Stimulus question 71

Symmetry Properties

Teaching notes

Key question/task

Here are several shapes which have had lines of symmetry marked in.
However, only on some of these are all the lines of symmetry marked correctly.
Circle the ones that are correct.
For the ones that are incorrect, explain what is wrong, and try to show the correct solutions.

Supplementary questions:

- Have you checked whether there are enough lines of symmetry indicated on each shape?
- Have you checked whether there are too many lines of symmetry marked on each shape?
- Are there any shapes that have no lines of symmetry?

Resources:

- Resource sheet 'Symmetry Properties';
- Plain paper, pencils, rulers.

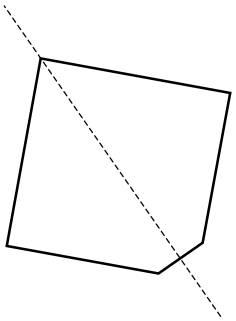
Commentary/notes:

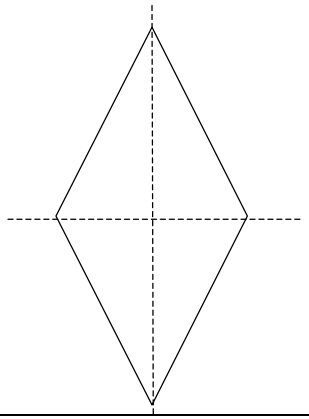
These activities will require reasoning about symmetry: reasoning about links between reflection and rotation symmetries, about how lines of symmetry are oriented within a shape, and why the number of lines of symmetry that a shape can have is always a factor of the number of sides. This reasoning is not often tackled in regular exercises.

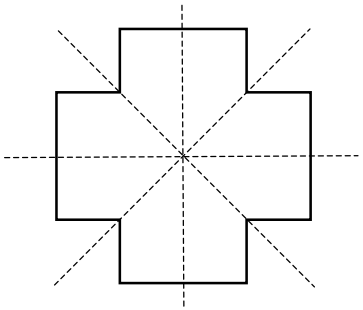
The content is suitable for all tiers.

Solutions:

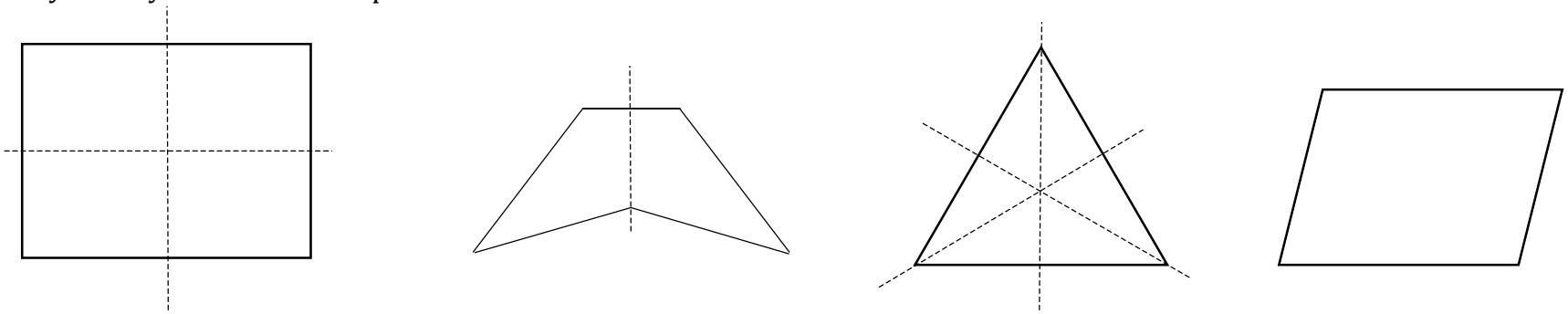
The 3 correct answers are:







The lines of symmetry on the other shapes should look like this:



A common error is to place lines of symmetry along the diagonals of a rectangle.
The triangle is equilateral, hence three lines of symmetry.
A parallelogram has no lines of symmetry.

