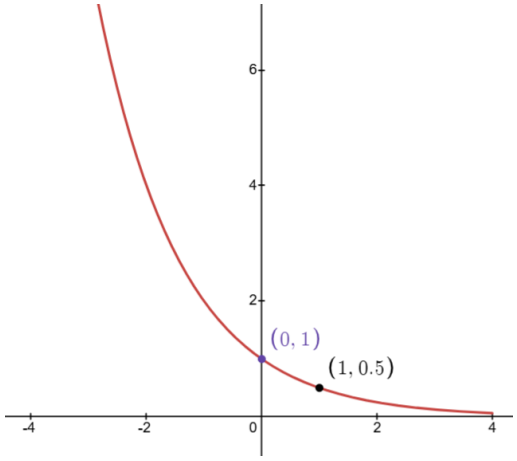
Graphs of Exponential Functions

Key Points:

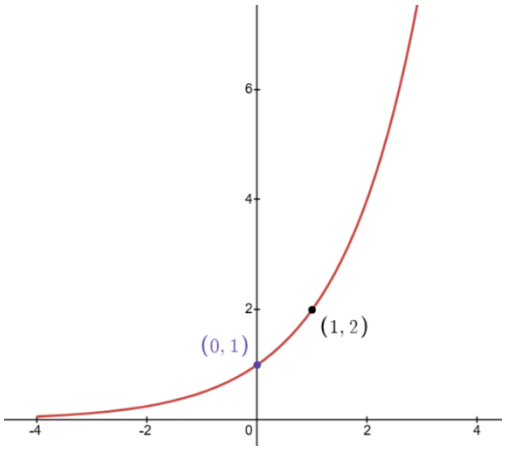
- The graph of the function $f(x) = b^x$ has a y −intercept at (0, 1), domain $(-\infty, \infty)$, range $(0, \infty)$, and horizontal asymptote $y = 0$.

- If $b > 1$, the function is increasing. The left tail of the graph will approach the asymptote $y = 0$, and the right tail will increase without bound.

- If $0 < b < 1$, the function is decreasing. The left tail of the graph will increase without bound, and the right tail will approach the asymptote $y = 0$.

