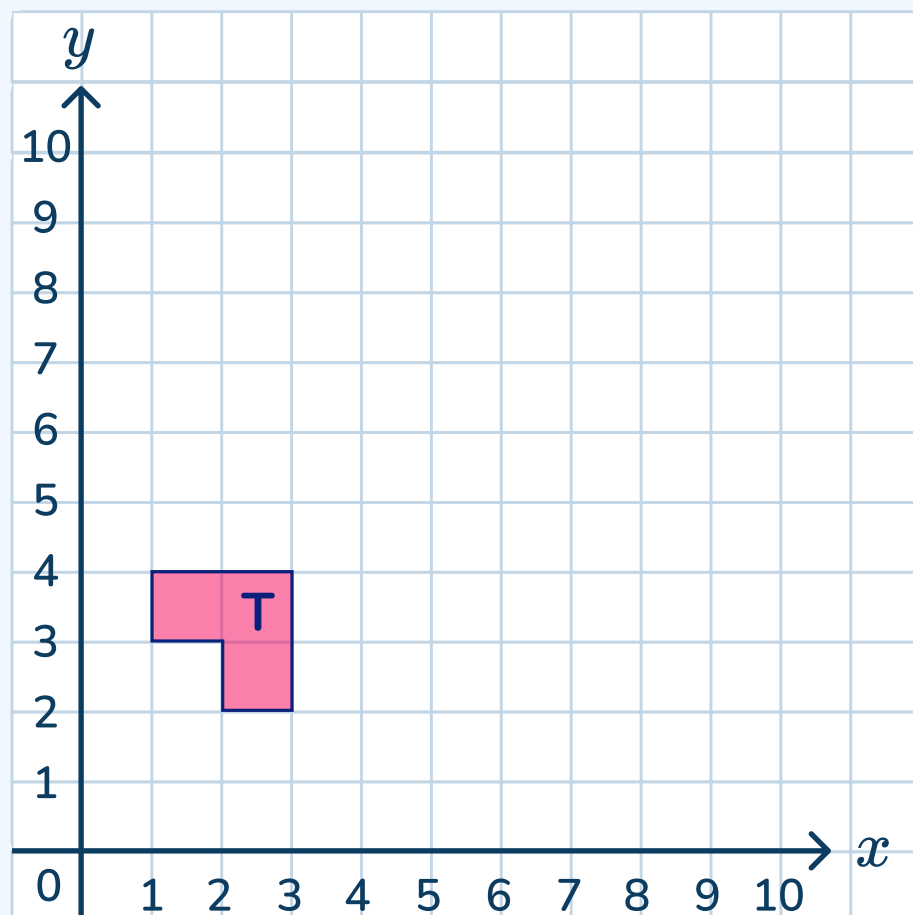
Try this exam-style question...

Enlarge shape T from centre $(0,1)$
by scale factor 2.



(2)

Enlarge shape T from centre (0,1) by scale factor 2.



An **enlargement** makes a shape bigger or smaller by **multiplying its side lengths** by a scale factor.

We are often given a **centre of enlargement** from which to enlarge the shape.

- 1 Plot the centre of enlargement on the grid.
- 2 Choose a vertex of shape T, label it A.
- 3 Starting at the centre of enlargement (CoE), work out how many units you need to move.

In the x -direction:

In the y -direction:

- 4 Multiply these amounts by the scale factor.

