

# Functions & Graph Transformations

## What is a Function?

A function describes a relation between two (or more) values. Each input value has one output.

For example: let  $f(x) = x^3 + x^2 - 3x$

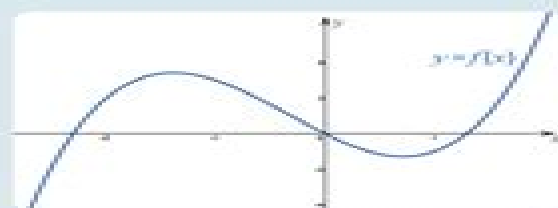
$$f(2) = 2^3 + 2^2 - 3 \times 2 = 6, \quad f(0) = 0^3 + 0^2 - 3 \times 0 = 0$$



A function is usually called  $f$  but can, like a variable, be called any letter or symbol.

## Graphing a Function

A function is graphed the same as the " $y = \dots$ " equations you're used to, we just use " $f(x) = \dots$ " instead!



## Transformations

Transformations cause functions to change in some way. Constants are used to either **translate** or **stretch** a function's graph.

**Translate:** a shift, the graph moves:

up & down

$$f(x) + a$$

or

left & right

$$f(x + b)$$

**Stretch:** (or squeeze) parallel to:

y axis

$$cf(x)$$

or

x axis

$$f(dx)$$

## Top tip

If the constant is **inside** the function, in with the  $x$ , then it causes transformations in the direction of the  $x$  axis.



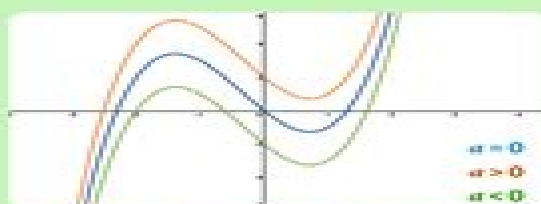
If it is **outside** the function, operating on  $f(x)$ , then it causes changes in the direction of the  $y$  axis.



$$f(x) + a$$

Shifts the graph  
up for  $a > 0$   
down for  $a < 0$

Think of moving  
the graph  $a$  units  
up the  $y$  axis

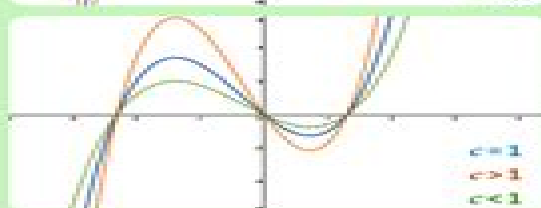


$a = 0$   
 $a > 0$   
 $a < 0$

$$cf(x)$$

Stretches the graph  
parallel to the  $y$  axis  
out for  $c > 1$   
(squeeze) in for  $c < 1$

The scale factor is  $c$ ,  
think of points being  $c$   
times further from  $y = 0$

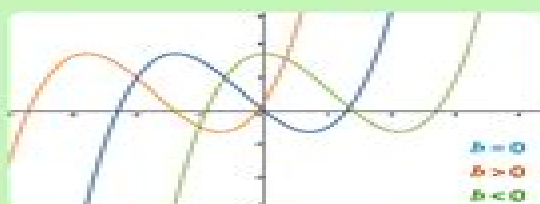


$c = 1$   
 $c > 1$   
 $c < 1$

$$f(x + b)$$

Shifts the graph  
left for  $b > 0$   
right for  $b < 0$

Think of moving the  
graph " $-b$ " units along  
the  $x$  axis

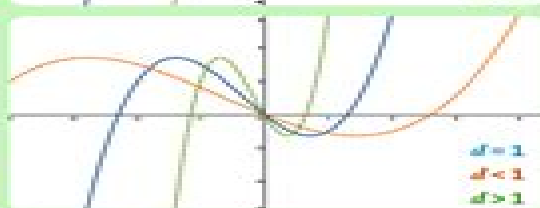


$b = 0$   
 $b > 0$   
 $b < 0$

$$f(dx)$$

Stretches the graph  
parallel to the  $x$  axis  
out for  $d < 1$   
in for  $d > 1$

The scale factor is  $1/d$ ,  
think of points being  $d$   
times as close to  $x = 0$



$d = 1$   
 $d < 1$   
 $d > 1$

These bottom two graphs only use positive constants. Exercises: can you sketch what they'd look like with negative constants?



# Summary Sheet Of Graph Transformations

**Michael Rajnik**



## **Summary Sheet Of Graph Transformations:**

## Embracing the Beat of Phrase: An Psychological Symphony within **Summary Sheet Of Graph Transformations**

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