Unit 18 · Symmetry and Tessellation

STUDY NOTES

Key terms

Symmetrical figure: a straight line divides it into two halves that fit exactly on each other when folded along it.

Line of symmetry (**axis of symmetry**, **mirror line**): that fold line; a figure can have none, one or many.

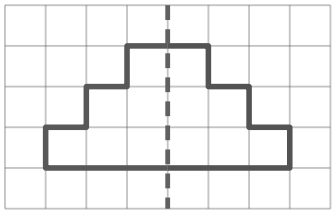
Point symmetry: the figure looks exactly the same after **half a turn (180°)** about a point (rotated through 180°).

Center of symmetry: that point; every point of the figure has a partner opposite it, the same distance away.

Tessellation: covering a flat surface with one or more shapes, **no gaps**, **no overlaps**; also the pattern made.

Line symmetry

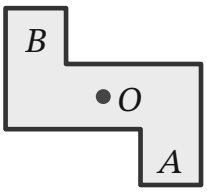
- the test is the **fold**: one half must land exactly on the other
- two equal halves are not enough: a slanting parallelogram's diagonal makes two equal triangles, but they land crossed over
- fold paper twice, cut, open: **2** lines (the folds), crossing at right angles
- complete a half figure: each corner as far behind the line as it is in front (half an H → H); on squared paper count the squares to the line



Half a figure completed across the dotted line.

Point symmetry

- turn a tracing about O: after 180° it fits again, A and B swapped; in a full turn it fits **twice** (180°, 360°)
- rotate a tracing 180° about O: each point goes through O to as far on the other side

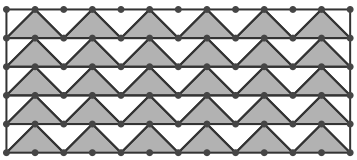


The shape after half a turn about O: it looks the same, A and B swapped.

- capitals with point symmetry: **H, I, N, O, S, X, Z** (turn the page upside down); M ↔ W, so no

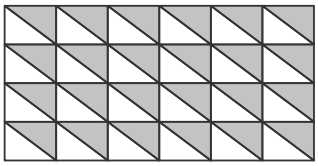
Tessellation

- floors, brick walls, the weave of a *nanglo* or *doko*, a football's panels
- **any triangle** tiles a floor: turn every other copy half a turn
- why: six corners meet at a point, each angle twice: $2 \times 180° = \mathbf{360}°$, a full turn
- on dots: rows of triangles up and down by turns, a half triangle at each end



Dots joined into a triangular tessellation.

- right-angled triangles: cut rectangles along a diagonal; equilateral: rows up and down by turns

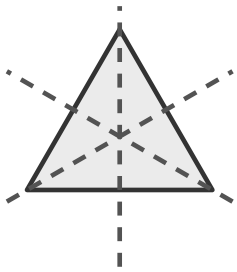


A tessellation of right-angled triangles.

Which figure has which

Figure	Lines of symmetry	Point symmetry
A, W, M, peepal leaf, protractor	1	no
isosceles triangle	1	no
equilateral triangle	3	no
rectangle (not its diagonals), H, razor blade	2	yes
rhombus	2 (the diagonals)	yes
square	4	yes
slanting parallelogram; S, Z, N; pinwheel	0	yes
L, mug	0	no

- a square's 4: two through the middles of the sides, two diagonals; a regular hexagon has 6 lines; a circle has both kinds



An equilateral triangle's three lines of symmetry.

Back to the pinwheel

- four blades: fits after every **quarter turn** (four times a turn) → point symmetry; so does any even number of equal blades
- **no** line of symmetry: every blade curls the same way; a mirror would curl them the other way
- king of hearts: bottom half = top half turned 180° → point symmetry, no line: no upside down

COMMON MISTAKES

✗ a parallelogram's diagonal is a line of symmetry
✓ equal halves, but folded they land crossed over.

✗ an equilateral triangle has point symmetry
✓ after 180° it points down; it fits only at 120° and 240°.

✗ N, S, Z have a line of symmetry
✓ none; they have point symmetry.

✗ only special triangles tile a floor
✓ any triangle does, every other copy turned 180°.