

Describing and Combining Transformations

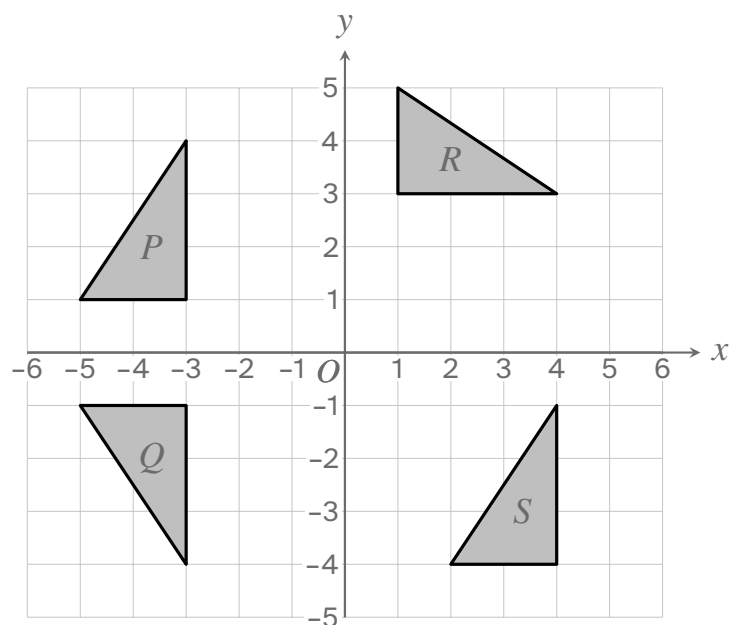
Solutions

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 (2 marks)

The grid shows four triangles, P , Q , R and S .



(a) Which shape is a translation of shape P ?

A translation slides a shape. It stays the same size and the same way round.

S is P moved 7 squares right and 5 squares down.

Q is flipped over and R is turned, so they are not translations.

Answer: S

- (b) Which shape is a reflection of shape P ?

A reflection gives a mirror image: the shape is flipped over.

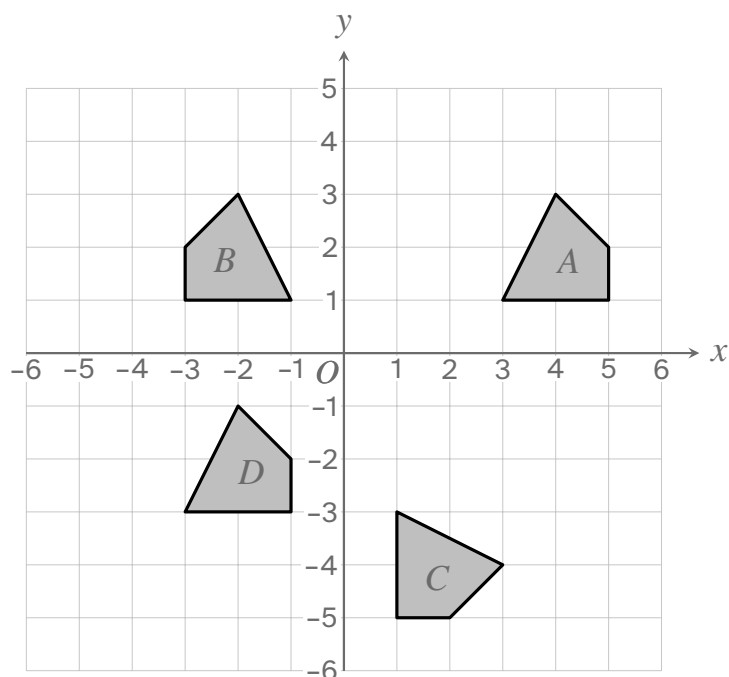
Q is the mirror image of P in the x -axis.

Answer: Q

Tip: R has been turned, not flipped. Turning a shape is a rotation.

2 (7 marks)

The grid shows four shapes, A , B , C and D .



- (a) Describe fully the single transformation that maps shape A onto shape B .