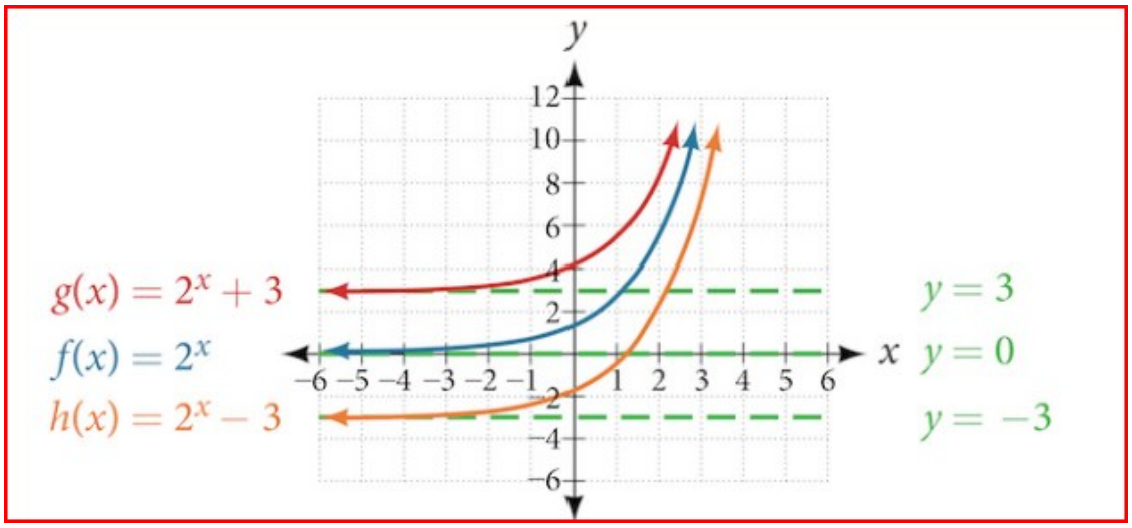


$f(x) = \frac{1}{2}^x$

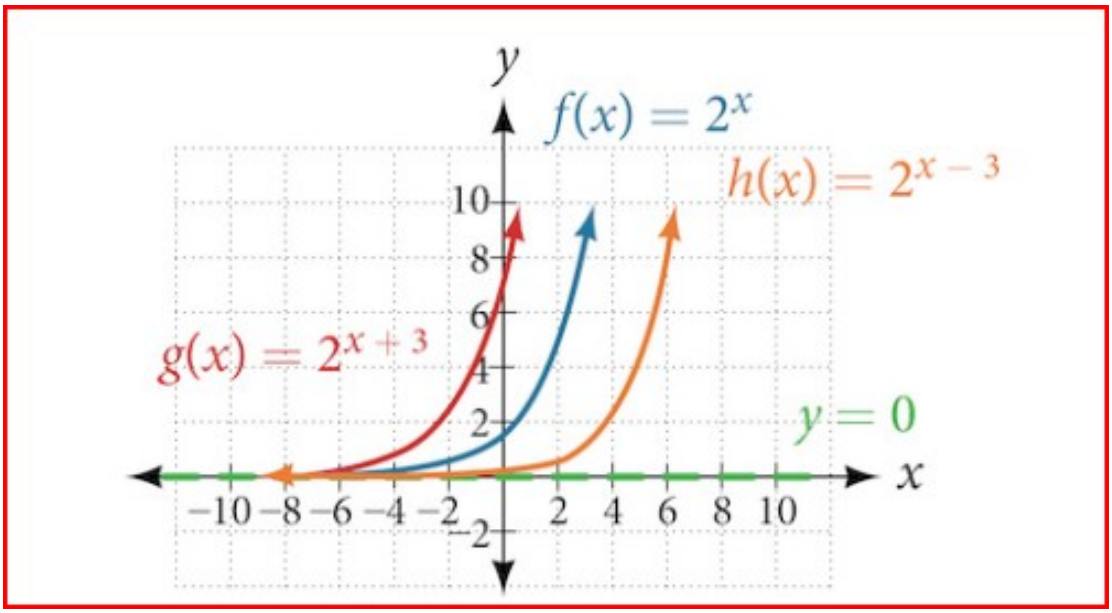


$f(x) = 2^x$

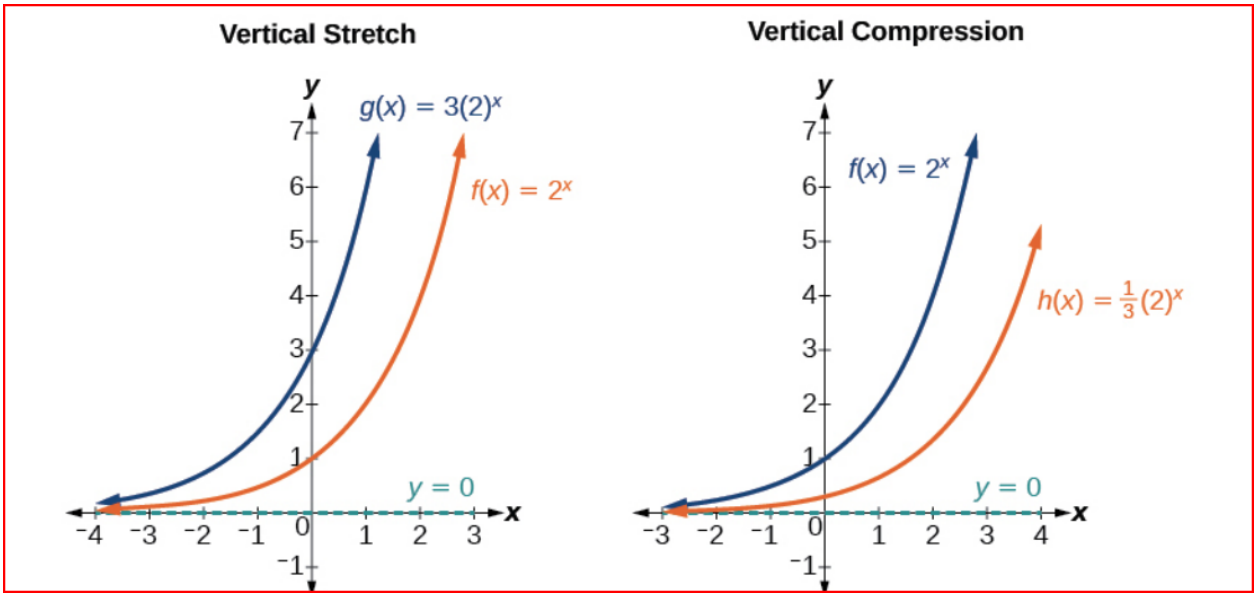
- The equation $f(x) = b^x + d$ represents a vertical shift of the parent function $f(x) = b^x$.



