Unit 19 · Transformation

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. **(3, 5).** In the X-axis the x-coordinate stays and the y-coordinate changes sign. (−3, −5) is its image in the Y-axis.

ii. **(0, 4)**: it lies on the Y-axis, the mirror itself, so it doesn't move.

iii. A point moves **twice its distance from the mirror**: points near the mirror move a little, points far away a lot. Every point moving the same distance is a translation.

iv. **The sides don't change.** A translation only moves the triangle: the image is congruent to it.

MARKING SCHEME

✓ i. (3, 5).

✓ ii. (0, 4): it is on the mirror.

✓ iii. Points far from the mirror move further.

✓ iv. The sides stay the same.

2 One mirror, then the other

ANSWER A · 4

i. A'**(2, −1)**, B'**(5, −1)**, C'**(5, −4)**.

ii. **(−2, 1), (−5, 1), (−5, 4)**.

iii. A''**(−2, −1)**, B''**(−5, −1)**, C''**(−5, −4)**: both signs have changed, $(x, y) \to (-x, -y)$.

iv. **Not an image in an axis**: in an axis only one sign changes, and here both have. **Not a translation** either: A has moved 4 units left and 2 down, but C 10 left and 8 down, so the corners didn't all move the same distance in the same direction. (Each corner has gone to the other side of the origin, as far away: half a turn about O, a rotation, which comes in Grade 8.)

MARKING SCHEME

✓ i. (2, −1), (5, −1), (5, −4).

✓ ii. (−2, 1), (−5, 1), (−5, 4).

✓ iii. (−2, −1), (−5, −1), (−5, −4).

✓ iv. Neither: both signs change, and the corners move by different amounts.

3 Find the object, find the mirror

ANSWER A · 4

i. Reflecting back in the Y-axis: P**(3, 7)**. (Check: (3, 7) → (−3, 7) ✓.)

ii. **The X-axis**: x stays 4 and only the sign of y changed.

iii. **Back at (5, 3)**: (5, 3) → (5, −3) → (5, 3). The y-coordinate changes sign twice, so the second reflection undoes the first.

iv. **Every point on the X-axis**, $(x, 0)$; only **the origin** is its own image in both.

MARKING SCHEME

✓ i. (3, 7).

✓ ii. The X-axis.

✓ iii. Back at (5, 3): the second undoes the first.

✓ iv. Points on the X-axis; the origin.

4 How far does it move?

ANSWER

i. A'**(3, −4)**; $AA' = 4 - (-4) =$ **8 units**.

ii. At **(3, 0)**, **4 units** from each: the mirror cuts AA' in half, at right angles.

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iii. $B'(2, 5)$, so $BB' = 2 - (-2) =$ **4 units**. A · 4

iv. It is 3 units above the X-axis and its image 3 below: **(2, 3)**.

MARKING SCHEME

- ✓ i. (3, −4), 8 units.
- ✓ ii. (3, 0), 4 units from each.
- ✓ iii. 4 units.
- ✓ iv. (2, 3).

5 A slide and a parallelogram

ANSWER A · 4

i. The right angle at A and the 45° at B (90° bisected) constructed with a compass; each corner moved 5 cm in the arrow's direction. B' is K itself.

ii. $B'C' =$ **5 cm**: $B'C'^2 = 4^2 + 3^2 = 25$. It equals BC: the image is congruent.

iii. **They are all 5 cm and parallel to the arrow.** $ABB'A'$ is a **parallelogram**: AA' and BB' are equal and parallel, and so are AB and $A'B'$ (the side moved without turning).

iv. **5 cm long, parallel to** BK, **pointing the opposite way**: from K back to B, down and to the left.

MARKING SCHEME

- ✓ i. The triangle and its image by the arrow.
- ✓ ii. 5 cm, $4^2 + 3^2 = 5^2$.
- ✓ iii. Equal and parallel: a parallelogram.
- ✓ iv. The same length, the opposite way.

6 Reflection, translation or neither?

ANSWER U · 4

a. **Translation**: every point of the rook moves the same three squares in the same direction, and it doesn't turn.

b. **Reflection**: a pair of shoes are mirror images of each other, so one print is the other flipped over, not just moved.

c. **Reflection**: from the back, every letter is back to front, as in a mirror stood beside the page (an R faces the other way).

d. **Neither** on its own: the wheel turns as it moves, so its points don't all move the same way (the top of the wheel moves faster than the bottom).

MARKING SCHEME

- ✓ a. Translation.
- ✓ b. Reflection.
- ✓ c. Reflection.
- ✓ d. Neither: it turns.

7 The clock in the mirror

ANSWER A · 4

i. The hour hand points right, at 3; in the mirror it points left, at **9 o'clock**.

ii. 2 is 2 steps right of 12, so the mirror shows 2 steps left of it: **10 o'clock**.

iii. Reflecting back: 4 steps right of 12 seems 4 steps left: really **8 o'clock**.

iv. **6 o'clock and 12 o'clock**: both hands lie on the mirror line, so they don't move.

MARKING SCHEME

- ✓ i. 9 o'clock.
- ✓ ii. 10 o'clock.
- ✓ iii. 8 o'clock.
- ✓ iv. 6 and 12 o'clock.

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8 Think: the shortest way to the river

ANSWER HA · 4

i. A'**(1, −4)**.

ii. At P**(4, 0)**: from A', the line goes 3 across for every 4 up, and from P on to B 6 across and 8 up.

iii. The X-axis is the mirror: P is on it, and A and A' are the same distance from it on opposite sides, so AP and $A'P$ are mirror images, equal. $AP^2 = 3^2 + 4^2 = 25$, $AP = 5$; $PB^2 = 6^2 + 8^2 = 100$, $PB = 10$. The walk is **15 units**.

iv. **Longer.** $AQ = 4$, and $QB^2 = 9^2 + 8^2 = 145$, a little more than $12^2 = 144$: about $4 + 12 =$ **16 units**. For any point R on the river, the walk is $A'R + RB$. If R is not on the line $A'B$, then A', R and B make a triangle, and two sides of a triangle are longer than the third: $A'R + RB$ is more than $A'B = 15$. Only P, on the line, gives 15.

MARKING SCHEME

- ✓ i–ii. $A'(1, -4)$ and $P(4, 0)$.
- ✓ iii. $AP = A'P$ by the mirror; $5 + 10 = 15$ units.
- ✓ iv. Longer, about 16 units.
- ✓ iv. Any other point makes a triangle $A'RB$, longer than $A'B$.

9 Make your own

ANSWER A · 3

For example:

i. (2, 5) and (2, −5).

ii. A triangle ABC, an arrow, and $A'B'C'$, with AA', BB' and CC' as long as the arrow, parallel to it and pointing the same way.

iii. (−2, 0), (2, 0), (3, 4), (−3, 4): each corner's partner $(-x, y)$ is also a corner.

Any correct answers are right.

MARKING SCHEME

- ✓ i. A point and its image 10 apart.
- ✓ ii. A triangle and its image by the arrow.
- ✓ iii. A figure whose corners come in pairs (x, y) and $(-x, y)$.

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.

- **The Kaleidoscope** (exhibit): Each mirror inside is an axis of reflection: every colored piece and its image have the same shape and size, but the image is flipped.

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

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