Guidance for tutors

<table>
<tr><td>Outcome</td><td>SA4</td><td>Student can consistently:</td><td>Carry out simple transformations including reflections, rotation, translations and enlargements (including negative and fractional scale factors)</td></tr>
<tr><td>How the topic is examined</td><td colspan="3">• Examined through test paper questions.
• Questions are equally likely to appear on calculator and non-calculator papers.
• Transformation questions are very common at GCSE; usually at least three of the four transformations will be tested.
• Questions could involve students having to perform a transformation or recognise a transformation that has taken place and then describe this.</td></tr>
<tr><td>Prior knowledge</td><td colspan="3">• Students should be confident with:
  ○ Simple vectors
• In addition questions involving this topic can have links to:
  ○ Vectors (SA8)
  ○ Transformation of graphs (AG10)</td></tr>
<tr><td>Suggested tuition approaches</td><td colspan="3">• There are four key transformations that could be examined at GCSE; rotations, translations, reflections and enlargements

<table><tr><th>Transformation</th><th>Notes</th></tr><tr><td>Translation</td><td>Translation means “move”.

Shape A has been translated 3 units left and 3 units up.

We say that shape A has been translated by the vector $\begin{pmatrix}-3\\3\end{pmatrix}$

The top number tells you how many left or right a shape moves.</td></tr></table></td></tr>
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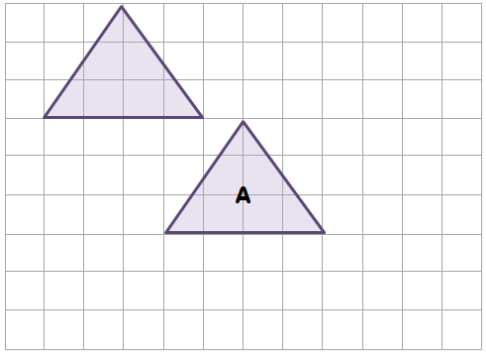
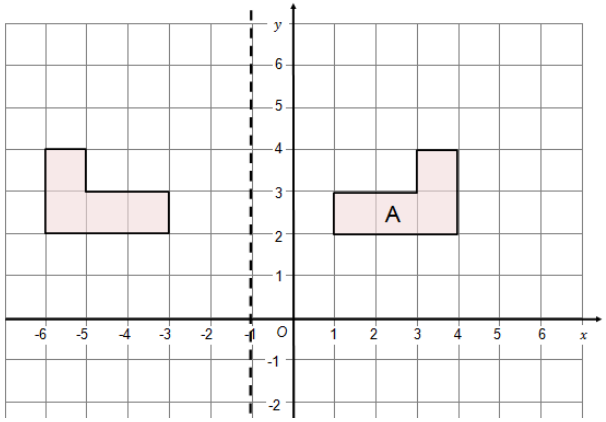
	The bottom number tells you how many up or down it moves. Students need to give their answer using a vector.
Reflection 	Students will be asked to reflect a shape in either the x-axis, y-axis, line $y = x$ and $y = -x$. Students could be asked to reflect in any line $y = a$ and $x = a$. Shape A has been reflect in the line $x = -1$ To describe the transformation students should state the word reflection and then the reflection/mirror line that it has been reflected in.
Rotations	A rotation is a “turn”. Shape A has been rotated 90 degrees clockwise around the point (0, 3).

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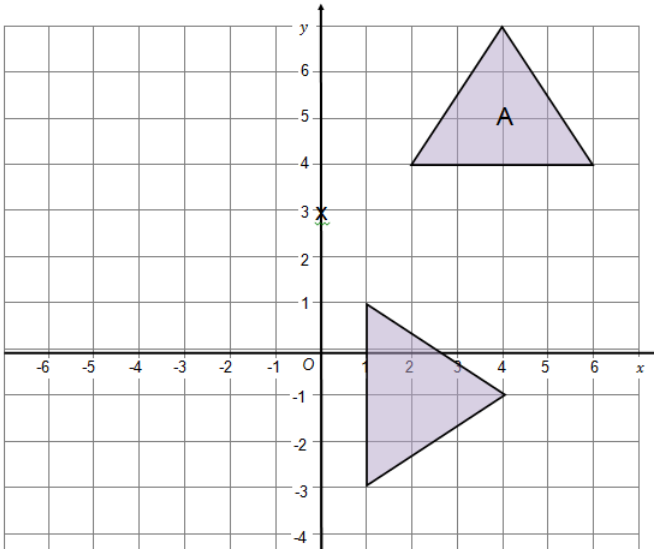

In order to describe a rotation students need to state the following:

- The word rotation
- The number of degrees
- The direction (clockwise or anti-clockwise)
- The centre of rotation (the point around which you are going to rotate it)

Enlargements

An enlargement is when a shape is made bigger (or smaller).

