

Single transformations

G7, G8, G24 · Geometry and measures · revision notes

Carry out and fully describe a single translation, reflection, rotation or enlargement. Use a coordinate grid and include every detail: a vector, mirror line, angle and centre, or positive scale factor and centre.

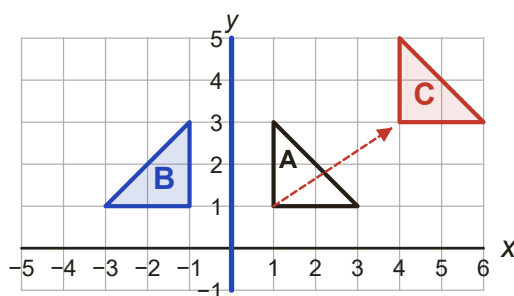
Key facts

- Translation: column vector (top: right +/left -; bottom: up +/down -)
- Rotation: angle, direction and centre
- $x = a$ is vertical; $y = b$ is horizontal
- Reflection: equation of the mirror line
- Enlargement: scale factor and centre
- Image distance from the centre = scale factor $\times$ original distance

Notes

Translation and reflection

- A **translation** slides a shape. It is described by a column vector $\begin{pmatrix} x \\ y \end{pmatrix}$: x across (right is positive) and y up (down is negative).
- A **reflection** flips a shape in a mirror line. Each image point is the same perpendicular distance from the line as the original point, on the other side.
- $x = a$ is a vertical line and $y = b$ is a horizontal line. Also know the diagonal lines $y = x$ and $y = -x$.



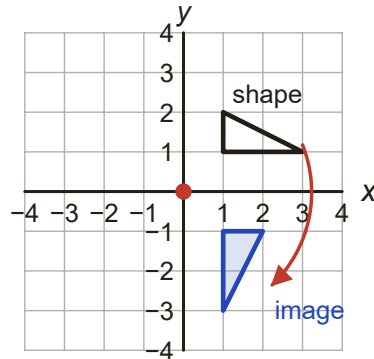
$A \rightarrow B$: reflection
in the y -axis ($x = 0$)

$A \rightarrow C$: translation
3 right, 2 up

Each point of B is the same distance from the mirror line as the matching point of A.

Rotation

- A **rotation** turns a shape through an angle, clockwise or anticlockwise, about a **centre of rotation**.
- Use tracing paper: trace the shape, hold the centre still with your pencil point and turn the paper.
- To find the centre, try points with tracing paper until the shape lands on its image.
- A rotation of 180° needs no direction, as clockwise and anticlockwise give the same image.

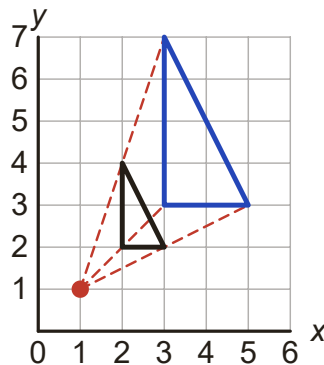


Rotation 90° clockwise
about $(0, 0)$

Give the angle, the direction and the centre.

Enlargement

- An **enlargement** changes the size of a shape by a scale factor from a **centre of enlargement**. Angles stay the same, so the image is similar to the original.
- Multiply the distance (or the vector) from the centre to each vertex by the scale factor.
- A scale factor between 0 and 1 makes the shape smaller; $\frac{1}{2}$ halves every length.
- To find the centre, draw straight lines through corresponding vertices of the shape and image; they meet at the centre.



Enlargement, scale factor 2,
centre $(1, 1)$

Lines through matching
corners meet at the centre.

Every distance from the centre is doubled.

Describing a single transformation

- Describe fully: translation + vector; reflection + equation of the mirror line; rotation + angle, direction and centre; enlargement + scale factor and centre.
- Translations, reflections and rotations give congruent images; enlargements give similar images.

How to answer each type of question

M = method mark, A = answer mark, B = a mark on its own.

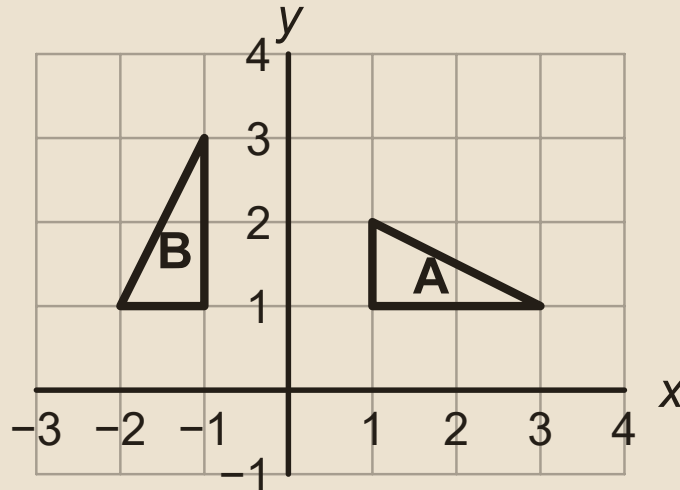
Describe fully the single transformation

2 to 3 marks

Grade 5

1. Decide the type: same size and same way round (translation), flipped (reflection), turned (rotation) or resized (enlargement).
2. Find every detail: vector, mirror line, angle, direction, centre or scale factor.
3. Write one transformation only, with all its details.