B is a mirror image of A , so it is a reflection.

The mirror line is halfway between matching points.

(3, 1) on A and (-1, 1) on B are each 2 squares from $x = 1$.

So the mirror line is the vertical line $x = 1$.

Answer: Reflection in the line $x = 1$

Tip: Vertical lines are $x = \dots$ and horizontal lines are $y = \dots$. Mixing these up is a very common mistake.

Marks: 1 mark for reflection. 1 mark for the line $x = 1$.

- (b) Describe fully the single transformation that maps shape A onto shape C .

C is the same size as A but turned, so it is a rotation.

It has turned a quarter turn clockwise: 90° clockwise.

Check the centre with tracing paper. Try the origin.

Turning about $(0, 0)$ takes $(3, 1)$ to $(1, -3)$, which is a vertex of C ✓

Answer: Rotation, 90° clockwise, about $(0, 0)$

Tip: Say “rotation”, not “turn”. You need the angle, the direction **and** the centre.

Marks: 1 mark for rotation. 1 mark for 90° clockwise. 1 mark for the centre $(0, 0)$.

- (c) Describe fully the single transformation that maps shape A onto shape D .

D is the same size and the same way round as A , so it is a translation.

Follow one vertex: $(3, 1)$ on A moves to $(-3, -3)$ on D .

That is 6 left and 4 down.

Write this as a column vector.

Answer: Translation by $\begin{pmatrix} -6 \\ -4 \end{pmatrix}$

Marks: 1 mark for translation. 1 mark for the vector $\begin{pmatrix} -6 \\ -4 \end{pmatrix}$.

3 (1 mark)

Which of these transformations can change the size of a shape?
Circle your answer.

Options: rotation, reflection, translation, enlargement

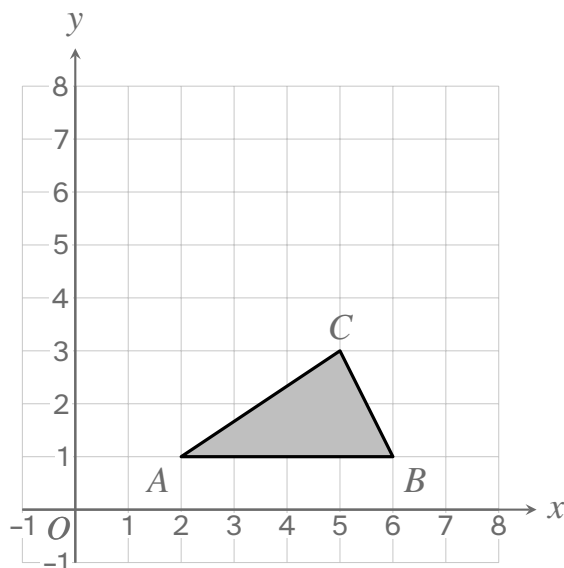
Reflections, rotations and translations keep the shape exactly the same size (the image is congruent).

An enlargement changes the size (unless the scale factor is 1).

Answer: enlargement

4 (2 marks)

Here is triangle ABC on a grid.



The triangle is reflected in a horizontal line.

The image of vertex A is at $(2, 7)$

(a) Write down the equation of the mirror line.

A is at $(2, 1)$ and its image is at $(2, 7)$.

The mirror line is halfway between them: $\frac{1+7}{2} = 4$

It is a horizontal line, so its equation is $y = \dots$

Answer: $y = 4$

Tip: A horizontal line has equation $y = \dots$, not $x = \dots$

- (b) Work out the coordinates of the image of vertex C .

C is at $(5, 3)$, which is 1 square below the line $y = 4$.