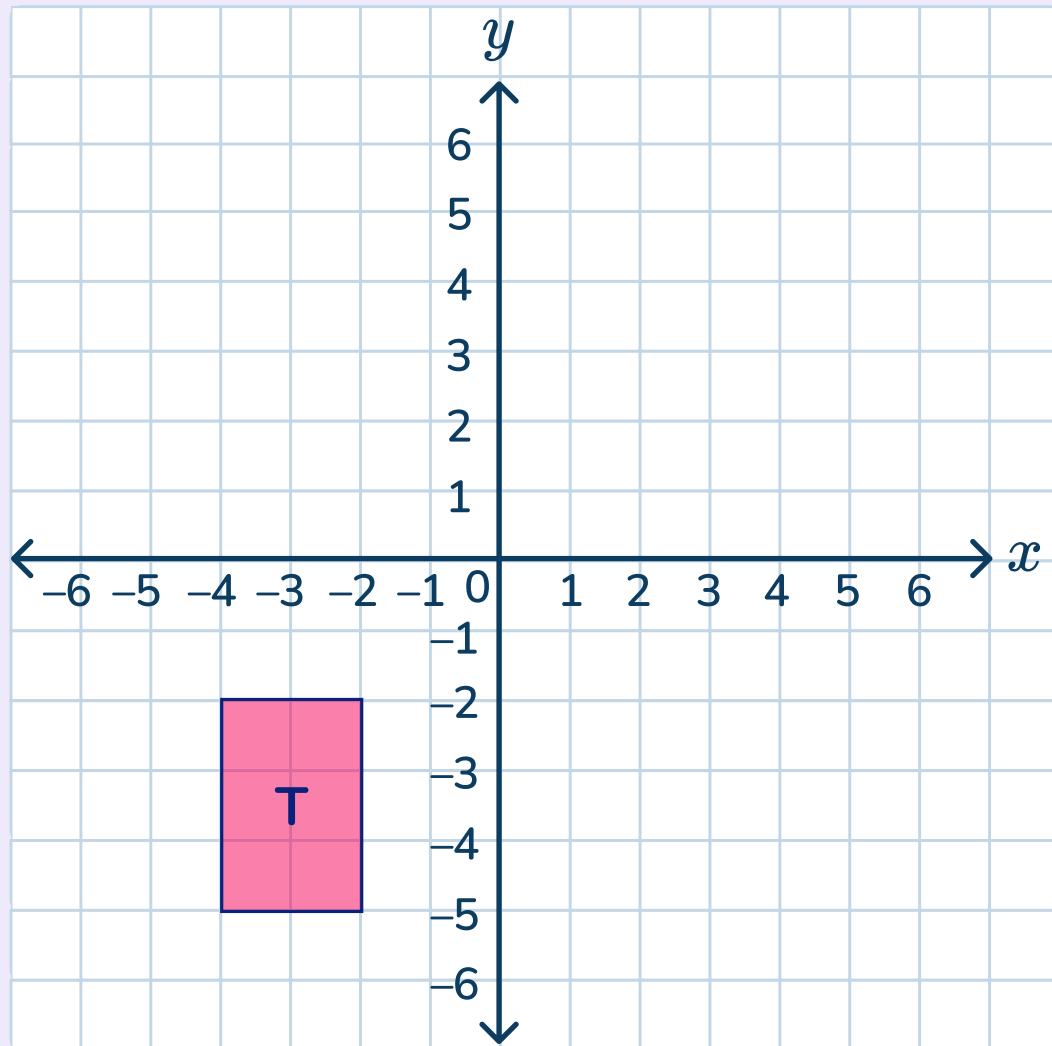
Units to A' in x -direction:

Units to A' in y -direction:

- 5 Starting at the CoE, move the given number of units and mark the vertex of the new shape A'.
- 6 Repeat this for the other vertices of T (B, C, D, E, F) to find (B', C', D', E', F') and join up the vertices to find T'.

