Graphing Quadratics
Stretches and Reflections

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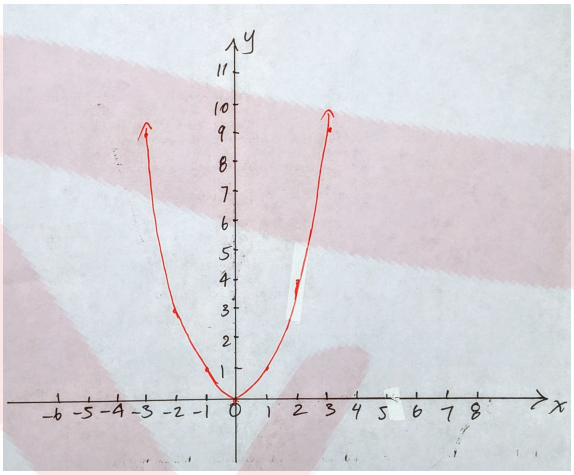
Graph Quadratics: Stretches and Reflections

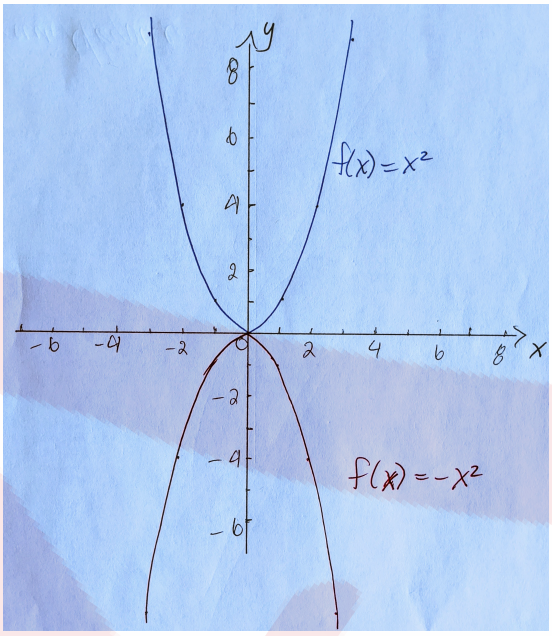
How do we determine the intervals of increase and decrease? We need to determine the vertices of the function. This brings us to sketching graphs and transformations of functions. We will consider sketching quadratics here. Let's consider the most basic quadratic, $f(x) = x^2$, and it's graph. Note, quadratics may also be called *parabolas*.



We will call this function a *parent function*. There are many other parent functions but we will start with this one to illustrate the basic transformations.

Reflection

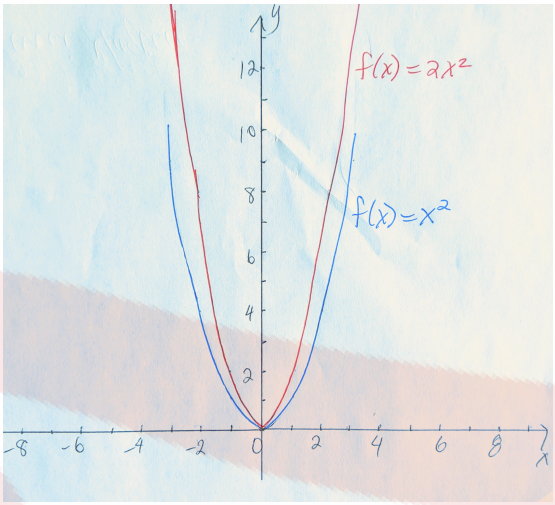
Reflection in the x-axis can be written as $f(x) = -x^2$.



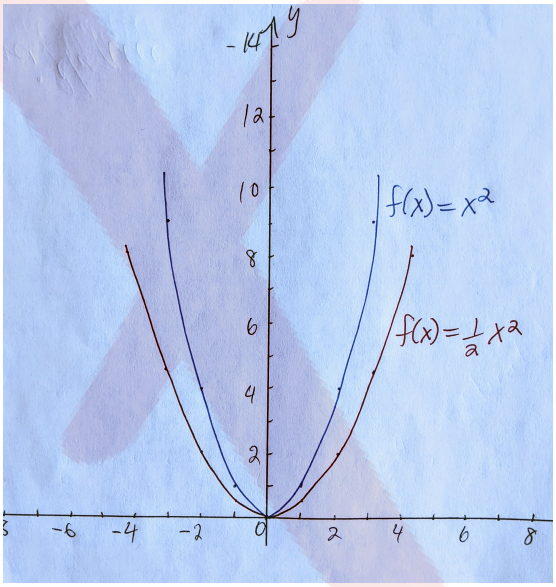
Reflection in the y-axis can be written as $f(x) = (-x)^2 = ^2$.

Stretch or Compression

An example of a **vertical stretch** is the following function, $f(x) = 2x^2$.



An example of a **vertical compression** is the following function, $f(x) = \frac{1}{2}x^2$.



A vertical compression or stretch may be written as,

$$f(x) = ax^2,$$

where $a \in (0, \infty)$.

When $a > 1$ then we have a **vertical stretch**.

When $a < 1$ then we have a **vertical compression**.

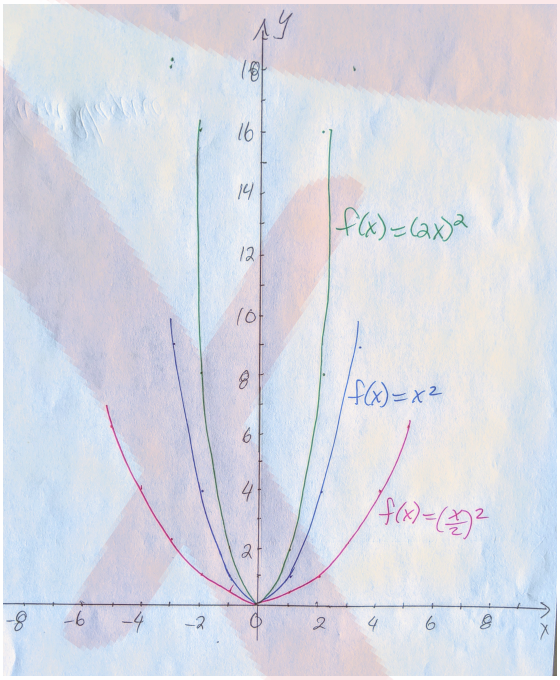
An example of a horizontal stretch or compression can be seen from the following function. This function represents a horizontal compression,

$$f(x) = (2x)^2 = 4x^2$$

is the same as a vertical stretch. And the following function represents a horizontal stretch,

$$f(x) = \left(\frac{1}{2}x\right)^2 = \frac{1}{4}x^2$$

which is the same as a vertical compression.



In general, a horizontal stretch or compression may be written as,

$$f(x) = (kx)^2,$$

where $k \in \mathbb{R}$.

When $k > 1$ then we have a **horizontal compression**.

when $k < 1$ then we have a **horizontal stretch**. Notice that horizontal compression is the same as a vertical stretch and a horizontal stretch is the same as a vertical compression.

Exercises

For each quadratic below, indicate if there is

a) Sketch the graph.

b) Indicate if there is a stretch, compression and/or reflection.

c) Indicate how much of a stretch or compression. Indicate which axis the graph is being reflected in.

1. $y = 2x^2$

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

3. $y = -x^2$

4. $y = -3x^2$

5. $y = -\frac{1}{4}x^2$

6. $y = -5x^2$

7. $y = \frac{1}{2}x^2$

8. $y = -x^2 + 1$