

Rotations

Solutions

For Pearson Edexcel GCSE Mathematics (1MA1) • 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)

- (a) The point $(2, 5)$ is rotated 180° about the origin, O .
Write down the coordinates of the image.

O is the origin, $(0, 0)$.

A half turn about O changes the sign of both coordinates.

$$(2, 5) \rightarrow (-2, -5)$$

Answer: $(-2, -5)$

- (b) The point $(4, 1)$ is rotated 90° clockwise about the origin, O .
Write down the coordinates of the image.

Sketch it. The point is 4 right and 1 up from O .

A quarter turn clockwise takes it to 1 right and 4 down.

Answer: $(1, -4)$

2 (2 marks)

On the grid, rotate triangle A 90° anticlockwise about O .

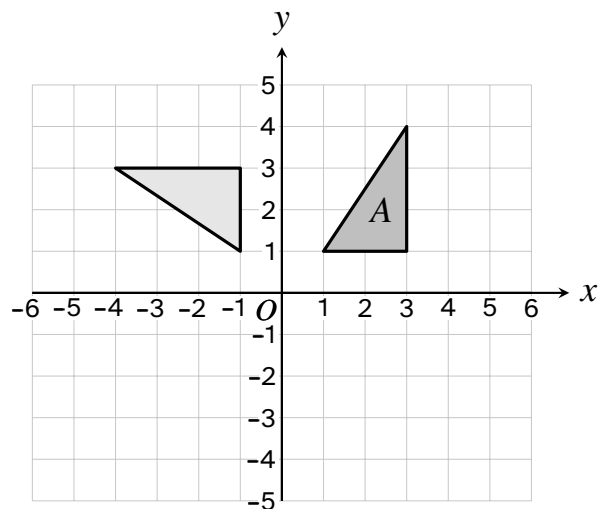
Trace triangle A , put your pencil point on O and turn the paper a quarter turn anticlockwise.

Or move one vertex at a time.

The vertex $(3, 1)$ is 3 right and 1 up from O .

A quarter turn anticlockwise takes it to 1 left and 3 up: $(-1, 3)$

The image has vertices $(-1, 1)$, $(-1, 3)$, $(-4, 3)$



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

Tip: Anticlockwise is the opposite way to a clock's hands. Turning the wrong way, or turning 180° , are the most common mistakes.

Marks: 2 marks for the correct image. 1 mark for a rotation of 90° clockwise, or for the right shape and way round but in the wrong place.

3 (2 marks)

On the grid, rotate shape *B* 180° about the point $(2, 0)$

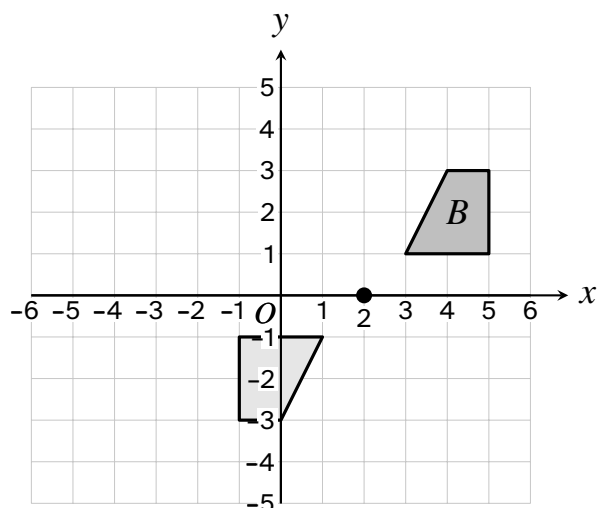
In a half turn each vertex moves to the opposite side of the centre, the same distance away.

The vertex $(5, 3)$ is 3 right and 3 up from $(2, 0)$.

So its image is 3 left and 3 down from $(2, 0)$: $(-1, -3)$

Do the same for the other vertices.

The image has vertices $(1, -1)$, $(-1, -1)$, $(-1, -3)$, $(0, -3)$



Answer: $(1, -1), (-1, -1), (-1, -3), (0, -3)$

Tip: Rotate about $(2, 0)$, not the origin. Put your pencil point on the centre you are given.

Marks: 2 marks for the correct image. 1 mark for a rotation of 180° about another point.

4 (2 marks)

On the grid, rotate triangle T 90° clockwise about the point $(0, 1)$

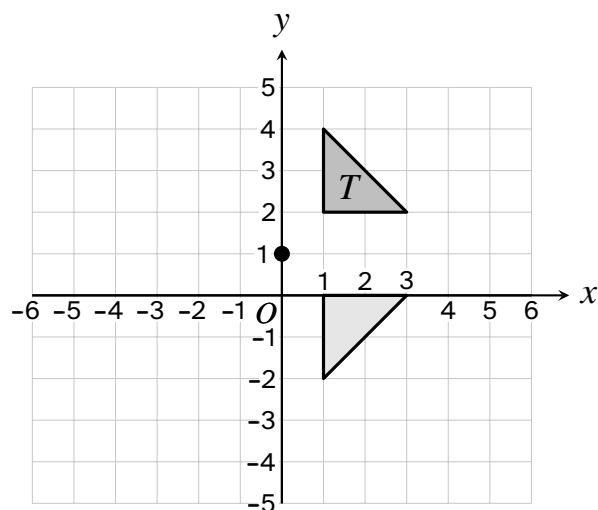
Measure each vertex from the centre $(0, 1)$.