An enlargement needs a scale factor and a centre of enlargement.

- A SF of 2 means all sides of the new shape should be twice as big.
- A SF of 3 means all sides of the new shape should be three times as big.
- A SF of ½ means all sides of the new shape should be half the size.

In order to describe an enlargement students need to state the following:

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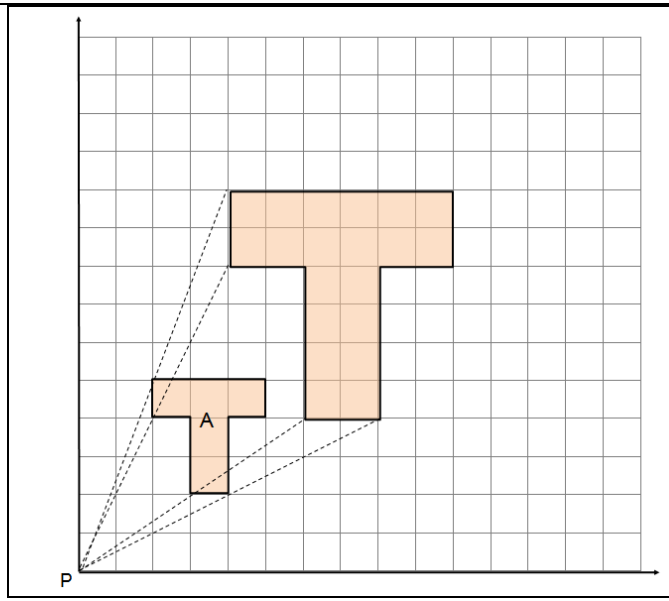

- The word enlargement
- The scale factor
- The centre of enlargement.

In order to enlarge a shape a common method is to use perspective lines to find a point or series of points.

Note that you only need one corner on the new shape to complete the enlargement.

- To do all of the above transformations, it is advisable to use tracing paper. This should be made available. If not, you should ask for it.
- As well as performing a given transformation, students should be able to describe one drawn.
- Sometimes students may be asked to enlarge a shape by a negative scale factor. The following video https://www.youtube.com/watch?v=7lvJ8fX_yxc gives an excellent detailed tutorial on how do so.
- A negative enlargement looks like the shape has been rotated and enlarged.

Common errors and misconceptions

- Translation
  - Students confuse this with the word transformation.
  - Students don't use a vector to describe the transformation.
  - They move the shape too many units. This is because they miscount or don't understand which value does what in a vector.
- Rotation

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	○ They rotate the shape in the wrong direction or the wrong number of degrees. ○ They use the origin as the centre of rotation all the time. ○ They put the corner of the transformed shape on the centre of rotation. ○ When describing the rotation students forget to include all three pieces of information. • Reflection ○ Students struggle to reflect shapes in any line other than the x or y-axis. Encourage them to draw on the mirror line and use tracing paper. • Enlargement ○ Often they get a starting point correct but don't plot the other points correctly and the shape is not twice as big (etc…). Get students to check that all the sides are the right new size. (e.g. if it was 3 squares long on the original shape and the SF is 2. The same side on the new shape should be 6 squares long) ○ Negative enlargements are often missed out. ○ Students struggle to find the centre of enlargement.
Suggested resources	• Questions ○ http://www.cimt.org.uk/projects/mepres/allgcse/bkc14.pdf (pp 96-138) ○ https://www.tes.com/teaching-resource/transformations-worksheets-6290620 ○ https://www.tes.com/teaching-resource/transformation-worksheets-6423345 • Past GCSE Questions ○ https://keshgcsemaths.files.wordpress.com/2013/11/42_mixed-transformations2.pdf ○ https://keshgcsemaths.files.wordpress.com/2013/11/38_rotations2.pdf ○ https://keshgcsemaths.files.wordpress.com/2013/11/39_reflections2.pdf ○ https://keshgcsemaths.files.wordpress.com/2013/11/40_enlargements2.pdf ○ https://keshgcsemaths.files.wordpress.com/2013/11/41_translations2.pdf ○ https://keshgcsemaths.files.wordpress.com/2013/11/103_enlargement_negative-scale-factor.pdf • Video tutorial ○ https://www.youtube.com/watch?v=7h46hKwyahQ ○ https://www.khanacademy.org/math/basic-geo/transformations-congruence-similarity-geo/transformations-basics/v/translations-of-polygons