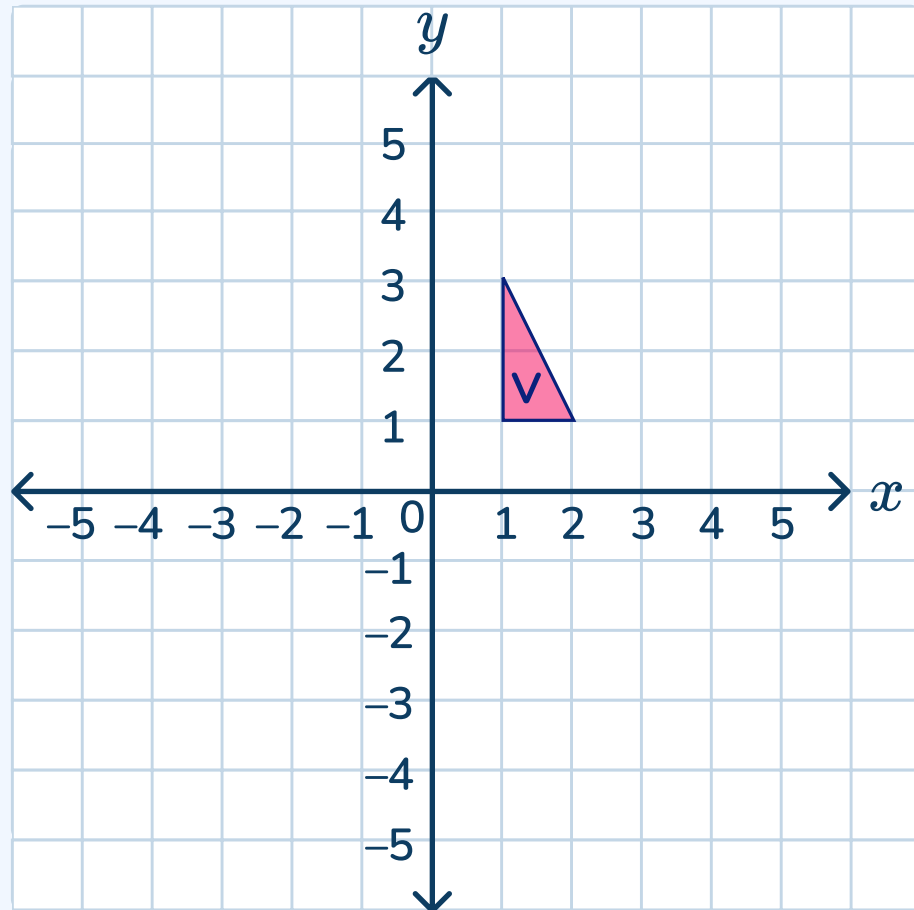
Let's go through it together...

Enlarge shape T from centre $(-6, -6)$ by scale factor 3.



Let's go through it together...

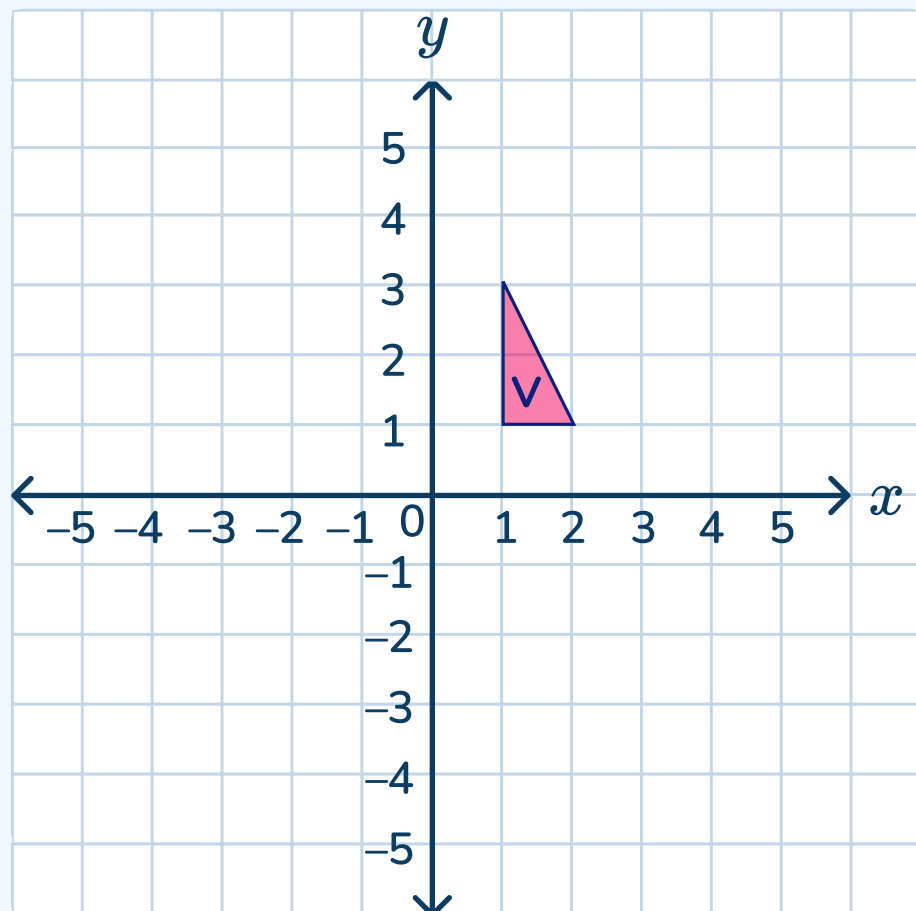
Translate shape V by the vector $\begin{pmatrix} 4 \\ -6 \end{pmatrix}$