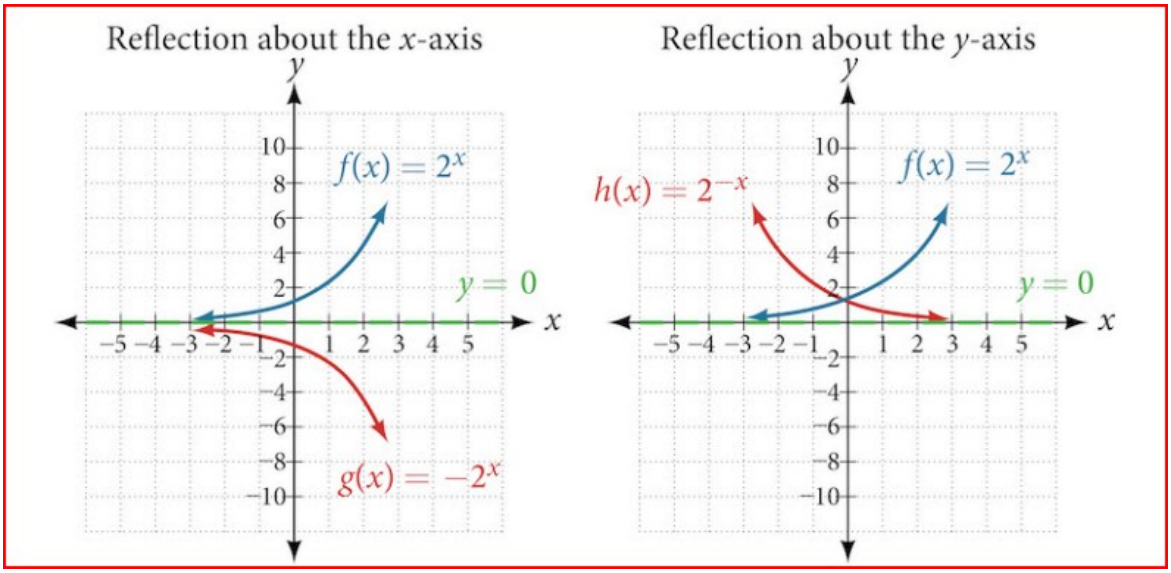
- The equation $f(x) = b^{x+c}$ represents a horizontal shift of the parent function $f(x) = b^x$.



- The equation $f(x) = ab^x$, where $a > 0$, represents a vertical stretch if $|a| > 1$ or compression if $0 < |a| < 1$ of the parent function $f(x) = b^x$.



- When the parent function $f(x) = b^x$ is multiplied by -1, the result, $f(x) = -b^x$, is a reflection about the x-axis. When the input is multiplied by -1, the result, $f(x) = b^{-x}$, is a reflection about the y-axis.



