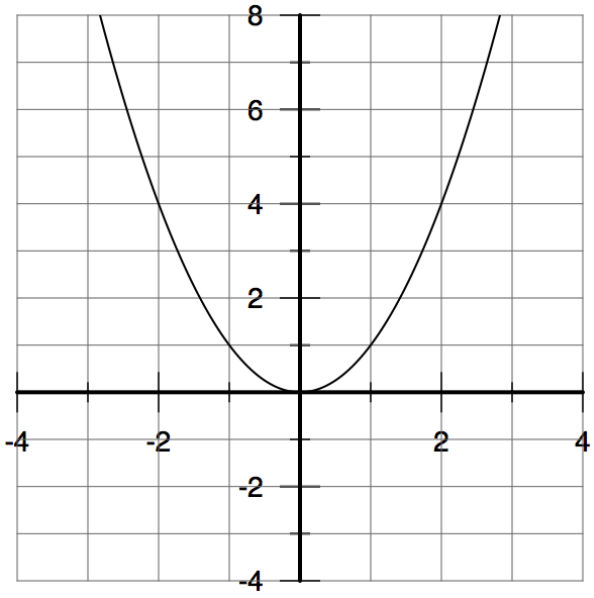
Translations

These notes are intended as a summary of section 3.1 (p. 162 – 168) in your workbook. You should also read the section for more complete explanations and additional examples.

Vertical Translations

On the axes pictured to the right, you will see the graph of $y = x^2$.



To see how the graph of $y = x^2 + k$ compares to the graph of $y = x^2$, plot the following functions on the same axes:

$$y = x^2 + 3$$

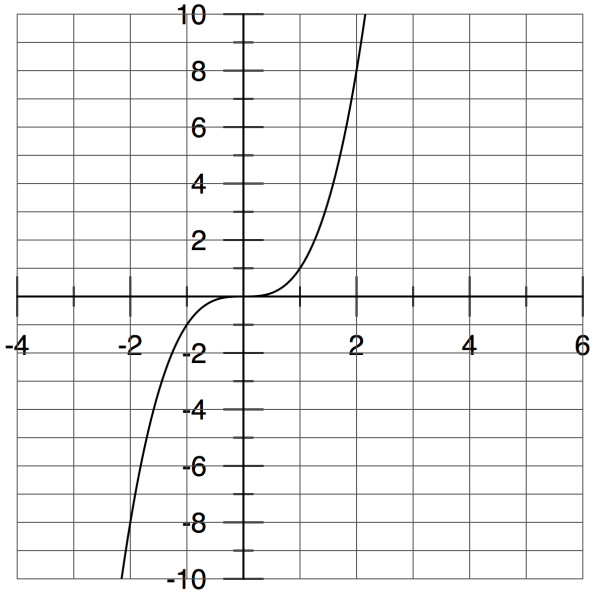
$$y = x^2 - 3$$

In general, the graph of $y = f(x) + k$, also written $y - k = f(x)$, is the graph of $y = f(x)$ shifted $|k|$ units up (if $k > 0$) or down (if $k < 0$).

Note: The easiest way to draw the translation of a graph is to identify a few **lattice points** (points on a graph that are directly on the intersection of the grid) on the parent graph, move those lattice points the desired amount, and then sketch the resulting graph.

Horizontal Translations

On the axes pictured to the right, you will see the graph of $y = x^3$.



To see how the graph of $y = (x - h)^3$ compares to the graph of $y = x^3$, plot the following functions on the same axes:

$$y = (x + 2)^3$$

$$y = (x - 3)^3$$

In general, the graph of $y = f(x-h)$ is the graph of $y = f(x)$ shifted $|h|$ units right (if $h > 0$) or left (if $h < 0$).

