

Nonrigid Transformations

The transformations we just discussed are *rigid* since the basic shape of the graph is unchanged....only the position of the graph is affected. *Nonrigid transformations* are those that cause a distortion or change in the shape of the original graph. We will be considering vertical and horizontal *stretches* and *shrinks*.

Vertical and Horizontal stretches and shrinking of the graph of $y = f(x)$ are represented as follows:

- | | Transformation rule: |
|---|--|
| 1. $g(x) = c \cdot f(x)$ vertical stretch given that $c > 1$ | $(x, y) \rightarrow (x, cy)$ |
| 2. $g(x) = c \cdot f(x)$ vertical shrink or compress given that $0 < c < 1$ | $(x, y) \rightarrow (x, cy)$ |
| 3. $g(x) = f(c \cdot x)$ horizontal shrink or compress if $c > 1$ | $(x, y) \rightarrow \left(\frac{x}{c}, y\right)$ |
| 4. $g(x) = f(c \cdot x)$ horizontal stretch given that $0 < c < 1$ | $(x, y) \rightarrow \left(\frac{x}{c}, y\right)$ |

Example:

Describe the non-rigid change for the following function in comparison to the parent function:

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

vertical compress by factor of 3
shift right 2

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

horizontal compress by factor of $\frac{1}{4}$

$$y = \left(\frac{2x}{5}\right)^3$$

horizontal stretch by factor of $\frac{5}{2}$

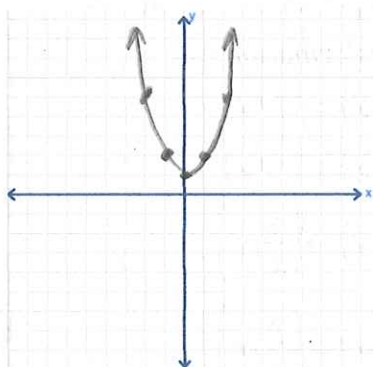
$$y = \frac{2}{5}\sqrt{x-3}$$

vertical compress by factor of $\frac{2}{5}$
shift right 3

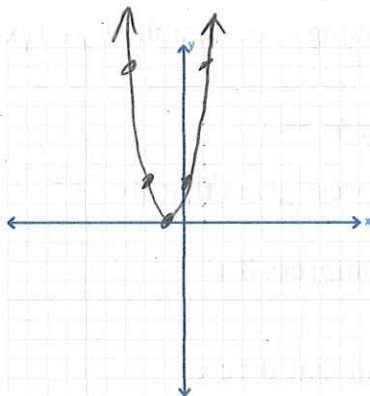
Example:

Sketch the following graphs without using your calculator:

$$y = (x+1)^2 \quad (x, y+1)$$

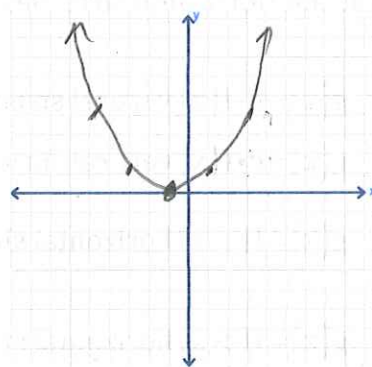


$$y = 2(x+1)^2 \quad (x-1, 2y)$$



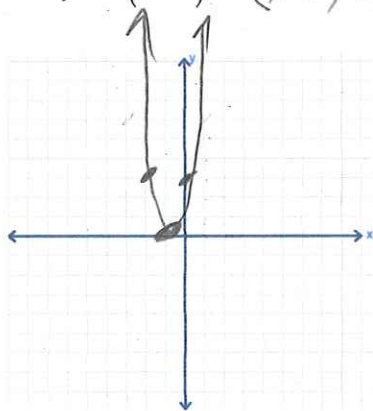
horizontal stretch

$$y = \left(\frac{1}{2}(x+1)\right)^2 \quad (2x-1, y)$$

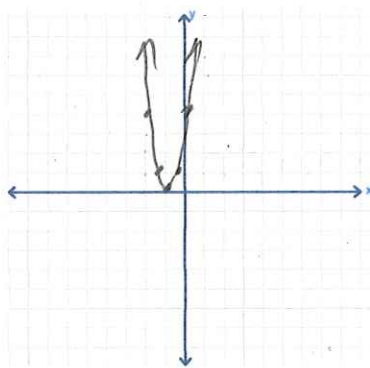


Try these:

$$y = 3(x+1)^2 \quad (x-1, 3y)$$

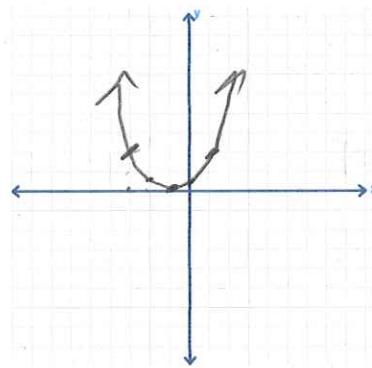


$$y = (2(x+1))^2$$



$$\left(\frac{1}{2}x-1, y\right)$$

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



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

$\left. \begin{array}{l} (-2, 4) \\ (-1, 1) \\ (0, 0) \\ (1, 1) \\ (2, 4) \end{array} \right\} \text{original points}$