

## 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

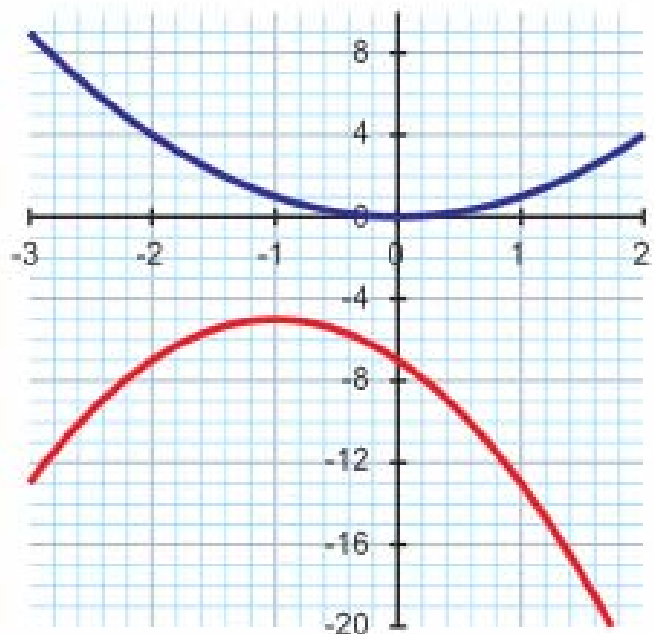
- **Vertical Compressing or Stretching:**  $a \cdot f(x)$ 
  - If  $0 < a < 1$ , then  $a \cdot f(x)$  compresses the graph of  $f(x)$
  - if  $a > 1$ , then  $a \cdot f(x)$  stretches the graph of  $f(x)$

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.

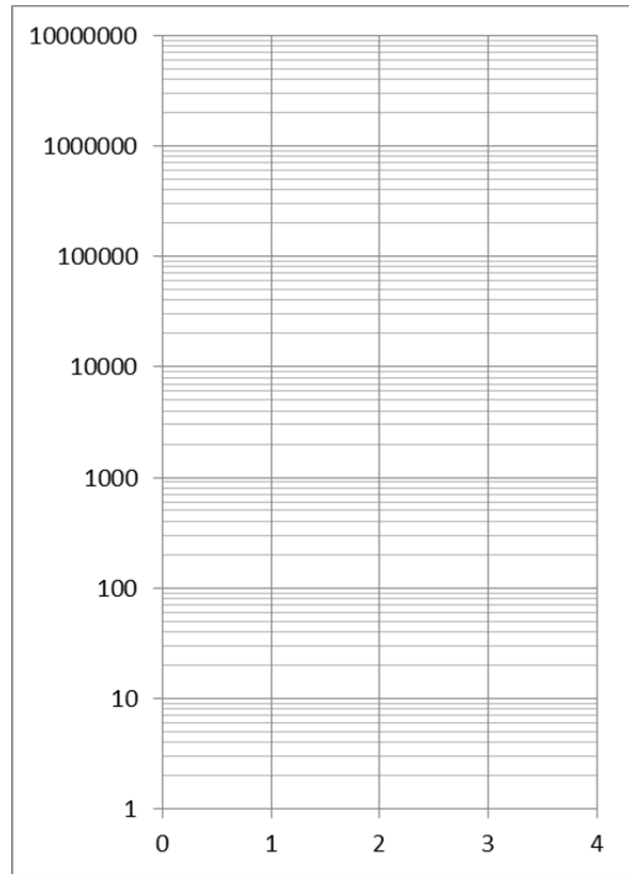
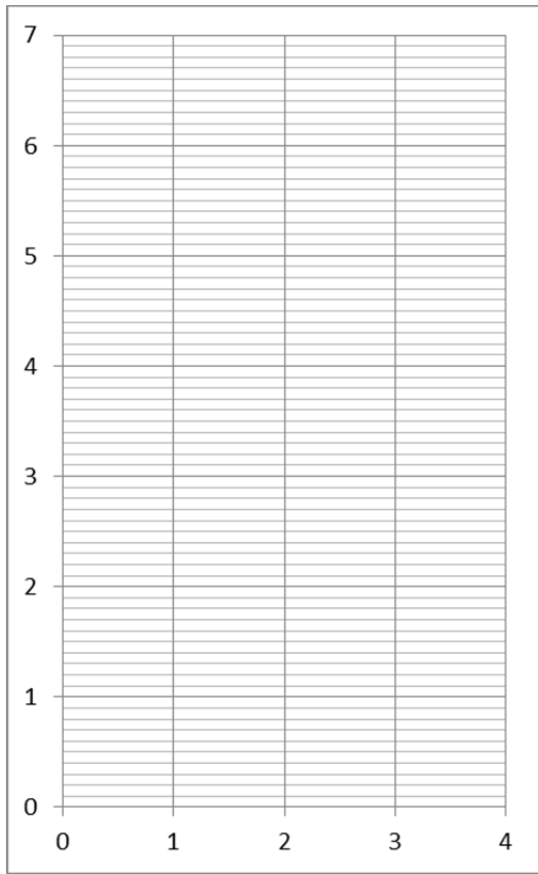


