Guidance for tutors

Outcome	AG10	**Student can consistently:**	Transform graphs using a given function.
How the topic is examined	▯ Examined through test paper questions. ▯ Questions are equally likely to appear on calculator or non-calculator papers. ▯ Students will be asked to transform a given function ( ) using either a translation or reflection. Also they should be able to describe a graphical transformation using function notation. ▯ Although the required graphical transformations are restricted to translations and reflections, for completeness students might want to cover stretches of functions. ▯ Students may be required also to work out a transformed function given the original function. ▯ Transformations should be restricted to linear, quadratic, sine and cosine graphs.		
Prior knowledge	▯ Students should be confident with: o Graphs (AG1 and AG5) o Substituting into expressions (AEx5) o Transformations (SA4) ▯ In addition questions involving this topic can have links to: o Sine, Cosine and Tangent graphs (SPT8)		
Suggested tuition approaches	▯ Students should understand what a translation and reflection are. They should also understand that a general function is denoted usually by ( ) ▯ Students should know and understand the following transformations o ( ) + – translation a units up or translation by the vector ( ) o ( ) – – translation a units down or translation by the vector (^{0}) o (+) – translation a units **left** or translation by the vector ($_{0}$) o (–) – translation a units **right** or translation by the vector ( ) o – ( ) – reflection in the -axis o (–) – reflection in the -axis		

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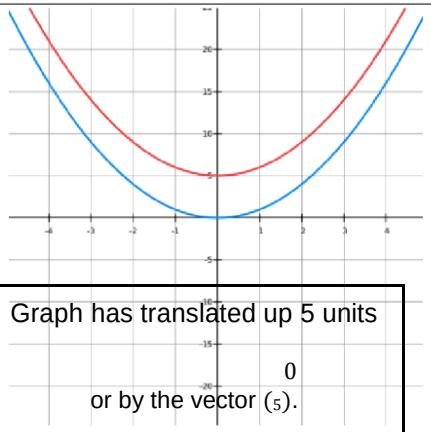
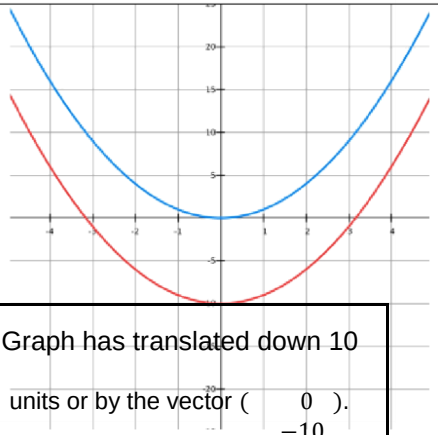
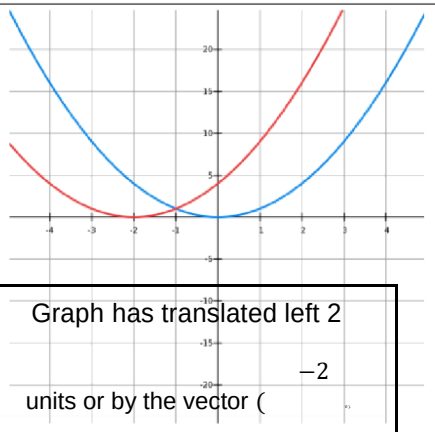
- Notice for the transformations where the a is in the bracket it does the opposite of what you intuitively expect it to do.
- The table below shows a summary of the different transformations. It is based on $f(x) = x^2$. The table shows what the function looks like after the transformation and also the equation of the transformed the function. $f(x)$ is shown in blue on here.

$f(x)+a = y+a$	$f(x)-a = y-a$	$f(x+a) = f(x+a)$
		
Graph has translated up 5 units or by the vector $\begin{pmatrix}0\\5\end{pmatrix}$.	Graph has translated down 10 units or by the vector $\begin{pmatrix}0\\-10\end{pmatrix}$.	Graph has translated left 2 units or by the vector $\begin{pmatrix}-2\\ \end{pmatrix}$
$f(x-a) = f(x-a)$	$-f(x) = -y$	$f(-x) = f(-x)$

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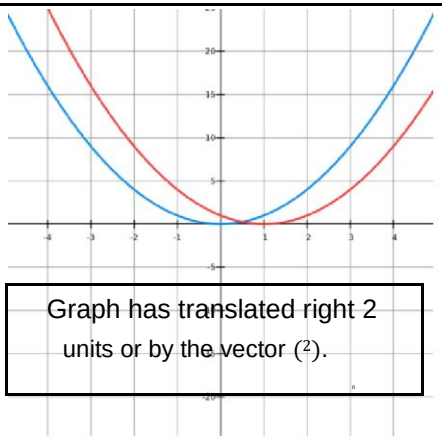
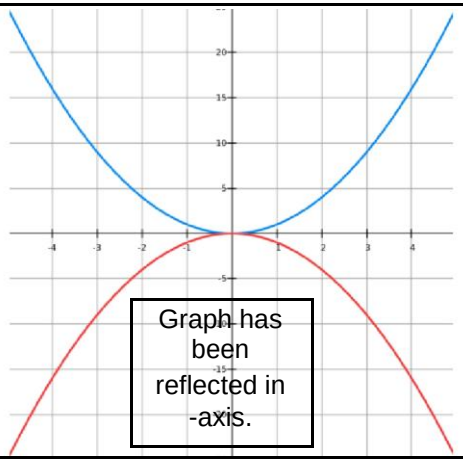
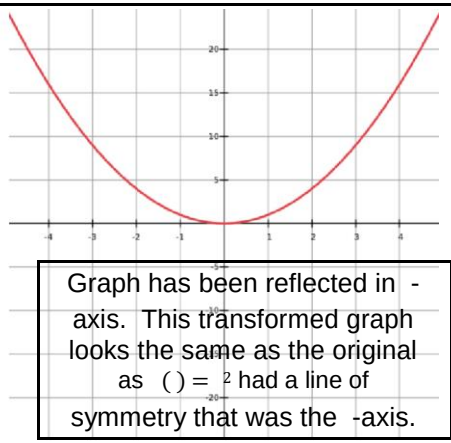


Graph has translated right 2 units or by the vector $\begin{pmatrix}2\\0\end{pmatrix}$.



Graph has been reflected in -axis.



Graph has been reflected in -axis. This transformed graph looks the same as the original as $f(x) = x^2$ had a line of symmetry that was the -axis.

Common errors and misconceptions

- Students mix up the different transformations.
- They particularly mix up the translation when the number is inside the bracket. They think that $f(x + a)$ translates the graph a units right.
- Students should use accurate terminology (e.g. translate and reflection)

Suggested resources

- Questions
  - http://www.cimt.org.uk/projects/mepres/allgcse/bkc17.pdf
  - https://corbettmaths.files.wordpress.com/2013/02/transformations-of-graphs-pdf.pdf
- Past GCSE Questions
  - https://keshgcsemaths.files.wordpress.com/2013/11/102_transformation-of-graphs.pdf
- Video tutorial
  - https://www.youtube.com/watch?v=5QFloIh_RbE