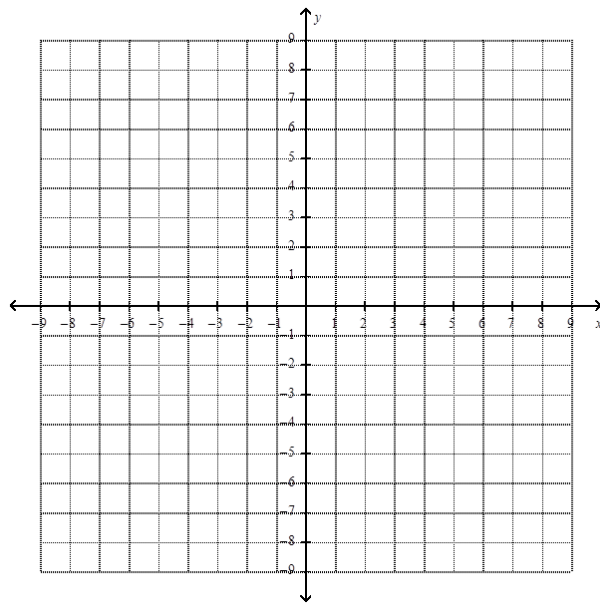
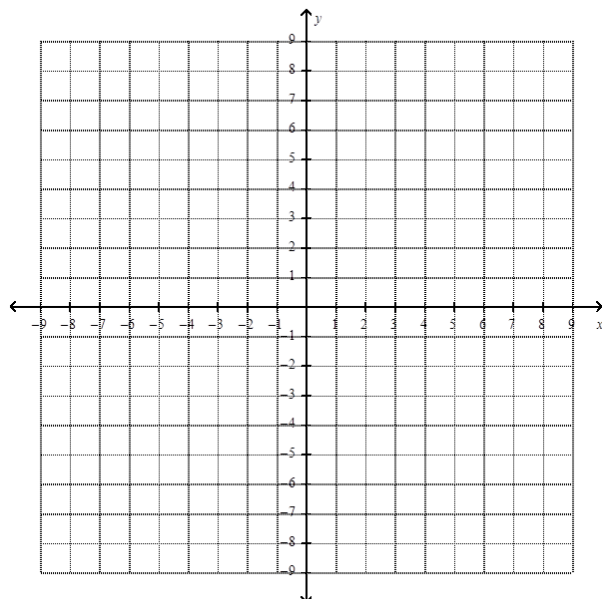


# Reflections and Stretches

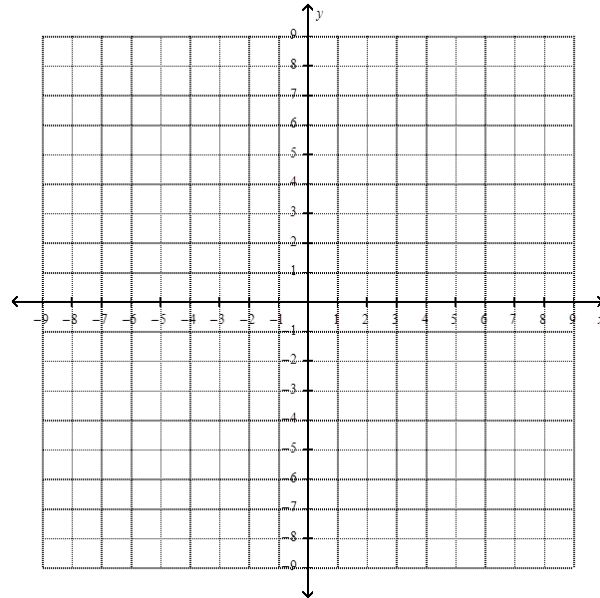
A \_\_\_\_\_ is a transformation that flips an image over a \_\_\_\_\_ . A reflection results in a \_\_\_\_\_ of the original shape.



Draw a graph of  $y = x^2 + 2$  and  $y = -f(x)$  on the same graph. What do you notice?



Draw a graph of  $y = (x - 1)^2$  and  $y = f(-x)$  on the same graph. What do you notice?



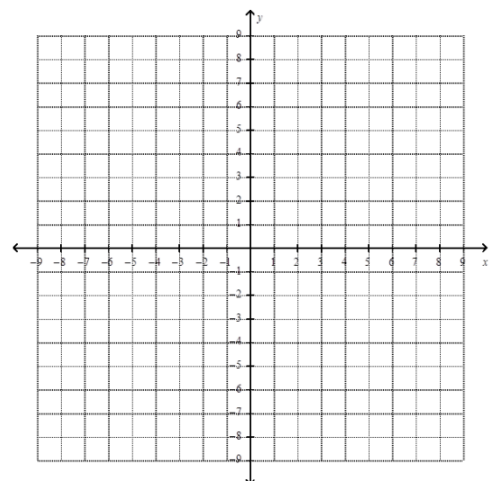
In general  $y = -f(x)$  is a reflection in the x-axis of the graph of  $y = f(x)$  and  $y = f(-x)$  is a reflection in the y-axis of the graph of  $y = f(x)$ .

An \_\_\_\_\_, is a point on a graph that does not change position after the graph undergoes a transformation.

