Symmetry and tessellations

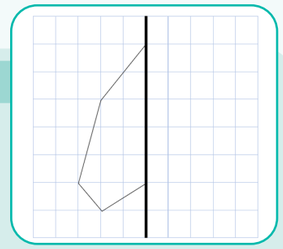
Lines of symmetry for 2-D shapes, planes of symmetry for 3-D shapes, rotational symmetry, and tessellations.

2-D shapes: lines of symmetry

A shape has line symmetry if one half of a shape is a mirror image of the other half of the shape. The line that divides the two halves of a symmetrical shape is called the **line of symmetry** (or mirror line).

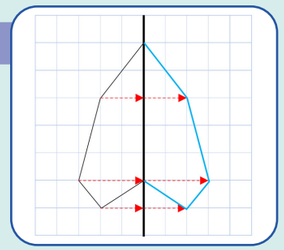
Lines of symmetry can be vertical, horizontal, or diagonal. Not all shapes have a line of symmetry. The number of lines of symmetry in a regular polygon is equal to the number of sides.

Example 1



This diagram shows one half of a symmetrical shape, together with its mirror line. Complete the diagram by drawing the other side of the shape.

Answer



Method 1

- Trace over the shape and the mirror line.
- Turn over the tracing paper and line up the mirror line.
- The image on the tracing paper will now show the other side of the shape.

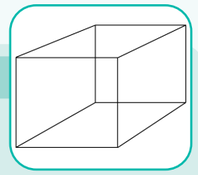
Method 2

- Mirror each vertex of the shape on the other side of the mirror line.
- Do this by counting how far each vertex is away from the mirror line.

3-D shapes: planes of symmetry

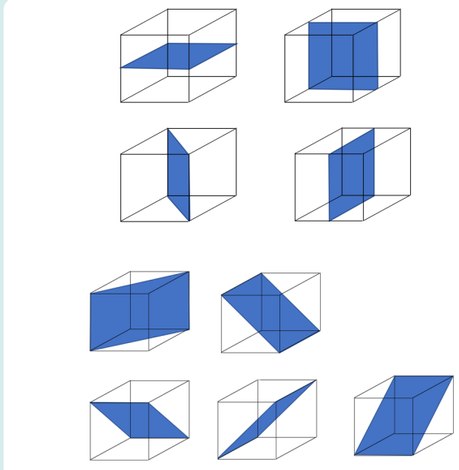
For 3-D shapes, if you could cut the shape into two halves that mirror each other, then the plane that divides the two halves is called a **plane of symmetry**.

Example 2

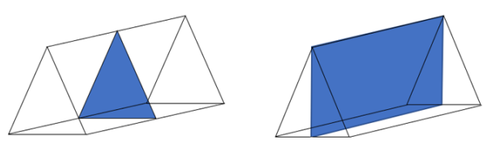


Consider a cube.

A cube can be cut into mirrored halves in nine different ways as the diagrams below show. Each diagram shows a different plane of symmetry.



Different 3-D shapes have different numbers of planes of symmetry. For example, an isosceles triangular prism only has two planes of symmetry.



Check that you can:

- recognise vertical, horizontal and diagonal lines
- use degrees (°) to describe and perform simple rotations of shapes
- recognise congruent shapes.

Rotational symmetry

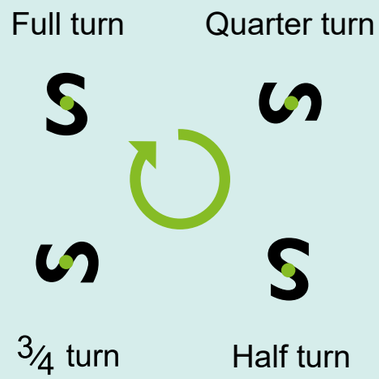
A shape has rotational symmetry if it fits onto itself two or more times as you turn it through one full turn about its centre.

Example 3

Consider the letter S.

If it is rotated about its centre, the following shapes are produced.

The letter S matches itself twice during a full turn.



We use the term '**order of rotational symmetry**' to describe how many times a shape matches itself in a full turn. Therefore, the letter S has a rotational symmetry of order two.

REMEMBER!

Not all shapes have a line of symmetry, and different 2-D and 3-D shapes have different numbers of lines of symmetry. Not all regular polygons tesselate.

Tessellations

A tessellation is when one or more shapes are used using a repeating pattern to completely cover a flat area with no overlaps and with no gaps. Many tiled surfaces on a wall or floor of a room use tessellations, as repeating patterns are usually used with no gaps or overlaps. Some tessellations use more than one shape in a repeating pattern.

As there can be no overlaps or gaps in a tessellation, the sides of the shapes making up the pattern should fit together perfectly. At each vertex where these shapes meet, the interior angles should all add to 360°.

Not all regular polygons tesselate. For regular polygons to tesselate, the size of each interior angle must be a factor of 360°.