Domain and Range

The **domain** of a function is the set of all x values for which the function is defined. In other words, it is the set of x values that result in valid y values. When determining the domain of a function, remember that

- the denominator of a fraction can't be zero
- the number under a square root sign must be positive

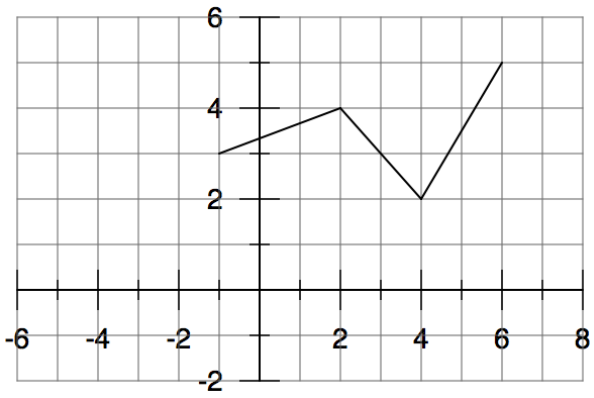
The **range** of a function is the set of all y values that result from the given domain. In other words, if you substituted every value of x from the domain into the function, the result would be the values of y in the range.

Example 1 (sidebar p. 165)

Here is the graph of $y = g(x)$. Sketch the image graph after each translation. Write the equation of the image graph in terms of the function g. State the domain and range of each function.

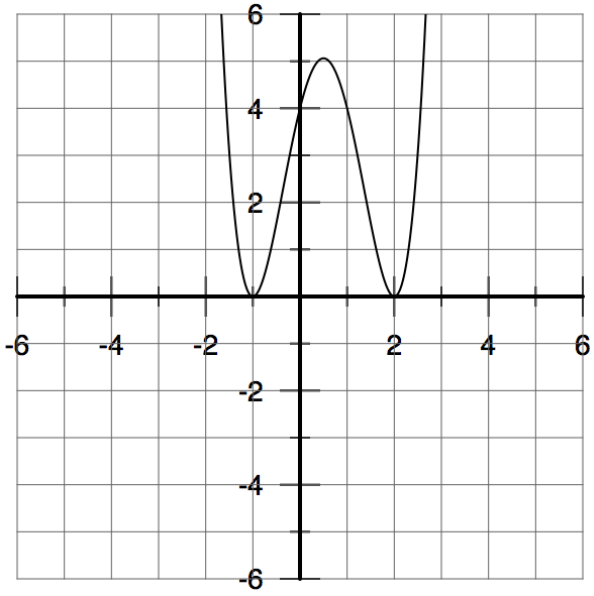
a) a translation of 4 units left

b) a translation of 1 unit up



Example 2 (sidebar p. 166)

Here is the graph of $y = j(x)$. Sketch the image graph after a translation of 4 units left and 5 units down. Write the equation of the image graph in terms of the function *j*. State the domain and range of each function.



Example 3 (sidebar p. 167)

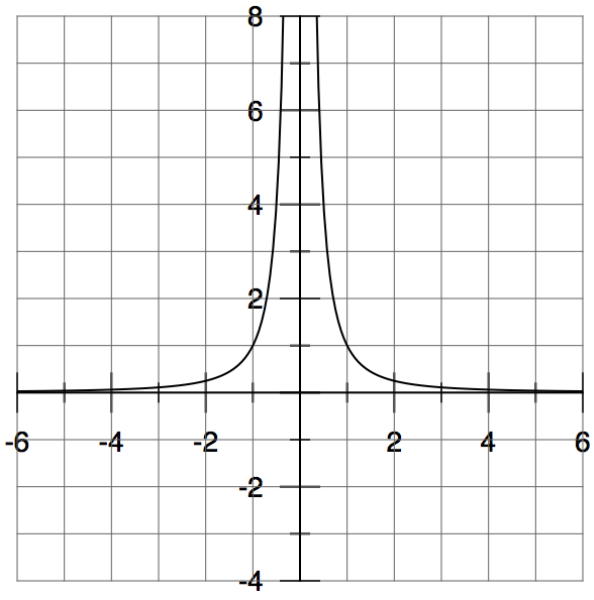
The graph of $y = \frac{1}{x}$ is translated 3 units left and 2 units up. What is the equation of the image graph?

Example 4 (sidebar p. 167)

Describe how the graph of $y = \frac{1}{x^2}$ (shown to the right) could have been translated to create the graph of each function below. What are the equations of the asymptotes of each image graph?

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

b) $y + 4 = \frac{1}{(x+3)^2}$



Homework: #4 – 10, 12 – 17 in the exercises (p. 169 – 175). Answers on p. 176.