

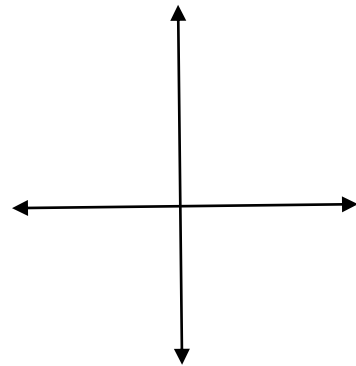
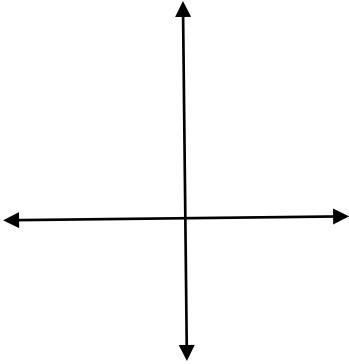
The **exponential function f** with base a is denoted by $f(x) = a^x$, where $a > 0$, $a \neq 1$, and x is any real number.

Graphs of $y = a^x$

- Construct a table of values $-3 \leq x \leq 3$
- Plot the coordinates on the graph
- What happened to the graph when the value of the base increased?

(a.) $f(x) = 2^x$

(b.) $g(x) = 4^x$

**Characteristics of $y = a^x$, $a > 1$**

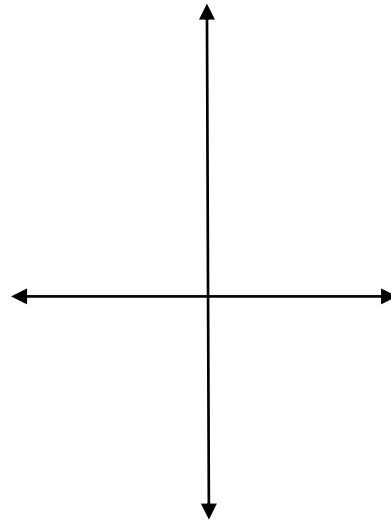
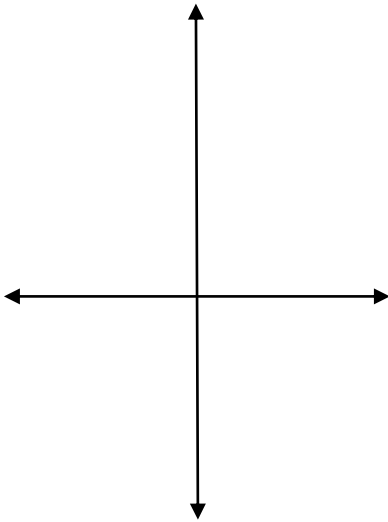
- Domain: $(-\infty, \infty)$
- Range: $(0, \infty)$
- Intercept: $(0, 1)$
- Increasing
- x-axis is a horizontal asymptote ($a^x \rightarrow 0, x \rightarrow -\infty$)
- Continuous

Graphs of $y = a^{-x}$

- Rewrite $f(x)$ and $g(x)$ using properties of exponents.
- Construct a table of values $-3 \leq x \leq 3$
- Plot the coordinates on the graph
- What happened to the graph when the value of the base increased?

(a.) $f(x) = 2^{-x}$

(b.) $g(x) = 4^{-x}$



Characteristics of $y = a^{-x}$, $a > 1$

- Domain: $(-\infty, \infty)$
- Range: $(0, \infty)$
- Intercept: $(0, 1)$
- Decreasing
- x-axis is a horizontal asymptote ($a^{-x} \rightarrow 0, x \rightarrow \infty$)
- Continuous

Transformations of Graphs of Exponential Functions:

Graph the following functions and describe the transformation of the graph $f(x) = 3^x$.

a. $f(x) = 3^{x+1}$

b. $f(x) = 3^x - 2$

c. $f(x) = -3^x$

d. $f(x) = 3^{-x}$

One-to-One Property for Exponential Functions:

For $a > 0$ and $a \neq 1$, $a^x = a^y$ if and only if $x = y$.

Examples:

1. $9 = 3^x$

2. $8 = 2^x$

3. $27 = 9^x$

4. $9 = 3^{x+1}$

5. $16 = 2^{x+2}$

6. $\left(\frac{1}{2}\right)^x = 8$

7. $\left(\frac{1}{3}\right)^x = 81$

8. $2^{x-2} = \frac{1}{32}$

9. $\left(\frac{1}{5}\right)^{x+1} = 125$

Practice/Homework

Describe the graph as a transformation of the graph $f(x) = 4^x$.

1. $f(x) = 4^{x-2}$

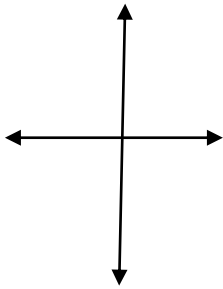
2. $f(x) = \frac{-1}{2}(4^x)$

3. $f(x) = 4^{-x} + 3$

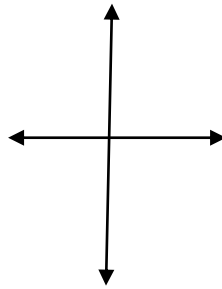
4. $f(x) = 4^{x+3} - 6$

Graph the following functions and describe the graph as a transformation of the graph $f(x) = 2^x$.

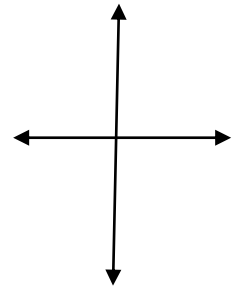
5. $f(x) = 2^{x+1}$



6. $f(x) = 2^{-x}$



7. $f(x) = -2^x + 3$



Use the One-to-One Property to solve the equations for x .

8. $32 = 4^x$

9. $16 = 2^{x-3}$

10. $36 = 4^{-x} + 4$

11. $3^{x+2} = \frac{1}{9}$

12. $\left(\frac{1}{3}\right)^{x-2} = 81$

13. $e^{5x-7} = e^{15}$