Graphs of Exponential Functions Videos

- Sketching the Graph of an Exponential Function of the form f(x)=b^x: Example 1
- Sketching Transformations of Exponential Functions: Shifts- Example 2
- Sketching Transformations of Exponential Functions: Vertical Compression-Example 3
- Sketching Transformations of Exponential Functions: Vertical Stretch-Example 4
- Transformation of Exponential Function: Reflection-Example 5
- Writing a Function from Description-Example 6

Practice Exercises

Follow the directions for each exercise below:

1. Graph the function $f(x) = 3.5(2)^x$. State the domain and range and give the y-intercept.

2. Graph the function $f(x) = 4\left(\frac{1}{8}\right)^x$ and its reflection about the y-axis on the same axes, and give the y-intercept.

3. The graph of $f(x) = 6.5^x$ is reflected about the y-axis and stretched vertically by a factor of 7. What is the equation of the new function, $g(x)$? State its y-intercept, domain, and range.
4. The graph below shows transformations of the graph $y = 2^x$. What is the equation for the transformation?

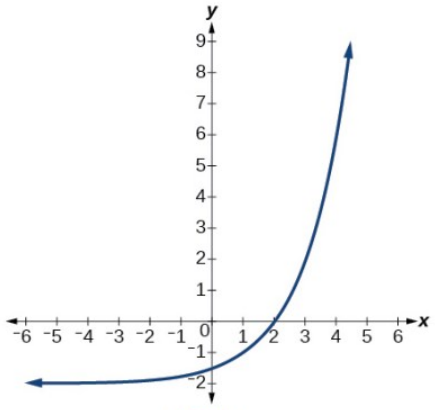
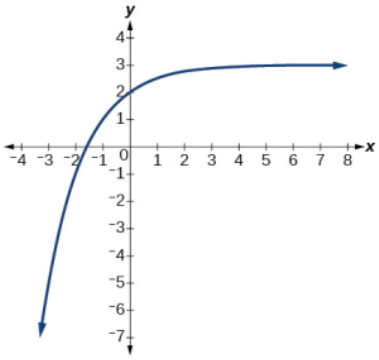


Figure 1

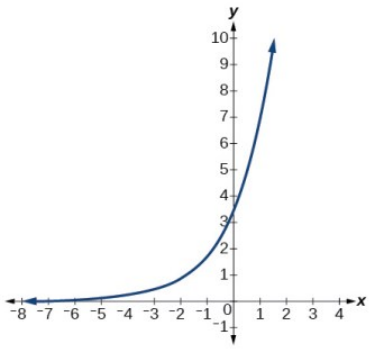
5. Graph the function $f(x) = 5(0.5)^x$ and its reflection across the y-axis on the same axes, and give the y-intercept.

6. The graph shows transformations of the graph of $f(x) = \left(\frac{1}{2}\right)^x$. What is the equation for the transformation?



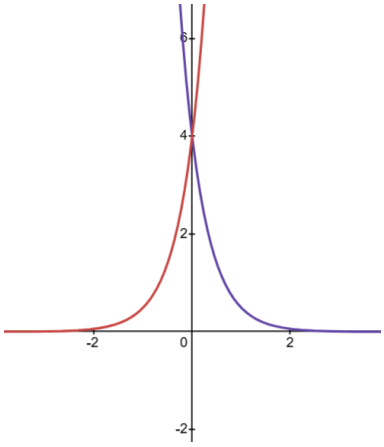
Answers:

1. Domain: all real numbers; range: all real numbers strictly greater than zero; y-intercept: (0, 3.5);



2. y —-intercept: (0,4);

$f(-x) = 4\left(\frac{1}{8}\right)^{-x}$



$f(x) = 4\left(\frac{1}{8}\right)^{x}$

3. $g(x) = 7(6.5)^{-x}$; y-intercept: (0, 7); domain: all real numbers; range: all real numbers greater than zero.

4. $g(x) = \frac{1}{2}(2)^{x} - 2$

5. y-intercept: (0, 5);

6. $g(x) = -\left(\frac{1}{2}\right)^{x} + 3$