Example. Triangle A has vertices $(1, 1)$, $(3, 1)$ and $(1, 2)$. Triangle B has vertices $(-1, 1)$, $(-1, 3)$ and $(-2, 1)$.



Describe fully the single transformation that maps triangle A onto triangle B.

Model answer. Rotation (B1)

90° anticlockwise (B1)

about $(0, 0)$ (B1)

Enlarge a shape by a fractional scale factor

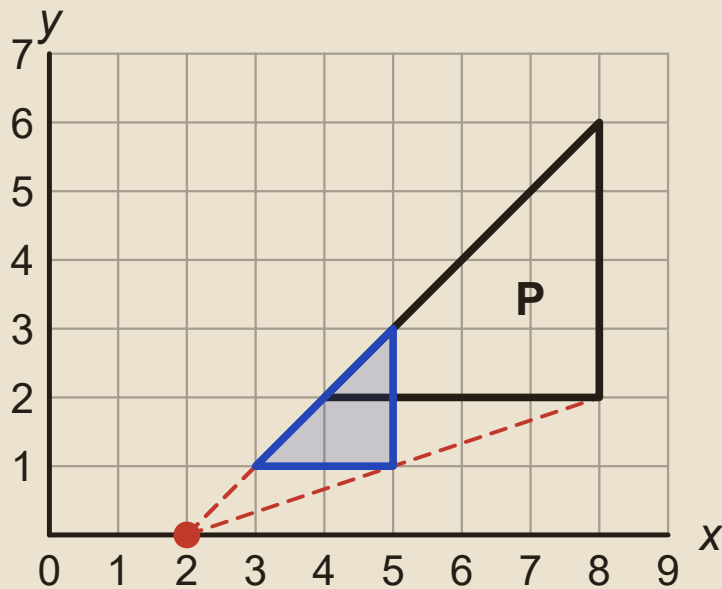
2 marks

Grade 5

1. Write the vector from the centre to each vertex.
2. Multiply each vector by the scale factor.
3. Add each new vector to the centre to plot the image.

Example. Triangle P has vertices (4, 2), (8, 2) and (8, 6).
Enlarge triangle P by scale factor $\frac{1}{2}$ with centre (2, 0).

Model answer.



Vectors from (2, 0) to the vertices: (2, 2), (6, 2), (6, 6); halved: (1, 1), (3, 1), (3, 3)

Image vertices (3, 1), (5, 1) and (5, 3) (B2)

(B1 for a triangle of the correct size and orientation in the wrong position)

Don't lose marks

- ✗ Describing two transformations when the question asks for a single transformation; this scores no marks.
- ✗ Mixing up $x = 3$ (a vertical line) and $y = 3$ (a horizontal line).
- ✗ Leaving out a detail, such as the direction or centre of a rotation, or the centre of an enlargement.
- ✗ Enlarging from the origin when the centre is somewhere else.
- ✗ Writing 'turn', 'flip' or 'move' instead of rotation, reflection or translation.
- ✗ Writing a translation as a coordinate such as (3, -2) instead of a column vector.

More tips

Memory tricks

- Rotations about (0, 0): 90° clockwise takes (x, y) to (y, -x); 90° anticlockwise takes (x, y) to (-y, x); 180° takes (x, y) to (-x, -y).
- Reflection in $y = x$ swaps the coordinates: (x, y) goes to (y, x). In $y = -x$: (x, y) goes to (-y, -x).
- Ask for tracing paper for rotations and reflections.
- Check an enlargement with straight lines from the centre through each vertex: the image vertices must lie on them.

Exam technique

- 'Describe fully' needs the name of the transformation and every detail; use the number of marks as a check.
- Only describe one transformation when the question says 'single transformation'.
- Draw images accurately and check two or three vertices using their coordinates.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

Reflect a shape in a mirror line

Reflect in lines such as $x = 2$, $y = -1$, $y = x$ and $y = -x$; each image point is the same distance from the line.

Grade 3

Translate a shape using a column vector

The top number moves right (+) or left (-); the bottom number moves up (+) or down (-).

Grade 4

Rotate a shape about a given centre

Use tracing paper, the angle and the direction (clockwise or anticlockwise).

Grade 4

Enlarge a shape by a positive scale factor

Multiply the distance from the centre of enlargement to each vertex by the scale factor.

Grade 5

Describe a single transformation fully

Give the type and every detail, e.g. rotation 90° clockwise about (1, 2).

Grade 5

Enlarge by a fractional scale factor

A scale factor between 0 and 1 makes the shape smaller, still measured from the centre.

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