*Example:*

Show the numbers 0.3, 4, 50, 200, and 7000 on a logarithmic scale.



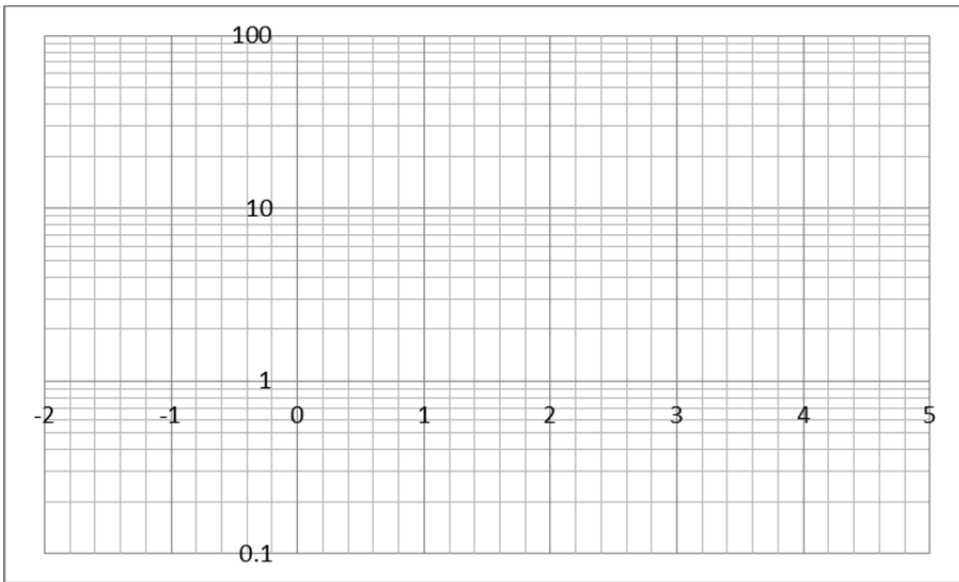
*Example:* Graph the log of the number of bacteria in a culture that starts with 4000 bacteria and the population triples every 30 minutes.