The vertex $(3, 2)$ is 3 right and 1 up from the centre.

A quarter turn clockwise takes it to 1 right and 3 down from the centre: $(1, -2)$

The vertex $(1, 4)$ is 1 right and 3 up, so it goes to 3 right and 1 down: $(3, 0)$

The image has vertices $(1, 0), (1, -2), (3, 0)$

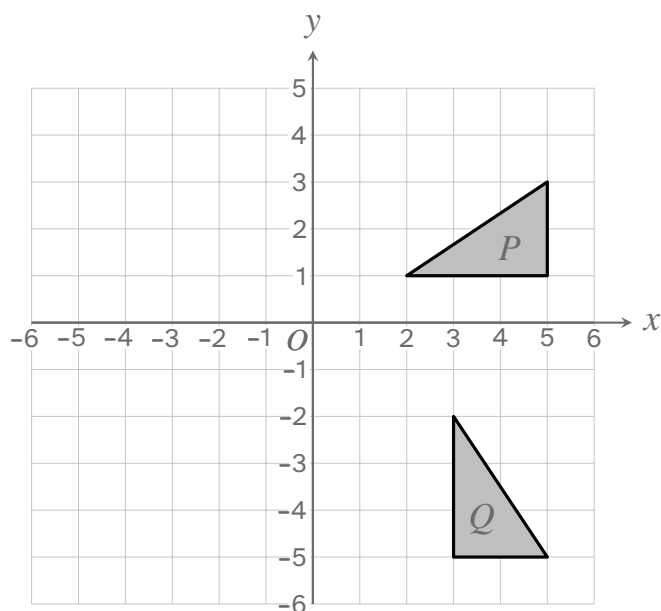


Answer: (1, 0), (1, -2), (3, 0)

Marks: 2 marks for the correct image. 1 mark for the right shape and way round but in the wrong place.

5 (2 marks)

Describe fully the single transformation that maps triangle P onto triangle Q .



Q is the same size as P but has turned, so it is a rotation.

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

Use tracing paper to find the centre. Try points until one works.

Turning about $(1, -1)$ takes $(2, 1)$ to $(3, -2)$ and $(5, 1)$ to $(3, -5)$ ✓

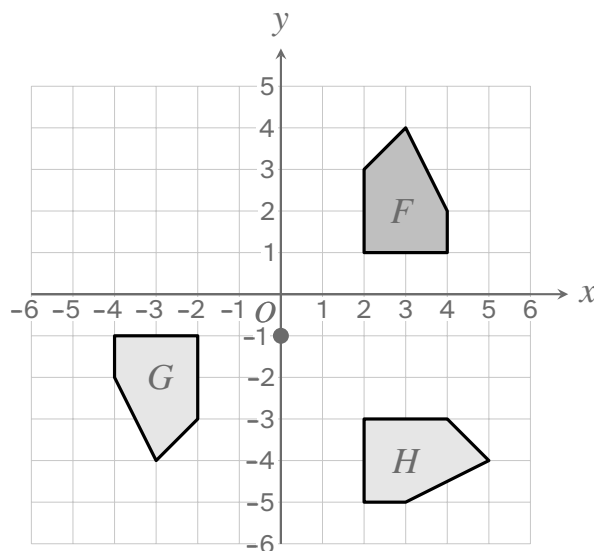
Answer: Rotation, 90° clockwise, about $(1, -1)$

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

Marks: 2 marks for rotation, 90° clockwise and centre $(1, -1)$. 1 mark for two of these. No marks if you give more than one transformation.

6 (3 marks)

Here is shape F on a grid.



- (a) On the grid, rotate shape F 180° about O .
Label the image G .

O is the origin. A half turn about O changes the sign of both coordinates of each vertex.

For example, $(4, 2) \rightarrow (-4, -2)$

G has vertices $(-2, -1)$, $(-4, -1)$, $(-4, -2)$, $(-3, -4)$, $(-2, -3)$

Answer: $(-2, -1)$, $(-4, -1)$, $(-4, -2)$, $(-3, -4)$, $(-2, -3)$

- (b) On the grid, rotate shape F 90° clockwise about the point $(0, -1)$
Label the image H .

Measure each vertex from the centre $(0, -1)$.

The vertex $(2, 1)$ is 2 right and 2 up from the centre.

