

Symmetry

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 (1 mark)

A shape has exactly 4 lines of symmetry.

Which of these could it be?

Circle your answer.

Options: Rectangle, Square, Rhombus, Regular hexagon

Rectangle: 2 lines of symmetry.

Square: 4 lines of symmetry (2 through the middles of opposite sides and 2 diagonals).

Rhombus: 2 lines of symmetry (its diagonals).

Regular hexagon: 6 lines of symmetry.

Answer: Square

Tip: A regular polygon has the same number of lines of symmetry as sides, so a regular hexagon has 6, not 4.

2 (1 mark)

A quadrilateral has exactly **one** line of symmetry.

Which of these could it be?

Circle your answer.

Options: Rectangle, Kite, Rhombus, Square

Rectangle: 2 lines of symmetry.

Kite: 1 line of symmetry, through the corners where the pairs of equal sides meet.

Rhombus: 2 lines of symmetry.

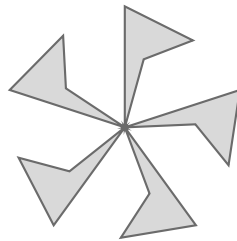
Square: 4 lines of symmetry.

Answer: Kite

Tip: A rhombus looks like a kite, but all four of its sides are equal, so both diagonals are lines of symmetry.

3 (1 mark)

Here is a design.



Circle the order of rotational symmetry of the design.

Options: 1, 2, 5, 10

Turn the design through one full turn about its centre.

It looks exactly the same 5 times (once every 72°).

So the order of rotational symmetry is 5.

Answer: 5

Tip: The design has no lines of symmetry, because each blade leans one way. It still has rotational symmetry.

4 (2 marks)

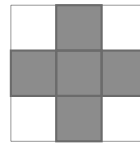
Here are four shapes made from squares.



A



B



C



D

- (a) Which shape has rotational symmetry of order 2?

Shape *B* looks the same after a half turn, so it has order 2.

C has order 4.

A and *D* have order 1 (they only look the same after a full turn).

Answer: B

- (b) Which shape has exactly one line of symmetry?

Shape *A* has one vertical line of symmetry.

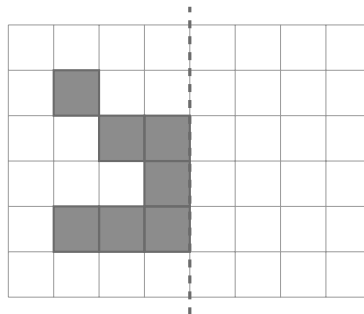
B and *D* have no lines of symmetry.

C has four lines of symmetry.

Answer: A

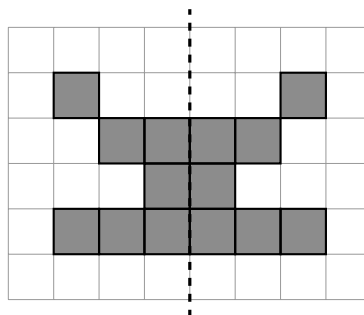
5 (2 marks)

Shade squares so that the dashed line is a line of symmetry of the shape.



Reflect each shaded square in the dashed line.

Each new square is the same distance from the line as the original, but on the other side:



Answer: See diagram

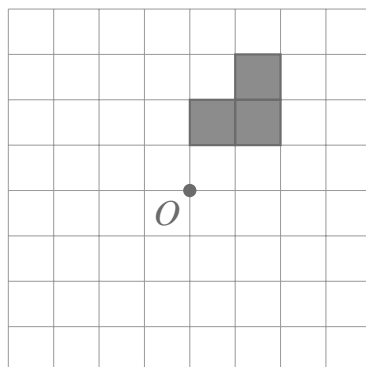
Tip: Count squares from the mirror line. A square 1 square away from the line has a partner 1 square away on the other side.

Marks: 2 marks for fully correct. 1 mark for at least 5 correct squares.

6 (2 marks)

The diagram shows part of a pattern on a square grid.

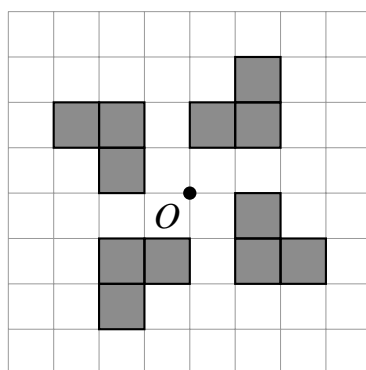
Shade 9 more squares so that the completed pattern has rotational symmetry of order 4 about the point O .



Order 4 means the pattern looks the same after every quarter turn (90°).

Rotate the 3 shaded squares through 90° , 180° and 270° about O .

That gives $3 \times 3 = 9$ new squares:



Answer: See diagram

Tip: Rotate the shape, do not reflect it. Tracing paper helps: turn it a quarter turn about O each time.

