How to Transform a Function

Perform transformations in the order given here.

In general, if something is happening to the "*x*", perform the <u>opposite operation</u> to each *x*-value.

Whereas, if something is happening to the "*y*", then perform that <u>exact operation</u> to each *y*-value.

<u>Horizontal Shifts</u>

The function has a horizontal shift if there is a number added to or subtracted from **<u>the x</u>**.

Horizontal shifts are illogical.

- If you see $f\left(x+c\right)$, then **subtract** *c* from each *x*.
- If you see $f\left(x-c\right)$, then **add** *c* to each *x*.

<u>Shrinking/Stretching</u>

Shrinking and stretching is caused by a positive number being multiplied by either the *x*-value (causing an <u>illogical horizontal</u> shrink/stretch) or the function itself (causing a <u>logical vertical</u> shrink/stretch).

- If you see $f\left(cx\right)$, then **divide** each *x* by *c*.
- If you see $c\cdot f\left(x\right)$, then **multiply** each *y* by *c*. (Because *c* is being multiplied by the *function*, that's the same as multiplying by the *y*-value, since $f\left(x\right)=y$.)

<u>Reflections</u>

Reflections are caused by -1 being multiplied by either the *x*-value or the function.

- If you see $f\left(-x\right)$, then **divide** each *x* by -1. This causes a *y*-axis flip.
- If you see $-f\left(x\right)$, then **multiply** each *y* by -1. This causes an *x*-axis flip.

<u>Vertical Shifts</u>

The function has a vertical shift if there is a number added to or subtracted from the function.

Vertical shifts are logical.

- If you see $f\left(x\right)+c$, then **add** *c* to each *y*.
- If you see $f\left(x\right)-c$, then **subtract** *c* from each *y*.