Unit 19 · Transformation

HARDER PRACTICE QUESTIONS · ANSWER KEY

Full marks 26

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

1 Two moves, one move

ANSWER A · 3

i. $(3, -2) \to$ **(3, 2)** $\to$ **(−3, 2)**.

ii. A rotation through **180°** about O: $(3, -2) \to (-3, 2)$.

iii. $(x, y) \to (x, -y) \to (-x, -y)$, which is the rule for 180°.

MARKING SCHEME

✓ $(3, 2)$ and $(-3, 2)$.

✓ A rotation through 180°.

✓ $(x, y) \to (-x, -y)$.

2 Work backwards

ANSWER HA · 3

i. $(x, y) \to (-y, x)$, so $-y = -3$ and $x = 4$. It started at **(4, 3)**.

ii. Undo the moves from the last: reflecting $(5, 1)$ back gives $(5, -1)$. Undoing the translation: $(5 - 2, -1 + 3) =$ **(3, 2)**.

(Check: $(3, 2) \to (5, -1) \to (5, 1)$. ✓)

MARKING SCHEME

✓ i. $(4, 3)$.

✓ ii. Undoing the reflection: $(5, -1)$.

✓ ii. $(3, 2)$.

3 Find the move

ANSWER A · 3

Each point (x, y) has gone to $(-y, x)$: $(1, 2) \to (-2, 1)$, $(4, 2) \to (-2, 4)$, $(1, 6) \to (-6, 1)$.

This is a **rotation through +90° about** O.

$D(5, -3) \to$ **(3, 5)**.

MARKING SCHEME

✓ The rule $(x, y) \to (-y, x)$ found from the points.

✓ A rotation through +90°.

✓ $(3, 5)$.

4 Does the order matter?

ANSWER HA · 3

i. $(1, 3) \to (3, 3) \to$ **(−3, 3)**.

ii. $(1, 3) \to (-1, 3) \to$ **(1, 3)**.

iii. **Yes**, the order matters here. A translation up or down, such as $(0, 2)$, doesn't: the reflection in the Y-axis changes only x, and the translation only y.

MARKING SCHEME

✓ $(-3, 3)$.

✓ $(1, 3)$.

✓ The order matters; a translation by $(0, b)$ wouldn't change the result.

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5 Which points stay still?

ANSWER HA · 3

i. **Every point on the X-axis**: $(x, y) \to (x, -y)$ stays put only when $y = 0$.
ii. **Only the origin**: every other point turns round O.
iii. **None**: every point moves 3 right and 1 up.

MARKING SCHEME

✓ Every point on the X-axis.
✓ Only O.
✓ No point.

6 Spot the error

ANSWER U · 3

i. That is the rule for $+90°$. For $-90°$, $(x, y) \to (y, -x)$, so the image is **(5, −2)**.
ii. That is a reflection in the X-axis. In the Y-axis, x changes sign: **(−3, −4)**.
iii. Left takes away: **(−1, 1)**.

MARKING SCHEME

✓ i. $(5, -2)$.
✓ ii. $(-3, -4)$.
✓ iii. $(-1, 1)$.

7 In a real setting

ANSWER HA · 4

i. B'**(7, −5)**.
ii. T is on the mirror line, and a point and its image are the same distance from every point of the mirror.
iii. $AT + TB = AT + TB'$, which is shortest when it is straight: $AB' = \sqrt{6^2 + 8^2} =$ **10 km**.
iv. The line crosses the X-axis at about **(3.25, 0)**. (Check: $AT = 3.75$ and $TB = 6.25$, which add up to 10.)

MARKING SCHEME

✓ $B'(7, -5)$.
✓ T is on the mirror, so $TB = TB'$.
✓ 10 km.
✓ T at about $(3.25, 0)$.

8 Think

ANSWER HA · 2

After a **reflection** they go **anticlockwise**: the shape is turned over. After a rotation or a translation they still go clockwise.
So if the order of the corners has changed, the move must have been a reflection.

MARKING SCHEME

✓ Reflection reverses the order; rotation and translation keep it.
✓ So a change of order shows a reflection.

9 Make your own

ANSWER HA · 2

For example, reflect in the X-axis, reflect in the Y-axis, then rotate through 180°.
$(2, 3) \to (2, -3) \to (-2, -3) \to (2, 3)$, and $(x, y) \to (x, -y) \to (-x, -y) \to (x, y)$.

MARKING SCHEME

✓ Three moves tested on $(2, 3)$.
✓ Shown for (x, y).

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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): Look into it: each mirror is a mirror line, and the colored pieces are reflected again and again, each image a reflection of a reflection.
- **Build a Gear Train** (exhibit): Turn one gear clockwise about its axle, a negative rotation: the gear it touches turns anticlockwise, the positive direction, about its own center.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	0	3	6	17	**26**