Marks: 2 marks for fully correct. 1 mark for one correct rotated copy of the 3 squares.

7 (2 marks)

Write down the order of rotational symmetry of

- (a) a parallelogram

A parallelogram looks the same after a half turn and after a full turn.

So the order is 2.

Answer: 2

- (b) a regular octagon

A regular octagon looks the same after every $\frac{1}{8}$ of a turn (45°).

So the order is 8.

Answer: 8

8 (2 marks)

- (a) Kai says,

‘A regular hexagon has 3 lines of symmetry, one through each pair of opposite corners.’

Is Kai correct?

Give a reason for your answer.

Kai has found the 3 lines through opposite corners.

But there are also 3 lines through the middles of opposite sides.

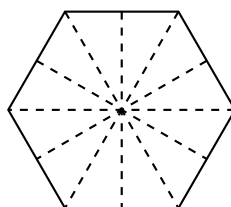
So a regular hexagon has $3 + 3 = 6$ lines of symmetry.

Answer: No. There are also 3 lines through the middles of opposite sides, so there are 6 lines

- (b) Draw all the lines of symmetry on this regular hexagon.

Draw a line through each pair of opposite corners (3 lines)

and a line through the middles of each pair of opposite sides (3 lines):



Answer: 6 lines

Tip: A regular polygon with n sides has n lines of symmetry.

9 (1 mark)

Which of these statements is true?

Tick one box.

A parallelogram has no lines of symmetry, so the first statement is false.

A parallelogram has rotational symmetry of order 2 but no lines of symmetry, so the second statement is false.

A rectangle looks the same only after a half turn and a full turn, so it has order 2, not 4.

An equilateral triangle looks the same after every third of a turn (120°), so it has order 3. True

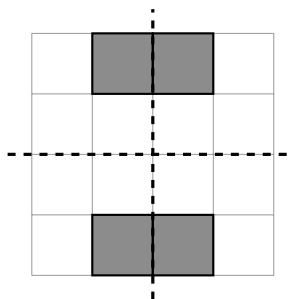
Answer: An equilateral triangle has rotational symmetry of order 3

10 (2 marks)

In the grid below, shade one quarter of the squares so that the grid has exactly two lines of symmetry. Shade complete squares only.

There are 16 squares, so shade $16 \div 4 = 4$ squares.

For example, shade the middle two squares of the top row and of the bottom row:



This has a vertical and a horizontal line of symmetry (dashed), but the diagonals are not lines of symmetry.

Shading the middle 2×2 block is wrong: that gives four lines of symmetry.

Answer: e.g. the middle two squares of the top row and of the bottom row

Tip: Check the diagonals too. You need **exactly** two lines, so the diagonals must not be lines of symmetry.

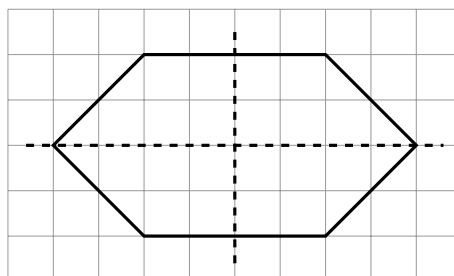
Marks: 2 marks for fully correct. 1 mark for four squares shaded with at least one line of symmetry.

11 (2 marks)

On the grid, draw a hexagon that has exactly **two** lines of symmetry.
Show the lines of symmetry as dashed lines.

A hexagon has 6 sides.

For example, a 'stretched' hexagon with a vertical and a horizontal line of symmetry:



Its diagonals are not lines of symmetry, so it has exactly two.

Other answers are possible. A regular hexagon is wrong: it has 6 lines of symmetry.

Answer: e.g. a hexagon with vertices (1, 3), (3, 1), (7, 1), (9, 3), (7, 5), (3, 5) on the grid

Tip: Count the sides: a hexagon has 6. Check your shape folds exactly onto itself along each dashed line.

Marks: 2 marks for a correct hexagon with both lines of symmetry shown. 1 mark for a hexagon with exactly two lines of symmetry, or a hexagon with at least one correct line of symmetry shown.

12 (2 marks)

A rectangle has lines of symmetry $x = 1$ and $y = 5$

One vertex of the rectangle is at $P(4, 7)$

Work out the coordinates of the vertex opposite P .

The lines of symmetry cross at (1, 5), the centre of the rectangle.

The opposite vertex is the same distance from the centre, but on the other side.

P is 3 to the right of $x = 1$, so the opposite vertex is 3 to the left: $x = 1 - 3 = -2$

P is 2 above $y = 5$, so the opposite vertex is 2 below: $y = 5 - 2 = 3$

Answer: $(-2, 3)$

Tip: $x = 1$ and $y = 5$ are not the axes. Measure distances from these lines, and check your answer with a quick sketch.

Marks: 1 mark for -2 or 3 . 1 mark for both correct.
