Recognising reflection symmetry and counting axes — Teacher answers

Year 8, upper volume • text pp. 29–30 • foundation lesson 15

Project one fold test and require a reason for rejected lines. Keep a figure’ s own axes separate from a given axis exchanging two figures. A symmetry axis is a line, not a short segment.

Worked example 1

A rectangle has unequal adjacent side lengths. Find all of its symmetry axes and explain why its diagonals are excluded.



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

2 axes. The two lines through the centre joining opposite side midpoints. The diagonals fail for a non-square rectangle.

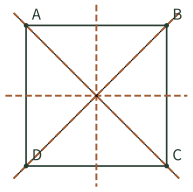
1. Check candidate lines by whether corresponding vertices and edges coincide after folding.
2. The two lines through the centre joining opposite side midpoints. The diagonals fail for a non-square rectangle.
3. The complete count is 2.

- List or draw all valid full lines without counting one line twice.
- Explain the fold test and exclude invalid candidates.

Guided attempt 2

Draw every symmetry axis of the square. Use the scaffold to ensure that no type of line is missing.

1. First draw the two lines through opposite side midpoints.
2. Then test lines through opposite vertices.
3. Extend each axis beyond the square and check the total.



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

Four full lines: two joining opposite side midpoints and the two diagonals.

1. The two midpoint lines exchange opposite pairs of vertices.
2. Each diagonal fixes two vertices and exchanges the other two.
3. All four pass the whole-figure fold test; count each line once.

- List or draw all valid full lines without counting one line twice.
- Explain the fold test and exclude invalid candidates.

Prerequisite 3

Which test defines reflection symmetry for a single figure?

A. The figure looks balanced from a distance.
B. Any two parts have equal areas.
C. Folding along a line makes the whole figure coincide.
D. The figure contains two equal sides somewhere.

Reference answer

The whole-figure fold test.

1. Reflection must match all corresponding points and edges.
2. Equal area or a visual impression alone is insufficient.

- Identify the fold-and-coincide definition.

Prerequisite 4

A pupil draws a short segment inside a symmetric figure and calls it the whole symmetry axis. Which correction is appropriate?

A. An axis must be a curved line.
B. Every internal segment is an axis.
C. An axis cannot pass through the figure.
D. Extend it in both directions: the axis is a full line.

Reference answer

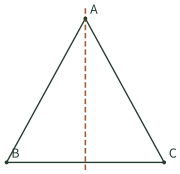
A symmetry axis is a line extending in both directions.

1. The line determines a reflection in the whole plane.
2. Draw it beyond the figure to make the intended full axis clear.

- Use the term line and show both extensions.

Independent practice 5

AB=AC, but △ABC is not equilateral. How many symmetry axes does it have?



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

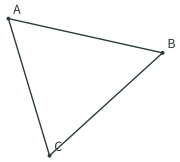
1 axes. The line through the apex and the base midpoint; the triangle is not equilateral.

1. Check candidate lines by whether corresponding vertices and edges coincide after folding.
2. The line through the apex and the base midpoint; the triangle is not equilateral.
3. The complete count is 1.

- List or draw all valid full lines without counting one line twice.
- Explain the fold test and exclude invalid candidates.

Independent practice 6

All three side lengths of a triangle differ. How many symmetry axes does it have?



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

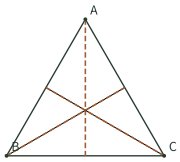
0 axes. No line can fold a scalene triangle onto itself: no pair of its sides is equal.

1. Check candidate lines by whether corresponding vertices and edges coincide after folding.
2. No line can fold a scalene triangle onto itself: no pair of its sides is equal.
3. The complete count is 0.

- List or draw all valid full lines without counting one line twice.
- Explain the fold test and exclude invalid candidates.

Independent practice 7

Find the number of symmetry axes of an equilateral triangle and state where each passes.



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

3 axes. Each line through a vertex and the opposite side midpoint is an axis.

1. Check candidate lines by whether corresponding vertices and edges coincide after folding.
2. Each line through a vertex and the opposite side midpoint is an axis.
3. The complete count is 3.

- List or draw all valid full lines without counting one line twice.
- Explain the fold test and exclude invalid candidates.

Independent practice 8

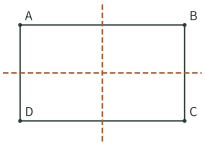
For a non-square rectangle, a pupil counts both diagonals as axes. Which reason shows the error?

A. Diagonals never occur in any symmetry axis.

B. A rectangle has no symmetry axes.

C. Every diagonal has to be horizontal.

D. A diagonal fold would match unequal adjacent sides, so the whole figure does not coincide.



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

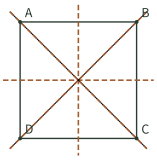
The diagonal fold fails because adjacent sides are unequal; the two midpoint lines are the axes.

