

Translating Graphs

Starter

- (Review of last lesson) State the equation of the line needed to solve the following equations using the graph of $y = 2x^2 - 3x + 1$.
 - $2x^2 - 3x + 3 = 9$
 - $2x^2 - 5x - 7 = 0$
- Write down the new coordinates of the points after the stated transformation:
 - $(2, 5)$ is translated under the vector $\begin{pmatrix} 4 \\ -1 \end{pmatrix}$
 - $(3, 1)$ is reflected in the x -axis
 - $(2, 7)$ is reflected in the y -axis

Notes

In the same way that shapes can be translated and reflected so can graphs of equations.

Column vectors, $\begin{pmatrix} a \\ b \end{pmatrix}$ – a reminder

Top number is **horizontal** movement (positive means to the right)

Bottom number is **vertical** movement (positive means up)

Translations

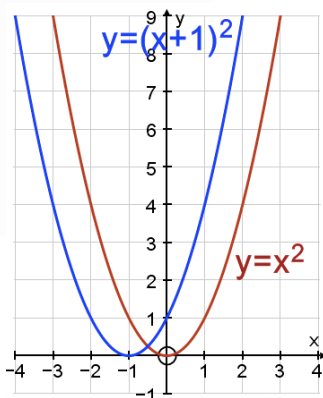
When we **add** (or **subtract**) to (from) a function, we cause a **translation**.

Consider the function $y = x^2$. There are 2 ways we can add 1 to the function.

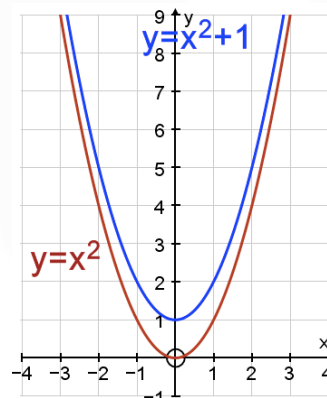
Add to the x : $y = (x + 1)^2$ — this causes a **horizontal** translation

Add to the **function**: $y = x^2 + 1$ — this causes a **vertical** translation

Horizontal translation
“+1” so to the **left**



Vertical translation
“+1” so **upwards**



In general, for any function $y = f(x)$

Add to the x \Rightarrow **horizontal translation** +ve \Rightarrow to the left, –ve \Rightarrow to the right

E.g. $y = f(x + 3) \equiv$ horizontal translation, 3 units to the left
 $y = f(x - 2) \equiv$ horizontal translation, 2 units to the right

Add to the function \Rightarrow **vertical translation** +ve \Rightarrow up, –ve \Rightarrow down

E.g. $y = f(x) + 4 \equiv$ vertical translation, 4 units up
 $y = f(x) - 1 \equiv$ vertical translation, 1 unit down

E.g. 1 Consider the function $y = x^3$.

(a) Describe the translation(s) that takes $y = x^3$ to the function:

- (i) $y = x^3 - 6$
- (ii) $y = (x + 7)^3$
- (iii) $y = (x - 1)^3 + 8$

(b) Give the equation of the curve after $y = x^3$ has undergone:

- (i) a translation of 3 units to the right
- (ii) a translation of 2 units upwards
- (iii) a translation $\begin{pmatrix} 5 \\ 4 \end{pmatrix}$

Working: (a) (i) $y = x^3 - 6$ *“to the function” so vertical
-6 so downwards*

Vertical translation, 6 units downwards

(b) (i) *“to the right” means horizontal so “to the x”
“3 units to the right” means -3*

$$y = (x - 3)^3$$

[Video: Transformation of graphs A](#)

[Video: Transformation of graphs B](#)

[Solutions to Starter and E.g.s](#)

Exercise

9-1 class textbook: p553 E17.3 Qu 1abd, 2abc, 3ace, 4-6, 8, 9ac, 10ab
A*-G class textbook: p511 E17.3 Qu 1abd, 2abc, 3ace, 4-7, 8ab, 9ac
9-1 homework book: p186 E17.3 Qu 1acd, 2abd, 3ac, 4, 6ab
A*-G homework book: p141 E17.3 Qu 1acd, 2abd, 3ac, 4

Summary

When we **add** (or **subtract**) to (from) a function, we cause a **translation**.

In general, for any function $y = f(x)$

Add to the $x \Rightarrow$ **horizontal translation** +ve \Rightarrow to the left, -ve \Rightarrow to the right

Add to the **function** \Rightarrow **vertical translation** +ve \Rightarrow up, -ve \Rightarrow down

[Homework book answers \(only available during a lockdown\)](#)