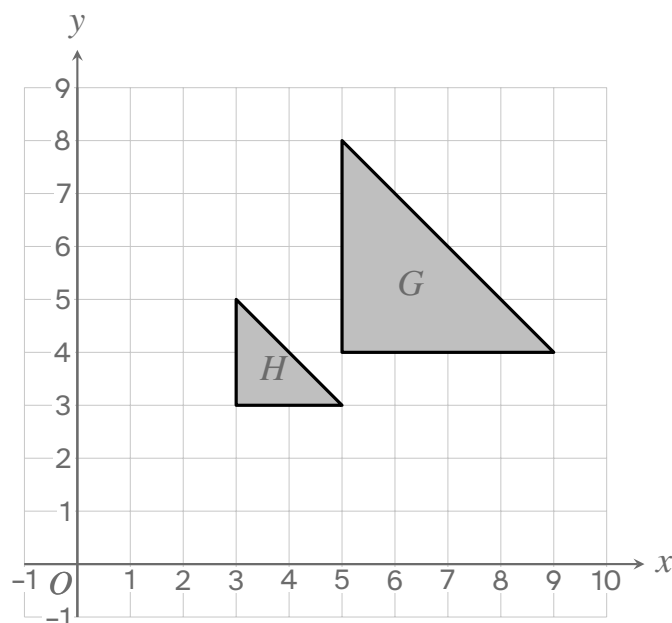
Its image is 1 square above the line $y = 4$, with the same x -coordinate.

So the image of C is $(5, 5)$

Answer: $(5, 5)$

5 (3 marks)

Describe fully the single transformation that maps triangle G onto triangle H .



H is the same shape as G but smaller, so it is an enlargement.

The base of H is 2 squares and the base of G is 4 squares.

$$\text{Scale factor} = \text{new} \div \text{old} = 2 \div 4 = \frac{1}{2}$$

Join matching vertices and extend the lines: $(5, 4)$ to $(3, 3)$, and $(9, 4)$ to $(5, 3)$.

The lines meet at (1,2), the centre.

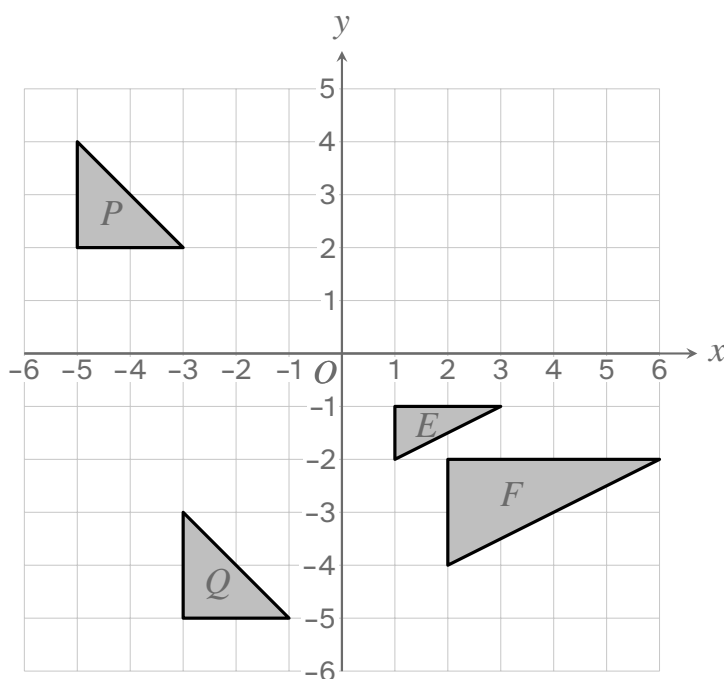
Answer: Enlargement, scale factor $\frac{1}{2}$, centre (1,2)

Tip: Use the word “enlargement” even when the shape gets smaller. Words like “reduction” or “shrink” do not get the mark.

Marks: 1 mark for enlargement. 1 mark for scale factor $\frac{1}{2}$. 1 mark for the centre (1,2). Giving more than one transformation loses the first mark.

6 (2 marks)

The grid shows four triangles, P , Q , E and F .



(a) Jess says,

‘ P is mapped onto Q by a translation by the vector $\begin{pmatrix} -2 \\ 7 \end{pmatrix}$,

Make **one** criticism of what Jess says.