(2)

Lets go through it together...

Translate shape V by the vector $\begin{pmatrix} 4 \\ -6 \end{pmatrix}$



A **translation** moves a shape **left and right** and **up and down**.

We use a **column vector** to record this movement.

$$\begin{pmatrix} x \\ y \end{pmatrix}$$

The **top number** represents the **movement in x** and moves the shape to the right if it is positive and left if it is negative.

The **bottom number** represents the **movement in y** and moves the shape up if it is positive and down if it is negative.

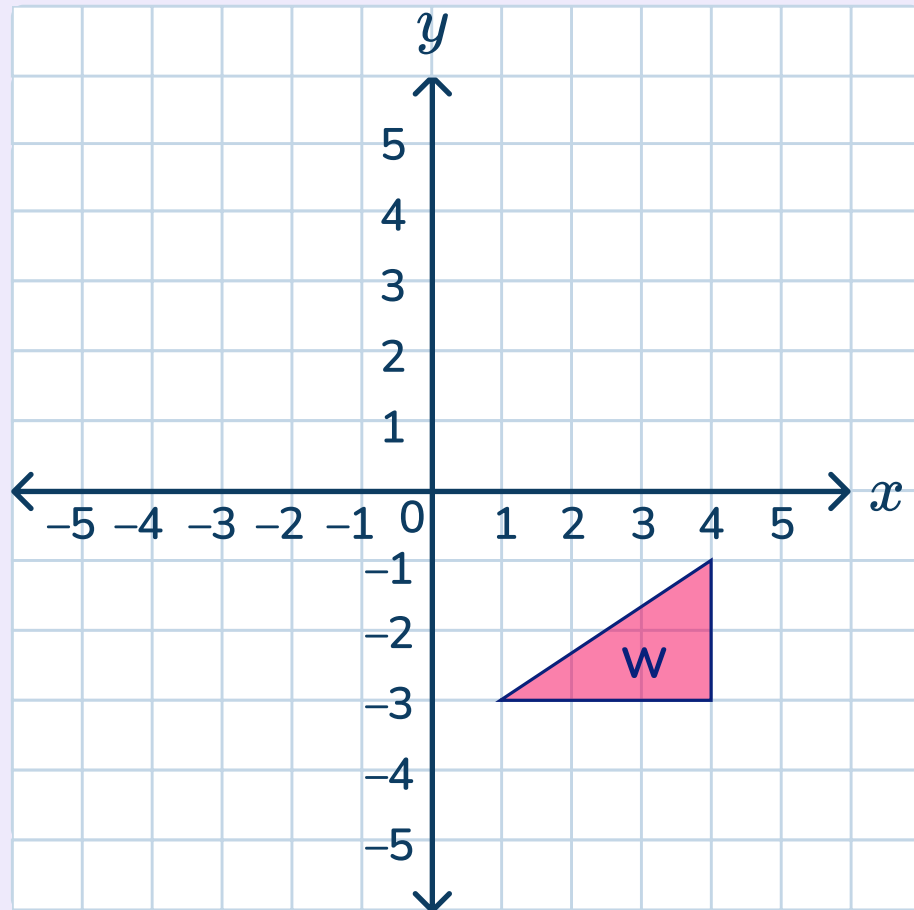
- 1 Choose a vertex of shape V, label it A.

