

Vertical Stretch

Vertical Stretch

$$\frac{1}{a}y = x^2$$

- Another transformation that can be made to the base function $y = x^2$ is to change the **vertical stretch**. The vertical stretch affects the graph by stretching (or compressing) the graph vertically. The result will produce an image graph that looks wider (or narrower) than the original base graph.
- Example 1:
Let's look at the following functions. We will use a mapping rule to generate a table of values for the image function and then graph all three functions on the same axes.

(a.) $y = x^2$

(b.) $2y = x^2$

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

$(x, y) \rightarrow (x, \frac{1}{2}y)$

$(x, y) \rightarrow (x, 2y)$

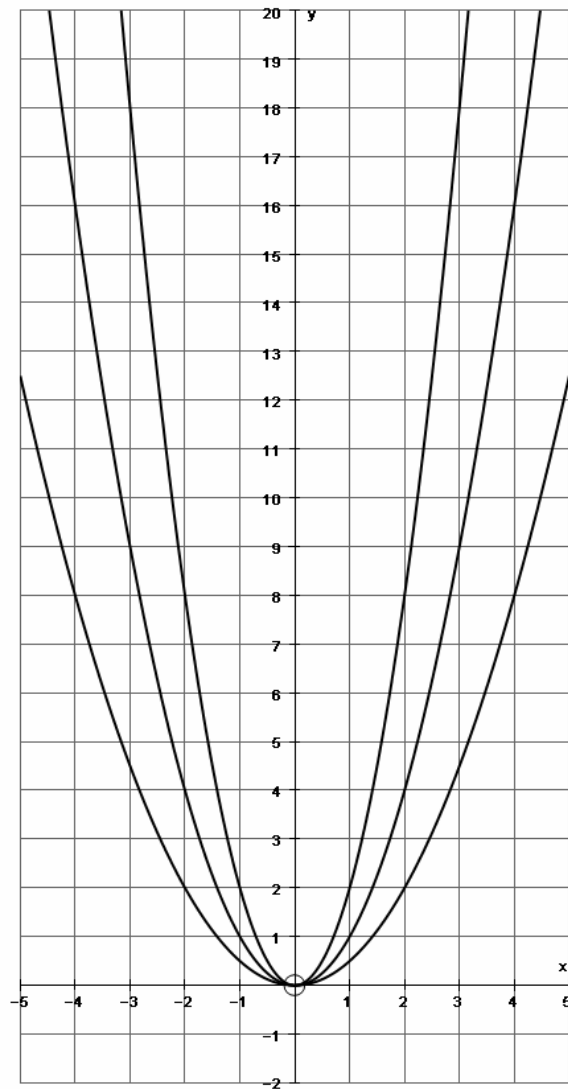
x	y
-3	9
-2	4
-1	1
0	0
1	1
2	4
3	9

x	y
-3	4.5
-2	2
-1	0.5
0	0
1	0.5
2	2
3	4.5

x	y
-3	18
-2	8
-1	2
0	0
1	2
2	8
3	18

multiplied by $\frac{1}{2}$

multiplied by 2



- When there is a $2y$ in the function, then there is a vertical stretch of $\frac{1}{2}$. This will result in a graph that is **wider** than the graph of $y = x^2$.
- When there is a $\frac{1}{2}y$ in the function, then there is a vertical stretch of 2. This will result in a graph that is **narrower** than the graph of $y = x^2$.
- The vertical stretch factor is the **reciprocal** of the coefficient of y in the function.

- To write the mapping rule of the function, notice what happens to the numerical coefficient of y :

<u>Equation</u>	<u>Mapping Rule</u>
$2y = x^2$	$(x, y) \rightarrow (x, \frac{1}{2}y)$
$VS = \frac{1}{2}$	
$\frac{1}{2}y = x^2$	$(x, y) \rightarrow (x, 2y)$
$VS = 2$	

- In the equation, the Vertical Stretch factor (VS) is the **reciprocal** of the numerical coefficient of y . However, in the mapping rule, the VS is the **same** as the numerical coefficient of y .
- Example 2:
Find the mapping rules for the following functions:

(a.) $5y = x^2$ (b.) $\frac{1}{4}y = x^2$

(a.) In the function $5y = x^2$, the mapping rule will be $(x, y) \rightarrow (x, \frac{1}{5}y)$, where the $VS = \frac{1}{5}$.

(b.) In the function $\frac{1}{4}y = x^2$, the mapping rule will be $(x, y) \rightarrow (x, 4y)$, where the $VS = 4$.

Summary

Equation:

$$\frac{1}{a}y = x^2$$

$$\boxed{VS = a}$$

Mapping Rule:

$$(x, y) \rightarrow (x, ay)$$

- The Vertical Stretch is the **RECIPROCAL** of the value multiplied by y in the equation.
- The Vertical Stretch is the **SAME** as the value multiplied by y in the mapping rule.
- When $VS > 1$, the graph is **NARROWER** in appearance.
- When $VS < 1$, the graph is **WIDER** in appearance.