It is a translation, so that part is right.

Follow one vertex: $(-5, 2)$ on P moves to $(-3, -5)$ on Q .

That is 2 right and 7 down, so the vector is $\begin{pmatrix} 2 \\ -7 \end{pmatrix}$.

Jess's vector maps Q back onto P : it is the wrong way round.

Answer: The vector should be $\begin{pmatrix} 2 \\ -7 \end{pmatrix}$ (2 right, 7 down), not $\begin{pmatrix} -2 \\ 7 \end{pmatrix}$

Tip: Say exactly what is wrong and what it should be. The top number is the move across and the bottom number is the move up or down.

(b) Jess says,

‘ E is mapped onto F by an enlargement, scale factor $\frac{1}{2}$, centre $(0, 0)$ ’

Make **one** criticism of what Jess says.

It is an enlargement with centre $(0, 0)$, so those parts are right.

F is bigger than E : the base of F is 4 squares and the base of E is 2 squares.

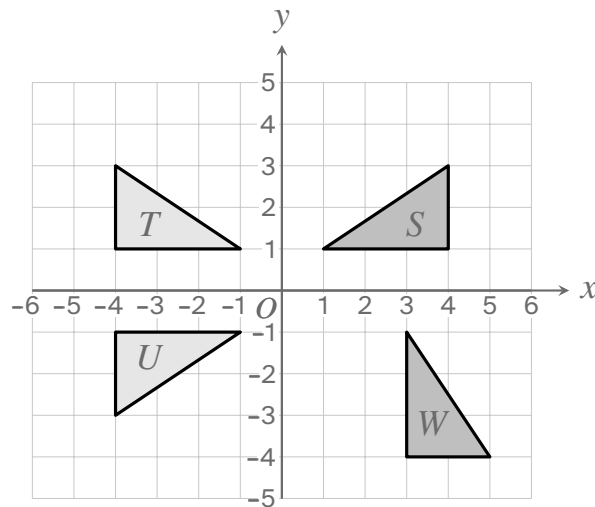
Scale factor = $4 \div 2 = 2$

A scale factor of $\frac{1}{2}$ would map F onto E .

Answer: The scale factor should be 2, not $\frac{1}{2}$

7 (5 marks)

Here are shapes S and W on a grid.



- (a) On the grid, reflect shape S in the y -axis.
Label the image T .

The y -axis is the vertical line $x = 0$.

Each vertex moves to the same distance on the other side: $(x, y) \rightarrow (-x, y)$

T has vertices $(-1, 1)$, $(-4, 1)$, $(-4, 3)$

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

- (b) On the grid, reflect shape T in the x -axis.
Label the image U .

The x -axis is the horizontal line $y = 0$.

Each vertex of T moves to the same distance on the other side: $(x, y) \rightarrow (x, -y)$

U has vertices $(-1, -1)$, $(-4, -1)$, $(-4, -3)$

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

- (c) Describe fully the single transformation that maps shape S onto shape W .

W is the same size as S but turned, so it is a rotation.

The side of S from $(1, 1)$ to $(4, 1)$ goes to the right; the matching side of W , from $(3, -1)$ to $(3, -4)$, goes down.

So S has turned a quarter turn clockwise: 90° clockwise.

Find the centre with tracing paper. Try $(1, -1)$:

$(1, 1)$ is 2 up from $(1, -1)$. After a quarter turn clockwise, 2 up becomes 2 right: $(3, -1)$, a vertex of W ✓

$(4, 3)$ is 3 right and 4 up from $(1, -1)$. After the turn this becomes 3 down and 4 right: $(5, -4)$, a vertex of W ✓

Answer: Rotation, 90° clockwise, about $(1, -1)$

Tip: The centre of rotation is not always the origin. Check your centre with tracing paper before you write it down.

Marks: 1 mark for rotation. 1 mark for 90° clockwise (or 270° anticlockwise). 1 mark for the centre $(1, -1)$.
