



Transformations of Functions III - Vertical Stretches, Compressions, and Reflections

Video Notes

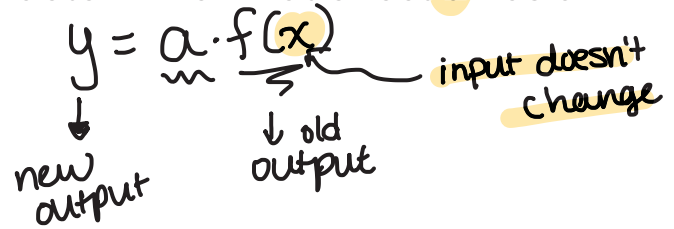
[Video Link](#)

Transformations of Functions III - Vertical Stretches, Compressions, and Reflections

Background Knowledge:

- Parent Functions, Parts I and II

Consider some parent functions (including quadratic, square root, absolute value, reciprocal, and exponential) and determine what effect a has on $y = af(x)$, for $a = 2, \frac{1}{3}, -4, \frac{1}{5}$.



Absolute Value Functions:

Parent Function: $f(x) = |x|$

$y = 2f(x)$: $y = 2|x|$

$y = \frac{1}{3}f(x)$: $y = \frac{1}{3}|x|$

$y = -4f(x)$: $y = -4|x|$

$y = -\frac{1}{5}f(x)$: $y = -\frac{1}{5}|x|$

x	$f(x) = x $	$2f(x)$	$\frac{1}{3}f(x)$	$-4f(x)$	$-\frac{1}{5}f(x)$
-3	3	6	1	-12	-3/5
-2	2	4	2/3	-8	-2/5
-1	1	2	1/3	-4	-1/5
0	0	0	0	0	0
1	1	2	1/3	-4	-1/5
2	2	4	2/3	-8	-2/5
3	3	6	1	-12	-3/5

input is the same (pointing to the x column)
 REFLECTION comes from negative values (pointing to the -4f(x) and -1/5f(x) columns)

Quadratic Functions:

Parent Function: $f(x) = x^2$

$y = 2f(x)$:

$y = 2x^2$

all outputs are doubled, \therefore

the graph is vertically

stretched

(scale factor = 2)

$y = \frac{1}{3}f(x)$:

$y = \frac{1}{3}x^2$ → vertically compressed

(scale factor is $\frac{1}{3}$)

$y = -4f(x)$:

$y = -4x^2$ → vertically stretched

(scale factor = 4)
AND reflected in the x-axis.

$y = -\frac{1}{5}f(x)$

$y = -\frac{1}{5}x^2$ → vertically compressed

(s.f. = $\frac{1}{5}$)

AND reflected in the x-axis

Exponential Function:

Parent Function: $f(x) = 2^x$ (we can use any base)

$y = 2f(x)$:

$y = 2(2^x)$

$y = \frac{1}{3}f(x)$:

$y = \frac{1}{3}(2^x)$

$y = -4f(x)$:

$y = -4(2^x)$

$y = -\frac{1}{5}f(x)$

$y = -\frac{1}{5}(2^x)$

Summary:

$$y = a \cdot f(x)$$

sign doesn't matter.

a determines • stretches/compressions and
• reflections in x-axis.

$|a| > 1$ → vertical stretch

$0 < |a| < 1$ → vertical compression

$a < 0$ (neg) → reflection in the x-axis.