..... units
- 2 Use the column vector to decide how many units left or right and up or down A should move.

..... units
- 3 Move A the given number of units and mark the vertex of the new shape A'.
- 4 Repeat this for the other vertices of V (B, C) to find (B', C') and join up the vertices to find V'.

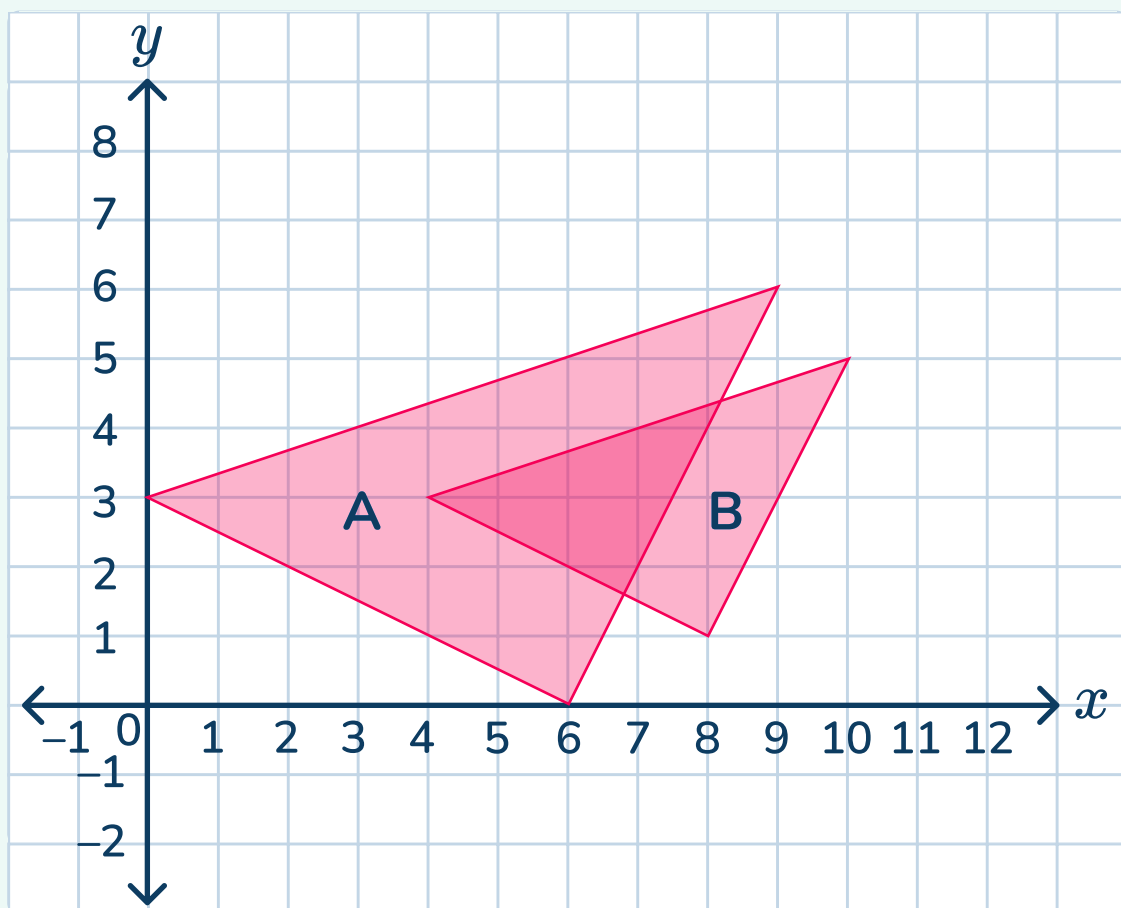
Your turn...

Translate shape W by the vector $\begin{pmatrix} -5 \\ 4 \end{pmatrix}$



Ready for a Challenge?

Find the scale factor and centre of enlargement from A to B.



Enlargements can make shapes larger or smaller.