1. A diagonal fixes its endpoints and would exchange the other vertices.
2. For unequal adjacent sides, those vertices and edges do not coincide.
3. Retain only the two midpoint axes.

- List or draw all valid full lines without counting one line twice.
- Explain the fold test and exclude invalid candidates.

Exit question 9

Without looking at the worked example, count all symmetry axes of a square.



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

4 axes. Two lines through opposite side midpoints and the two diagonals.

1. Check candidate lines by whether corresponding vertices and edges coincide after folding.
2. Two lines through opposite side midpoints and the two diagonals.
3. The complete count is 4.

- List or draw all valid full lines without counting one line twice.
- Explain the fold test and exclude invalid candidates.

Exit question 10

Two figures are congruent. Does this fact alone prove that they are reflections of one another in a single line? Explain what still must be checked.

Reference answer

No. One common reflection line must exchange all corresponding points; equal size and shape alone do not supply it.

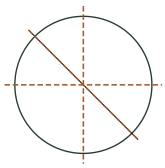
1. Congruence specifies equal shape and size.
2. The two figures may instead be related by a translation or rotation without the required reflection relationship.
3. Check that one line works for every corresponding pair.

- State that congruence alone is insufficient and identify the common-axis requirement.

Further practice 11

Which description gives all symmetry axes of a circle?

A. Only one chosen diameter.
B. Every tangent line.
C. Every line through its centre; there are infinitely many.
D. Only the horizontal and vertical diameters.



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Reference answer

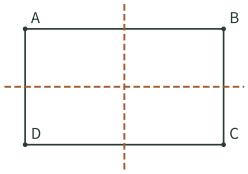
Every line through the centre is an axis, so there are infinitely many.

1. Reflection in a line through the centre preserves the distance to the centre.
2. Thus every circle point maps to another circle point for any such line.

- State infinitely many axes and require the centre to lie on each.

Further practice 12

Draw the complete symmetry axes of a non-square rectangle, using a dashed line for each.



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Reference answer

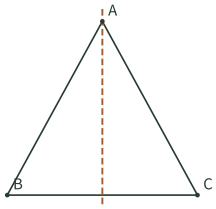
Two axes: the lines through the midpoints of opposite sides.

1. Mark both pairs of opposite-side midpoints.
2. Join the matching midpoint pairs and extend the lines.
3. Check that each fold exchanges corresponding corners and edges.

- List or draw all valid full lines without counting one line twice.
- Explain the fold test and exclude invalid candidates.

Further practice 13

AB=AC and the triangle is not equilateral. Draw its symmetry axis as a full line and mark the base midpoint.



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Reference answer

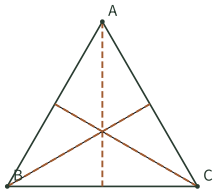
The line joining A to the midpoint of BC, extended in both directions.

1. Mark the midpoint of BC.
2. Draw the line through A and that midpoint.
3. It fixes A and exchanges B with C, giving the only axis.

- List or draw all valid full lines without counting one line twice.
- Explain the fold test and exclude invalid candidates.

Further practice 14

Draw every symmetry axis of an equilateral triangle. Mark each opposite-side midpoint to organise your work.



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Reference answer

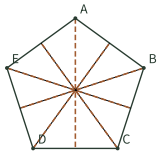
Three full lines, each through one vertex and the opposite side midpoint.

1. Construct or identify the midpoint of each side.
2. Join each midpoint to the opposite vertex and extend the line.
3. The three different lines all pass the fold test.

- List or draw all valid full lines without counting one line twice.
- Explain the fold test and exclude invalid candidates.

Extension 15

A regular pentagon has five equal sides and five equal angles. Find all its symmetry axes.



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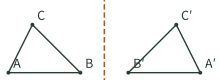
Reference answer

5 axes. Each axis joins a vertex to the opposite side midpoint; the five vertices give five axes.

1. Check candidate lines by whether corresponding vertices and edges coincide after folding.
2. Each axis joins a vertex to the opposite side midpoint; the five vertices give five axes.
3. The complete count is 5.

- List or draw all valid full lines without counting one line twice.
- Explain the fold test and exclude invalid candidates.

The shown scalene triangle and its mirror image are exchanged by the given vertical line. Does either triangle alone need its own symmetry axis? Explain the distinction.



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

No. Each scalene triangle has no axis of its own, but the given line exchanges the two whole triangles.

1. A figure’ s own symmetry maps that figure onto itself.
2. A pairwise reflection instead maps the first figure to the other.
3. These triangles are scalene, yet all three corresponding pairs match under the given line.

- Distinguish self-symmetry from two figures being mirror images.