Symmetry Properties: extension questions

It is expected that you will draw several examples of polygons to explore the ideas in these questions, before you reach a conclusion.
Please show your working, including diagrams that are drawn accurately and carefully with a pencil and ruler. Indicate lines of symmetry with dashed lines.

1. In what situations do a polygon's lines of symmetry bisect only its sides?
2. In what situations do a polygon's lines of symmetry bisect only its angles?
3. Can a polygon's lines of symmetry bisect an angle and an opposite side? In what situation does this happen?

Supplementary questions:

- What could be the differences we are looking for between polygons that might affect the lines of symmetry? *(E.g. possible answers are odd/even numbers of sides, regularity.)*
- Are there other diagrams we could draw?

Resources:

- Resource sheets, including the **extension questions** and **Polygons: regular and otherwise;**
- Plain paper, pencils, rulers, protractors, pairs of compasses. (Construction is not required here, but it may be an opportunity for construction work.)

Reasoning: questions to discuss and explore

- If two lines of symmetry bisect each other at 90°, what would happen when a shape has three, four or more lines of symmetry? At what angles do they cross?
- Do all multiple lines of symmetry bisect each other within a shape?
- The shapes offered in the resource Polygons: regular and otherwise are all convex. Will a concave shape have lines of symmetry? What do the words convex and concave describe?

*This question will link with **Task 25: The Album Cover**, which also explores symmetry properties. You may wish to tackle the two activities during the same sequence of lessons.*

Commentary/notes/solutions:

The intention with these questions is to give learners a greater insight into symmetry, beyond merely identifying and drawing the lines, as may be their more familiar experience. Knowing how it works might help them identify their own errors. If linking with Task 25: 'The Album Cover', some discussion of concave and convex shapes may arise and be useful here.

Note that there are many even-numbered sided polygons where the lines of symmetry bisect opposite sides *and* opposite angles, (including the regular even-numbered sided polygons), but never an angle opposite a side.

1. Lines of symmetry will bisect sides only when the polygon has an even number of sides but the sides are not the same length – e.g. in a rectangle.
2. Lines of symmetry will bisect angles only, again when there are an even number of sides but this time the angles are different, and the sides are the same length – e.g. as in a rhombus.
3. Lines of symmetry will bisect opposite angles and sides in polygons with an odd number of sides, (e.g. as in triangles and pentagons). In this case, not all the sides or angles may be the same sizes, and this will change the number of lines of symmetry. Where the polygons are regular, the number of lines of symmetry equals the number of sides/angles.

GCSE Subject Content		
Foundation	**Intermediate**	**Higher**
Simple description of symmetry in terms of reflection in a line/plane. Regular and irregular polygons. Vocabulary of triangles, quadrilaterals and circles: isosceles, equilateral, scalene, exterior/interior angle, diagonal, square, rectangle, parallelogram, rhombus, kite, trapezium, polygon, pentagon, hexagon. Bisecting a given line, bisecting a given angle.		
	Essential properties of special types of quadrilateral, including square, rectangle, parallelogram, trapezium, kite and rhombus; classify quadrilaterals by their geometric properties.	

Learner Outcomes and Assessment (*to aid comment-only marking*)	
Reasoning strand – Learners are able to:	**Assessment Guidance: Can learners:**
• Identify, measure or obtain required information to complete the task; • Identify what further information might be required and select what information is most appropriate; • Select appropriate mathematics and techniques to use; • Explain results and procedures precisely using appropriate mathematical language; • Interpret mathematical information; draw inferences from diagrams; • **Explain and justify strategies, methods, reasoning and conclusions in a variety of different ways, including orally, graphically, writing (both with mathematical notation and without), using appropriate digital literacy equipment;** • **Appreciate the difference between mathematical explanation and experimental evidence.**	• Support their arguments with convincing reasons? • Identify appropriate properties of shapes to support their arguments? • Create a chain of reasoning? • Use the correct mathematical vocabulary in their descriptions and explanations? • Draw diagrams accurately? • Recognise that simply by producing several examples of where a shape situation works, it does not mean that that it is always true? Some situations require deeper reasoning.