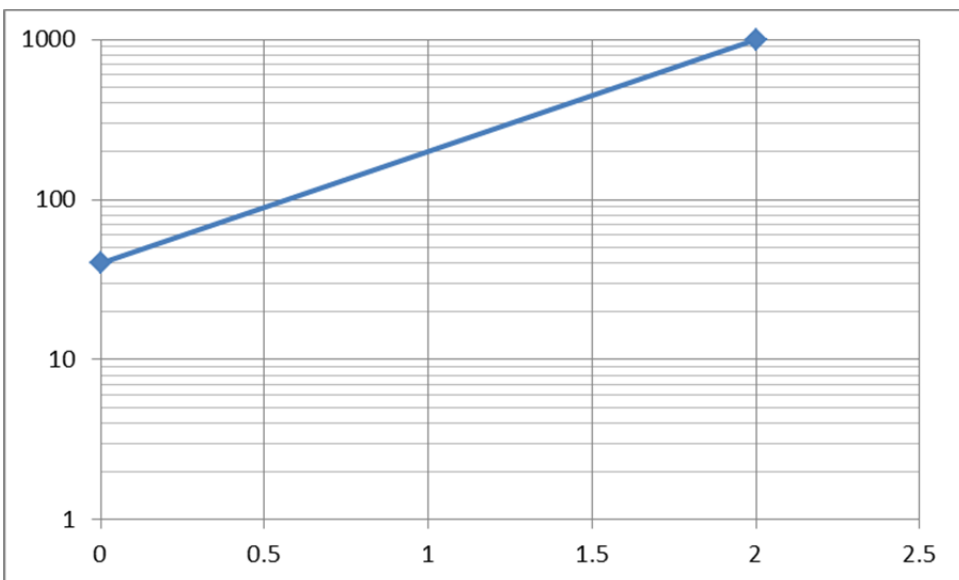
A graph in which the vertical axis is on a logarithmic scale and the horizontal axis is on a linear scale is called a **log-linear** or a **semilog plot**.

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  $y = 7\left(\frac{1}{2}\right)^x$ ,  $x \in \mathfrak{R}$  on a semilog plot

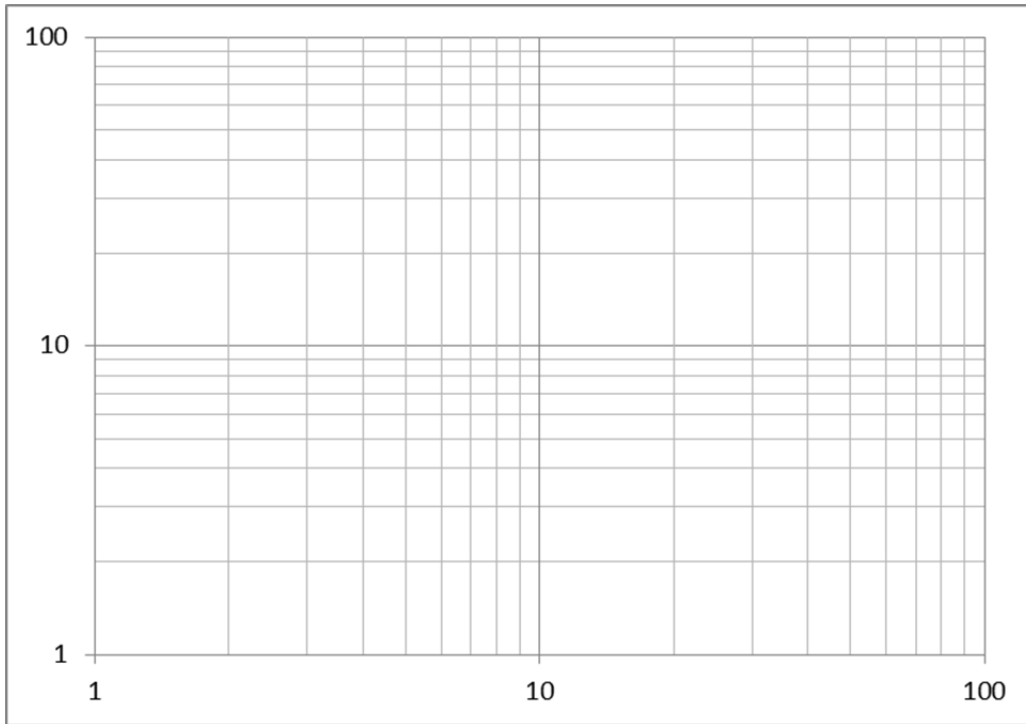


*Example:* Find the functional relationship between  $x$  and  $y$  based on the semilog plot shown below.



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.

