

Exercise walk-through

C7.1

Transformations

IGCSE Mathematics

You must be able to

- Perform single translations, reflections, rotations and enlargements
- State all parameters needed to describe a transformation
- Use a nonorigin centre and positive fractional enlargement factor

1

The method

Method — Key knowledge: Transformations

A translation moves every point by the same horizontal and vertical amounts, written as a column vector. A reflection uses a mirror line; corresponding points are perpendicular to it and equally far away. A rotation needs angle, direction and centre. An enlargement needs centre and scale factor: multiply each distance from the centre. Core uses horizontal or vertical mirrors, multiples of 90° and positive scale factors, including fractions; no combined transformations.

Exercises 2.1·2.3

2.1 Translate $(1, -3)$ by $\begin{pmatrix} 4 \\ 5 \end{pmatrix}$. [2]

2.2 Reflect $(3, 5)$ in the line $y = 2$. [2]

2.3 Rotate $(4, 1)$ by 90° clockwise about the origin. [2]

Exercises 2.1·2.3

2.1 Translate $(1, -3)$ by $\begin{pmatrix} 4 \\ 5 \end{pmatrix}$. [2]

2.1

- Add the vector components: $(5, -1)$.

2.2 Reflect $(3, 5)$ in the line $y = 2$. [2]

2.2

- The point is 3 above the line, so its image is 3 below: $(3, -1)$.

2.3 Rotate $(4, 1)$ by 90° clockwise about the origin. [2]

2.3

- Clockwise changes (x, y) to $(y, -x)$: $(1, -4)$.

Exercise 2.4

2.4 Enlarge $(6, 4)$ by scale factor $1/2$, centred at the origin.

[2]

3 Exam-style questions

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[2]

3 Exam-style questions

2.4

- Multiply both coordinates: $(3, 2)$.

Exercise 3.1 (a)

3.1 Apply the transformations methods below. Show working and include units where appropriate.

(a) Triangle A has vertices $(1, 1)$, $(3, 1)$, $(1, 2)$. Draw its image after enlargement by factor 2 about the origin. [2]

Exercise 3.1 (a)

3.1 Apply the transformations methods below. Show working and include units where appropriate.

(a) Triangle A has vertices $(1, 1)$, $(3, 1)$, $(1, 2)$. Draw its image after enlargement by factor 2 about the origin. [2]

(a)

- Double each coordinate: $(2, 2)$, $(6, 2)$, $(2, 4)$; join with a ruler.

Exercise 3.1 (b)

3.1 Apply the transformations methods below. Show working and include units where appropriate.

(b) A separate image of A has vertices $(4, 0)$, $(6, 0)$, $(4, 1)$. Describe this single transformation completely. [2]

Exercise 3.1 (b)

3.1 Apply the transformations methods below. Show working and include units where appropriate.

(b) A separate image of A has vertices $(4, 0)$, $(6, 0)$, $(4, 1)$. Describe this single transformation completely. [2]

(b)

- Every point moves 3 right, 1 down: **translation** by $\begin{pmatrix} 3 \\ -1 \end{pmatrix}$.

Exercise 3.1 (c)

3.1 Apply the transformations methods below. Show working and include units where appropriate.

(c) A separate image has vertices $(-1, -1)$, $(-3, -1)$, $(-1, -2)$. Describe this single rotation completely. [2]

Exercise 3.1 (c)

3.1 Apply the transformations methods below. Show working and include units where appropriate.

(c) A separate image has vertices $(-1, -1)$, $(-3, -1)$, $(-1, -2)$. Describe this single rotation completely. [2]

(c)

- **Rotation 180° about the origin;** either direction is valid for a half-turn.

Exercise 3.2 (a)

3.2 Triangle A has vertices $(2,2)$, $(6,2)$, $(2,6)$. Each transformation below acts on the original triangle.

(a) Find the image vertices under enlargement with centre $(2,2)$ and scale factor one half. [3]

Exercise 3.2 (a)

3.2 Triangle A has vertices $(2,2)$, $(6,2)$, $(2,6)$. Each transformation below acts on the original triangle.

(a) Find the image vertices under enlargement with centre $(2,2)$ and scale factor one half. [3]

(a)

- Keep the centre **$(2,2)$** fixed.
- Halve each displacement from it, giving the other image vertices **$(4,2)$** and **$(2,4)$** .

Exercise 3.2 (b)

3.2 Triangle A has vertices $(2,2)$, $(6,2)$, $(2,6)$. Each transformation below acts on the original triangle.

(b) Find the image vertices under reflection in $x = 4$. Explain how perpendicular distances from the mirror check the reflected points. [3]

Exercise 3.2 (b)

3.2 Triangle A has vertices $(2,2)$, $(6,2)$, $(2,6)$. Each transformation below acts on the original triangle.

(b) Find the image vertices under reflection in $x = 4$. Explain how perpendicular distances from the mirror check the reflected points. [3]

(b)

- Reflection gives $(6,2)$, $(2,2)$, $(6,6)$. The x-values 2 and 6 are both **2 units from $x = 4$** on opposite sides.
- Each reflected point keeps its y-coordinate, so the joining segment is perpendicular to the vertical mirror.