

Exercise walk-through

E4.5

Symmetry

IGCSE Mathematics

You must be able to

- state the number of lines of symmetry and the order of rotational symmetry of a shape
- name the symmetry properties of a circle: the perpendicular from the centre bisects a chord, and tangents from an external point are equal
- use those properties in a calculation with Pythagoras

1

The method

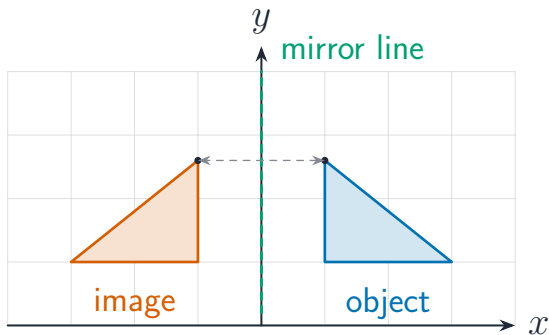
Method — Fold it, then turn it

- **Regular polygons:** a regular n -sided polygon has n lines of symmetry and rotational symmetry of order n .
- **Watch the parallelogram:** it has NO lines of symmetry but rotational symmetry of order 2. A rectangle has 2 and 2; a rhombus has 2 and 2; a square has 4 and 4.
- **Every shape** has rotational symmetry of at least order 1 — order 1 means no rotational symmetry.
- **Circle properties:** the perpendicular from the centre to a chord BISECTS it, and the two tangents from an external point are equal in length.

Answer shapes (marked by **method marks** — M1 for a correct method, A1 for the correct answer): in a circle calculation, naming the property used is a mark on its own — write it down before the arithmetic.

Method — Fold it, then turn it

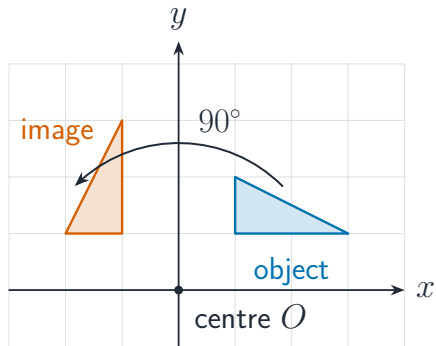
Answer shapes (marked by method marks — M1 for a correct method, A1 for the correct answer): in a circle...



A shape and its mirror image across a line of symmetry

Method — Fold it, then turn it

Answer shapes (marked by method marks — M1 for a correct method, A1 for the correct answer): in a circle...



A shape turned about a centre of rotation

2

Practice

Practice 2.1 ■ 2 marks

Write down the number of lines of symmetry and the order of rotational symmetry of a regular hexagon.

Solution 2.1

Method: Fold it, then turn it — p.4

Worked steps

- a regular n -gon has n of each

6 lines, order 6

B1 B1

Practice 2.2 ■ 1 mark

Write down the order of rotational symmetry of a parallelogram.

Solution 2.2

Method: Fold it, then turn it — p.4

Worked steps

- turning it through 180° gives the same shape, and a full turn gives it twice

order 2

B1

Practice 2.3 ■ 1 mark

Write down the number of lines of symmetry of an isosceles trapezium.

Solution 2.3

Method: Fold it, then turn it — p.4

Worked steps

- the fold line runs through the midpoints of the two parallel sides

1

B1

3

Exam-style

Exam-style 3.1 ■ 4 marks

For each shape, write down the number of lines of symmetry and the order of rotational symmetry.

Exam-style 3.1 (a) ■ 2 marks

A rectangle that is not a square.

Solution 3.1 (a)

Method: Fold it, then turn it — p.4

Worked steps

- the fold lines join the midpoints of opposite sides; the diagonals are NOT lines of symmetry

2 lines, order 2

B1 B1

Exam-style 3.1 (b) ■ 2 marks

A regular pentagon.

Solution 3.1 (b)

Worked steps

- regular, so both equal the number of sides

5 lines, **order 5**

B1 **B1**

Exam-style 3.2 ■ 4 marks

A chord AB of length 16 cm is drawn in a circle of centre O and radius 10 cm.

Exam-style 3.2 (a) ■ 1 mark

State the symmetry property of a circle that lets you find the distance from O to AB .

Solution 3.2 (a)

Method: Fold it, then turn it — p.4

Worked steps

- the perpendicular from the centre of a circle to a chord **bisects the chord**

B1

Exam-style 3.2 (b) ■ 3 marks

Find the distance from O to AB .

Solution 3.2 (b)

Worked steps

- half the chord is $16 \div 2 = 8$ cm **M1**
- the radius, the half-chord and the distance form a right-angled triangle, so
$$d = \sqrt{10^2 - 8^2}$$
M1
$$= \sqrt{36} = \mathbf{6} \text{ cm}$$
A1
- the radius is the HYPOTENUSE, so it is subtracted from, not added to