Unit 18 · Tessellation

HARDER PRACTICE QUESTIONS · ANSWER KEY

Full marks 23

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

1 How many fit round a corner?

ANSWER A · 3

Sides n	3	4	5	6	8	12
One angle	60°	90°	108°	120°	135°	150°
360° ÷ angle	6	4	3.33	3	2.67	2.4

Triangles, squares and hexagons: only for these is 360° ÷ angle a whole number, so a whole number of tiles fits round a corner.

MARKING SCHEME

- ✓ The angles.
- ✓ The second row.
- ✓ $n = 3$, 4 and 6, because 360° ÷ angle is whole.

2 The missing tile

ANSWER A · 3

i. $360° - 2 \times 150° = 60°$: an **equilateral triangle**, 3.12.12.

ii. $360° - 4 \times 60° = 120°$: a **hexagon**, 3.3.3.3.6.

iii. $360° - 90° - 120° = 150°$: a **12-sided polygon**, 4.6.12.

MARKING SCHEME

- ✓ Triangle, 3.12.12.
- ✓ Hexagon, 3.3.3.3.6.
- ✓ 12-sided polygon, 4.6.12.

3 Counting tiles

ANSWER HA · 3

i. There are $2C$ triangle corners, so $\frac{2C}{3}$ **triangles**. There are $2C$ hexagon corners, so $\frac{2C}{6} = \frac{C}{3}$ **hexagons**.

ii. $\frac{2C}{3} : \frac{C}{3} = \mathbf{2 : 1}$.

iii. Each corner has 1 square corner and 2 octagon corners: $\frac{C}{4}$ squares and $\frac{2C}{8} = \frac{C}{4}$ octagons, so **1 : 1**.

MARKING SCHEME

- ✓ $\frac{2C}{3}$ triangles and $\frac{C}{3}$ hexagons.
- ✓ 2 : 1.
- ✓ 1 : 1.

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4 Tiles that aren't regular

ANSWER A · 3

i. $360° - 250° = \mathbf{110}°$.

ii. The four angles add up to 360°, so one of each goes round every corner and fills it exactly.

iii. **Six**: each of the three angles comes twice, $2 \times 180° = 360°$.

MARKING SCHEME

✓ 110°.

✓ One of each angle meets at a corner, adding up to 360°.

✓ Six tiles.

5 Spot the error

ANSWER U · 3

i. A tessellation has **no gaps and no overlaps**: the angles must make exactly 360°. Three octagons overlap, and two leave a gap.

ii. The name starts from the smallest tile: **3.6.3.6**.

iii. The order round the corner matters. 3.6.3.6 is a real floor, and in 3.3.6.6 the angles fit at one corner, but the pattern is different.

MARKING SCHEME

✓ i. The angles must add up to exactly 360°.

✓ ii. 3.6.3.6.

✓ iii. The order round the corner is part of the name, so they are different.

6 In a real setting

ANSWER A · 3

i. Length: $360 \div 30 = \mathbf{12}$ exactly. Width: $250 \div 30 = 8.33\ldots$, so **9**, with the last row cut.

ii. $12 \times 9 = \mathbf{108\ tiles}$.

iii. The last row is only 10 cm wide ($250 - 8 \times 30 = 10$), so $\frac{20}{30} \times 100\% \approx \mathbf{67\%}$ of each tile in it is cut away.

MARKING SCHEME

✓ 12 and 9.

✓ 108 tiles.

✓ About 67%.

7 Think

ANSWER HA · 3

Each side of the pentagon has one neighbor, and two sides that meet at a corner must have **different** neighbors: one pentagon and one 10-gon. So the neighbors must alternate all the way round.
Alternating needs an **even** number of sides, but a pentagon has 5. Going round: pentagon, 10-gon, pentagon, 10-gon, pentagon. The fifth neighbor and the first, whose sides meet at a corner, are both pentagons.
So angles that add up to 360° at one corner aren't enough: the pattern must carry on.

MARKING SCHEME

✓ The neighbors must alternate round the pentagon.

✓ Five is odd, so the first and last neighbors are the same.

✓ The pattern can't carry on, though the angles add up to 360°.

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8 Make your own

ANSWER HA · 2

Whatever is cut from one side is added to the opposite side, so the area doesn't change.
The bump on one tile's side fits the dent in the next tile's opposite side, since the two sides are the same line. So there are no gaps and no overlaps.

MARKING SCHEME

- ✓ Six tiles that fit.
- ✓ What is cut away is added back, and opposite sides match.

See it at Science Playground

Exhibits and plants at the center, Bhaktapur, that go with this unit. Book a class visit at science-playground.com/booking.

- **Art with Hexagons** (exhibit): 817 hexagonal crayons stand side by side, each inner one with six neighbors: three hexagons meet at every corner, $3 \times 120^\circ = 360^\circ$, the regular tessellation 6.6.6.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	0	3	12	8	**23**

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