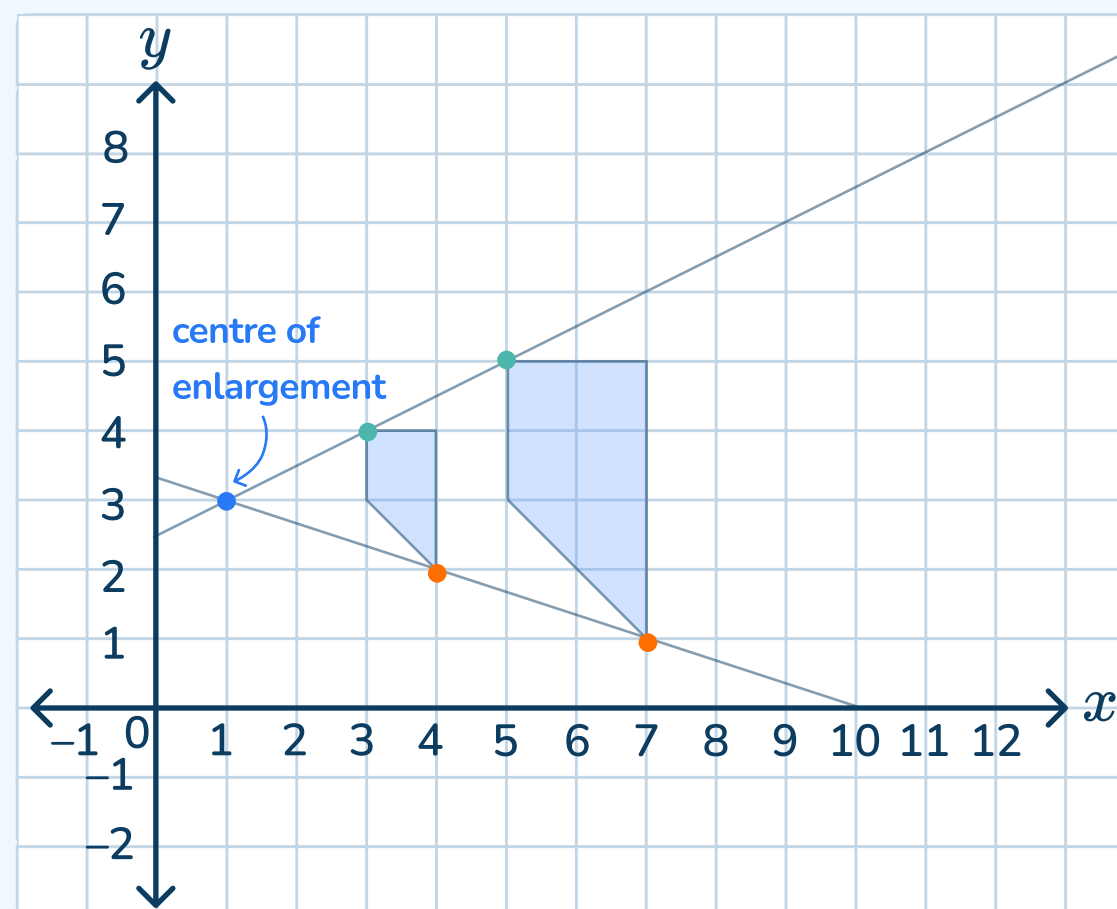
e.g

Scale factor 2: twice the length.

Scale factor 0.5: half the length.

