1.3 Graphing

Rigid Graph Transformations:

- **Vertical Translation**: $f(x) + k$ will shift the graph
  - $k$ units up if $k > 0$
  - $k$ units down if $k < 0$

- **Horizontal Translation**: $f(x + h)$ will shift the graph
  - $h$ units left if $h > 0$
  - $h$ units right if $h < 0$

- **Reflections**
  - $-f(x)$ reflects the graph of $f(x)$ about the $x$-axis
  - $f(-x)$ reflects the graph of $f(x)$ about the $y$-axis

Non-rigid Transformations

- **Vertical Compressing or Stretching**: $a \cdot f(x)$
  - If $0 < a < 1$, then $a \cdot f(x)$ compresses the graph of $f(x)$
  - If $a > 1$, then $a \cdot f(x)$ stretches the graph of $f(x)$

Example: How is the graph $g(x) = -2(x+1)^2 - 5$ obtained from the graph of $f(x) = x^2$?
Example: Graph the number of bacteria in a culture that starts with 4000 bacteria and the population triples every 30 minutes.

Two quantities are said to differ by an order of magnitude if the two quantities are about a factor of 10 different.

Example: Show the numbers 0.001, 0.1, 1, 100, 100000 on a logarithmic scale.

Example: Show the numbers 0.3, 4, 50, 200, and 7000 on a logarithmic scale.
Example: Graph the log of the number of bacteria in a culture that starts with 4000 bacteria and the population triples every 30 minutes.

A graph in which the vertical axis is on a logarithmic scale and the horizontal axis is on a linear scale is called a log-linear or a semilog plot.

An exponential function of the form $y = c \cdot a^x$ will result in a straight line when graphed on a semilog plot.
Example: Graph \( y = 7 \left( \frac{1}{2} \right)^x \), \( x \in \mathbb{R} \) on a semilog plot.

Example: Find the functional relationship between \( x \) and \( y \) based on the semilog plot shown below.
A graph in which the horizontal and vertical axes are on a logarithmic scale is called a **log-log** or a **double-log plot**.

**Example:** Graph \( y = 6\sqrt{x} \) on a double-log plot

A power function of the form \( y = b \cdot x^r \) will result in a straight line when graphed on a double-log plot.
**Example:** Find the functional relationship between $x$ and $y$ based on the double-log plot below.