



## Transformation of Graphs: Quick Notes

### REMEMBER:

A function,  $f(x)$ , is a set of instructions relating inputs ( $x$ -values) to outputs ( $y$ -values). The instructions might take the form of an algebraic equation ( $f(x) = 3x + 2$ ) or as a way of looking up  $y$ -values (as from a graph or a table of values).

### TRANSFORMATIONS

We can see what a graph might look like based on a related **parent graph**, a graph we already have, or one that we know well. You've already covered parabolas and quadratics in detail. The parent graph for all quadratics is the parabola  $f(x) = x^2$ , and a graph of any quadratic function can be derived from the basic parabola.

All graphs can be transformed this way. The available options are:

#### CHANGES TO THE FUNCTION

- $f(x) = y$ , so vertical change
- everything is **normal**, including order of operations: a before k

#### CHANGES TO X DIRECTLY

- horizontal change
- everything is **opposite**, including order of operations: h before b

$$y = \pm a f(\pm bx + h) + k$$

#### MULTIPLY OR DIVIDE

- change is a stretch or squish
- relative to "other" axis
- negative  $\rightarrow$  reflect over "other" axis

#### ADD OR SUBTRACT

- change is a shift
- shape of graph does not change

Each number that's been introduced into the modified function is either inside the bracket with  $x$ , and so affects  $x$  before the function gets applied, or outside the bracket, and so affects  $y$  after the function has been applied.

The "other" axis helps you remember that a reflection in the horizontal direction uses the  $y$ -axis (not the  $x$ -axis!) as the mirror, and vice versa. A stretch in the horizontal direction keeps anything on the  $y$ -axis fixed and everything else gets changed relative to that axis. (Stretching by two makes all points twice as far from the axis, and so on.)