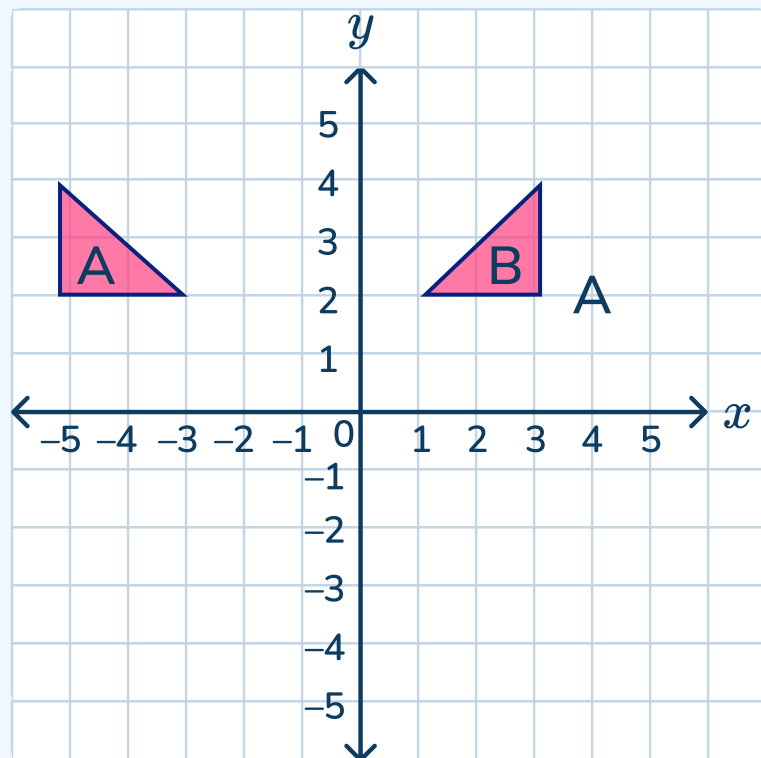
To find the centre of enlargement, we can join corresponding vertices with straight lines that will intersect at the centre of enlargement.

e.g



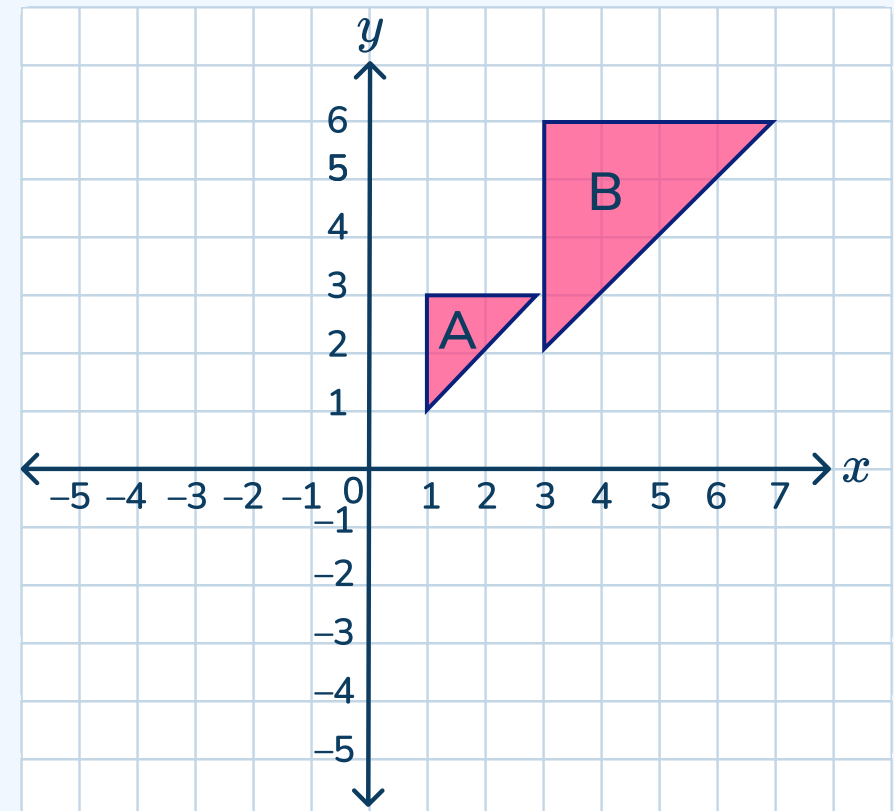
Can you correct the answers to the questions below?

Describe the transformation from A to B.



Reflection in y -axis

Describe the transformation from A to B.



Translation by 4

Where to go next?

For more diagnostic questions, and GCSE maths revision resources and worksheets to support students in fixing any misconceptions take a look at the free Third Space Learning [GCSE maths revision](#) pages.

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