Unit 18 · Symmetry and Tessellation

HARDER PRACTICE QUESTIONS · ANSWER KEY

Full marks 35

Give the marks for the points in the marking scheme; an answer in other words that says the same is right.

1 Spot the errors

ANSWER U · 4

i. **2 lines.** Folded along a diagonal, a rectangle that is not a square doesn't fit on itself: the corners miss each other. Only the two lines through the middles of opposite sides work.

ii. **N has no line of symmetry.** Folded down the middle, its slanting stroke lands the wrong way. It has **point symmetry**: half a turn brings it back.

iii. **Not always.** S, Z, N and a parallelogram have point symmetry and no line of symmetry.

iv. **No point symmetry.** It fits on itself after 120° and 240°, but point symmetry needs half a turn, 180°, and after half a turn it points down.

MARKING SCHEME

- ✓ i. 2 lines: the diagonals are not lines of symmetry.
- ✓ ii. No line of symmetry; it has point symmetry.
- ✓ iii. Not always: S, Z, N or a parallelogram.
- ✓ iv. No point symmetry: half a turn makes it point down.

2 Words in a mirror and upside down

ANSWER A · 4

i. Down: **A, H, M, T, X**. Across: **B, C, D, E, H, K, X**. Both: **H and X**.

ii. M and O each have a line of symmetry down the middle, and the word reads the same backwards. A mirror beside it swaps left and right, so the word comes back unchanged.

iii. **NOON, SIS and SWIMS.** MOM becomes **WOW**: half a turn makes each M a W.

iv. **BOX and CHOICE**: every one of their letters has a line of symmetry across the middle, and the mirror keeps the order. MOM and TOOT don't: M and T have no line across.

MARKING SCHEME

- ✓ i. Down A, H, M, T, X; across B, C, D, E, H, K, X; both H and X.
- ✓ ii. Symmetric letters, and the word reads the same backwards.
- ✓ iii. NOON, SIS, SWIMS; MOM becomes WOW.
- ✓ iv. BOX and CHOICE, with the reason.

3 Regular shapes

ANSWER A · 4

i. Triangle **3**, square **4**, hexagon **6**: a regular shape has as many lines of symmetry as it has sides.

ii. **5**: each runs from a corner to the middle of the opposite side.

iii. The **square** and the **hexagon**. The triangle and the pentagon point the other way after half a turn.

iv. Those with an **even** number of sides: each corner then has a corner straight opposite it across the center, so half a turn swaps them.

MARKING SCHEME

- ✓ i. 3, 4 and 6, drawn.
- ✓ ii. 5, corner to the middle of the opposite side.
- ✓ iii. Square and hexagon.
- ✓ iv. An even number of sides.

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4 Complete the figure

ANSWER A · 4

i. $(-1, 3)$, $(-2, 1)$ and $(-2, 0)$: each corner's x-coordinate changes sign.

ii. $(0, 4)$, $(1, 3)$, $(2, 1)$, $(2, -1)$, $(1, -3)$, $(0, -4)$, $(-1, -3)$, $(-2, -1)$, $(-2, 1)$, $(-1, 3)$.

iii. **10 corners.** The side from $(2, 1)$ down to $(2, 0)$ carries straight on to $(2, -1)$, so $(2, 0)$ is in the middle of a straight side, not a corner (and so is $(-2, 0)$).

iv. **Yes**, about the **origin**: each corner (x, y) has a partner $(-x, -y)$ in the figure, such as $(1, 3)$ and $(-1, -3)$.

MARKING SCHEME

- ✓ i. The three new corners.
- ✓ ii. The ten corners.
- ✓ iii. 10: $(2, 0)$ is on a straight side.
- ✓ iv. Point symmetry about the origin.

5 Line, point, both or neither?

ANSWER U · 4

a. **No lines, point symmetry**: no fold fits it on itself, but half a turn about the crossing of its diagonals does.

b. **2 lines** (its two diagonals) **and point symmetry**.

c. **1 line** (the diagonal between the corners where the equal sides meet), **no point symmetry**: half a turn makes it point the other way.

d. **1 line** (through the middles of the two parallel sides), **no point symmetry**: half a turn puts the long side on top.