### Example

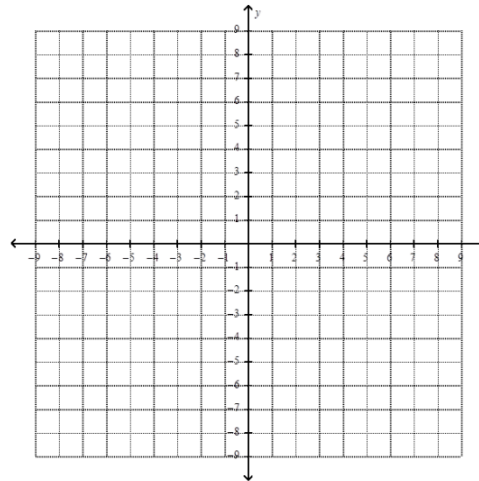
Consider the following graph.

Sketch the reflection of this graph in the x-axis. State any invariant points.

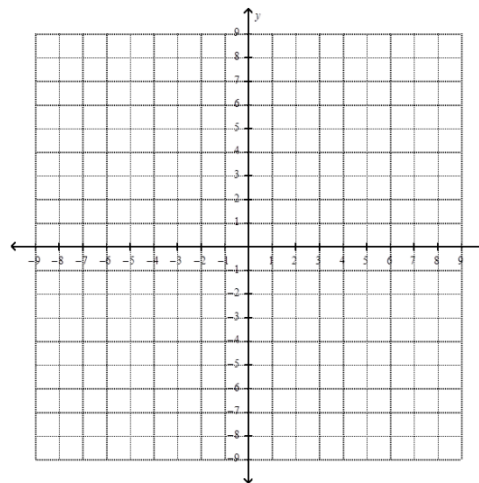


## Stretches

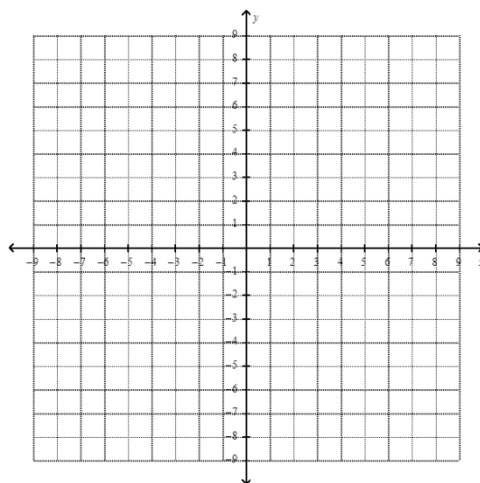
A \_\_\_\_\_ is a transformation that changes the shape of a graph, but not the orientation.



Draw a graph of  $f(x) = x^2$  and  $2f(x)$  on the same graph. What do you notice?

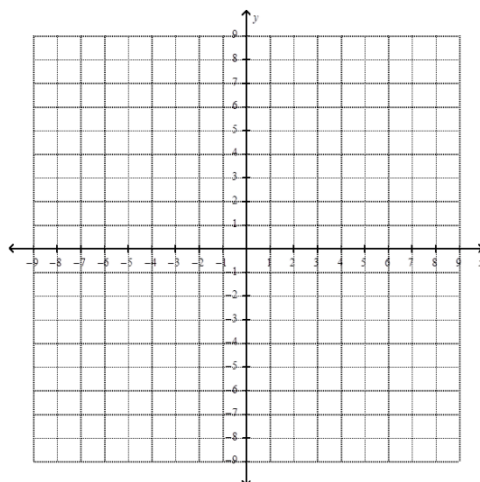


Draw a graph of  $f(x) = x^2$  and  $\frac{1}{2}f(x)$  on the same graph. What do you notice?

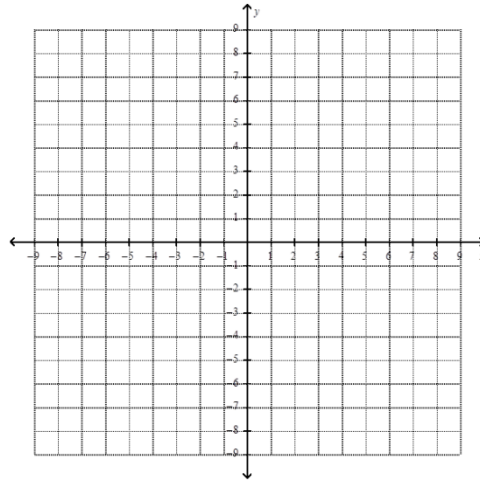


In general  $y = af(x)$  is a vertical stretch about the x-axis of the graph of the function  $f(x)$  by a factor of  $|a|$ . If  $a < 0$ , then the graph is also reflected in the x-axis.

Draw a graph of  $f(x) = x^2$  and  $f(2x)$  on the same graph. What do you notice?



Draw a graph of  $f(x) = x^2$  and  $f(\frac{1}{2}x)$  on the same graph. What do you notice?



In general  $y = f(bx)$  is a horizontal stretch about the y-axis of the graph of the function  $y = f(x)$  by a factor of  $\frac{1}{|b|}$ . If  $b < 0$ , then the graph is also reflected in the y-axis.

### Example 1

The graph of the function  $y = |x|$  has been stretched about the x-axis by a factor of 2. Write the equation of the transformed function, if the range of the transformed function is  $\{y|y \leq 0, y \in R\}$ .

Given the graph of  $y = f(x)$ , sketch the graph of the transformed function  $y = f(-\frac{1}{2}x)$ .