A quarter turn clockwise takes it to 2 right and 2 down from the centre: $(2, -3)$

The vertex $(3, 4)$ is 3 right and 5 up, so it goes to 5 right and 3 down: $(5, -4)$

H has vertices $(2, -3), (2, -5), (3, -5), (5, -4), (4, -3)$

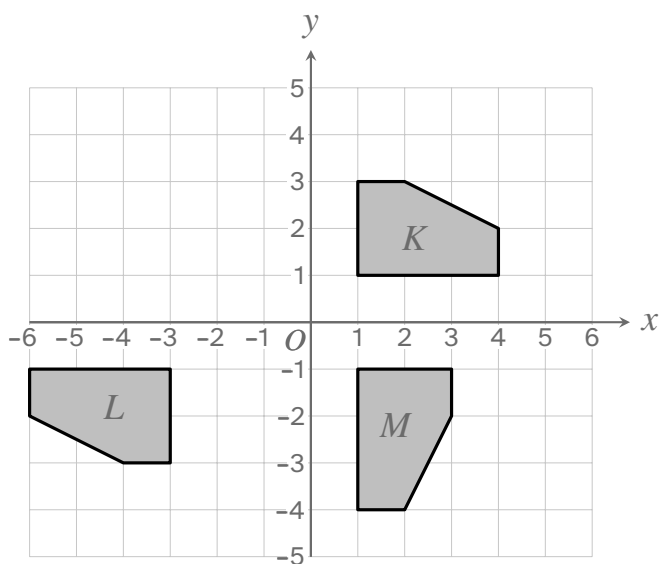
Answer: $(2, -3), (2, -5), (3, -5), (5, -4), (4, -3)$

Tip: Tracing paper helps: put your pencil on $(0, -1)$ and turn the paper a quarter turn clockwise.

Marks: 2 marks for the correct image. 1 mark for 90° clockwise about another centre, or 90° anticlockwise about $(0, -1)$.

7 (4 marks)

The grid shows three shapes, K , L and M .



- (a) Describe fully the single transformation that maps shape K onto shape L .

L is upside down compared with K , so it is a half turn: a rotation of 180° .

The centre is halfway between a vertex and its image.

(1, 1) on K goes to $(-3, -1)$ on L .

Halfway: $\left(\frac{1+(-3)}{2}, \frac{1+(-1)}{2}\right) = (-1, 0)$

Answer: Rotation, 180° , about $(-1, 0)$

Tip: Write the centre with x first: $(-1, 0)$. Many students lose the mark by writing $(0, -1)$.

Marks: 2 marks for rotation, 180° and centre $(-1, 0)$. 1 mark for two of these.

- (b) Describe fully the single transformation that maps shape K onto shape M .

M is K turned a quarter turn clockwise.

Try the origin as the centre.

Turning about $(0, 0)$ takes $(4, 1)$ to $(1, -4)$, which is a vertex of M ✓

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

Tip: Check you are going from K to M . Going from M back to K would be anticlockwise.

Marks: 2 marks for rotation, 90° clockwise and centre $(0, 0)$. 1 mark for two of these.

8 (2 marks)

Mo rotates the point $(3, 2)$ 90° anticlockwise about the origin, O .

He says,

‘The image of the point is $(2, -3)$ ’

Is Mo correct?

Give a reason for your answer.

$(3, 2)$ is 3 right and 2 up from O .

A quarter turn anticlockwise takes it to 2 left and 3 up.

So the image is $(-2, 3)$, not $(2, -3)$

$(2, -3)$ is the image for a rotation of 90° **clockwise**.

Answer: No: the image is $(-2, 3)$

Marks: 1 mark for $(-2, 3)$ or a correct sketch. 1 mark for No with a correct reason.

9 (2 marks)

On the grid, rotate triangle S 90° clockwise about the point $(-1, -1)$

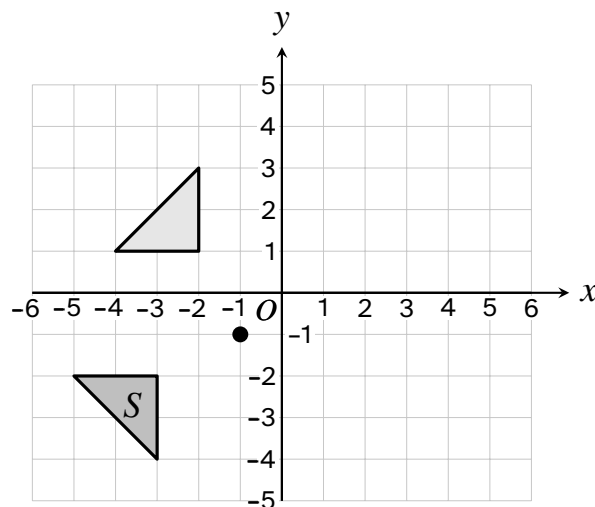
Measure each vertex from the centre $(-1, -1)$.

The vertex $(-3, -2)$ is 2 left and 1 down from the centre.

A quarter turn clockwise takes it to 1 left and 2 up from the centre: $(-2, 1)$

Do the same for the other two vertices.

The image has vertices $(-2, 3)$, $(-2, 1)$, $(-4, 1)$



Answer: $(-2, 3)$, $(-2, 1)$, $(-4, 1)$

Marks: 2 marks for the correct image. 1 mark for 90° clockwise about another centre, or 90° anticlockwise about $(-1, -1)$.