MARKING SCHEME

- ✓ a. No lines; point symmetry.
- ✓ b. 2 lines; point symmetry.
- ✓ c. 1 line; no point symmetry.
- ✓ d. 1 line; no point symmetry.

6 Triangles in a triangle

ANSWER A · 4

i. The rows have **1, 3, 5 and 7** small triangles, from the top. **10 point up** $(1 + 2 + 3 + 4)$ and **6 point down** $(1 + 2 + 3)$.

ii. Up: **1, 3, 6, 10**. Down: **0, 1, 3, 6**. In all: **1, 4, 9, 16**.

iii. **Square numbers**: the side times itself, 1^2, 2^2, 3^2, 4^2. With sides of 10 cm: $10^2 = \mathbf{100}$ small triangles (the rows 1, 3, 5, …, 19 add up to 100).

iv. $64 = 8^2$, so its sides are **8 cm**. Down: $1 + 2 + \cdots + 7 = \mathbf{28}$ (and $64 - 28 = 36$ point up, $1 + 2 + \cdots + 8$).

MARKING SCHEME

- ✓ i. Rows of 1, 3, 5 and 7: 10 up, 6 down.
- ✓ ii. The table.
- ✓ iii. Square numbers: 100.
- ✓ iv. 8 cm, 28 pointing down.

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7 Tiling a veranda

ANSWER A · 4

i. $400 \div 40 = \mathbf{10}$ along and $320 \div 40 = \mathbf{8}$ across.

ii. $10 \times 8 = \mathbf{80\ tiles}$.

iii. $20 \times 16 = \mathbf{320\ tiles}$: halving the side makes twice as many tiles along **and** twice as many across.

iv. $2 \times 80 = \mathbf{160\ triangles}$, from the same **80 tiles**: the two halves of a tile cover what the tile covered.

MARKING SCHEME

✓ i. 10 and 8.

✓ ii. 80 tiles.

✓ iii. 320, twice as many each way.

✓ iv. 160 triangles, the same 80 tiles.

8 Think: two lines make a point

ANSWER HA · 4

i. For example, an arrow or the letter A (one line, no point symmetry), and the letter S or a parallelogram (point symmetry only).

ii. For example, a rectangle or the letter H: **yes**, both have point symmetry.

iii. It **can't be done**: every shape with two lines of symmetry at right angles turns out to have point symmetry too.

iv. Flipping over one line moves a point to the other side of it; flipping over the second line moves it to the other side of that one. Together the point goes to the **opposite side of the crossing, as far away**: exactly where half a turn about the crossing takes it. Since each flip fits the shape on itself, so does the half turn.

MARKING SCHEME

✓ i. The two shapes.

✓ ii. A shape with two lines, and it has point symmetry.

✓ iii. It can't be done.

✓ iv. Two flips at right angles make half a turn.

9 Make your own

ANSWER A · 3

For example:

i. TOOT, WOW or MUM: the letters each have a line down the middle, and the word reads the same backwards.

ii. A plus sign drawn in the middle of a 5 by 5 square of squares, with the square's corners shaded: lines down, across and along both diagonals.

iii. A rectangle: its copies fit side by side in rows, with no gaps, and four of its right angles meet at each point, $4 \times 90^\circ = 360^\circ$.

Any correct answers are right.

MARKING SCHEME

✓ i. A word with a line of symmetry down the middle.

✓ ii. A design with exactly 4 lines of symmetry.

✓ iii. A shape that tiles, with a reason.

See it at Science Playground

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- **Peepal** (garden): Find a peepal leaf, like the one in your book: its middle vein is its one line of symmetry. Turned half a turn, it points the other way.
- **Art with Hexagons** (exhibit): The big hexagon's outline has 6 lines of symmetry, and point symmetry too: half a turn about the middle crayon brings the outline back onto itself.

- **Pac-Man Cube Mosaic** (exhibit): Each picture is a floor of small squares, nine to a cube face, fitted with no gaps and no overlaps: a tessellation of squares.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	0	8	23	4	**35**

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