

Exponential Functions

Before we study exponential functions, make sure to review and understand some of the properties of exponents that you learned in beginning and intermediate algebra:

$$a^n a^m = a^{n+m}$$

$$\frac{a^n}{a^m} = a^{n-m}$$

$$(a^n)^m = a^{nm}$$

$$(ab)^n = a^n b^n$$

$$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$$

$$a^0 = 1 \text{ for all } a \neq 0$$

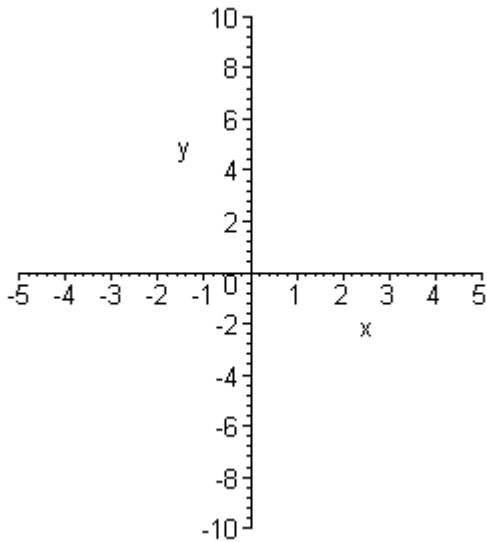
$$a^{-n} = \left(\frac{1}{a}\right)^n = \frac{1}{a^n} \quad (\text{examples: } 3^{-2} = \frac{1}{9} ; x^{-4} = \frac{1}{x^4})$$

$$a^{m/n} = (\sqrt[n]{a})^m = \sqrt[n]{a^m} \quad (\text{examples: } 3^{1/2} = \sqrt{3} ; 10^{2/3} = \sqrt[3]{100})$$

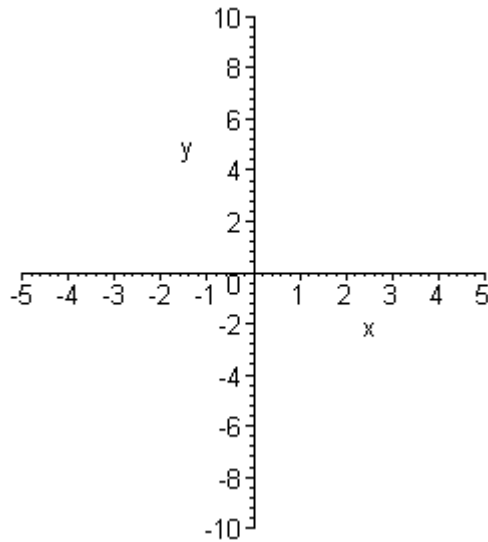
An **exponential** function is any function that can be written as $f(x) = a^x$ where a is any positive real number except 1.

Use the axes below and draw a graph of the functions $f(x) = 2^x$, $g(x) = 3^x$ and $h(x) = \left(\frac{1}{2}\right)^x$ by independently choosing value for x and plotting points.

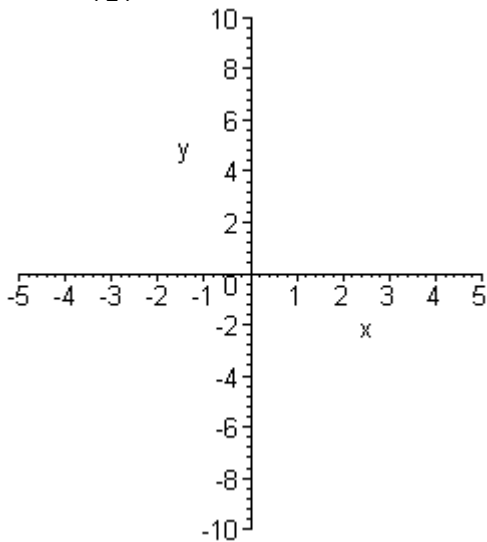
$$y = 2^x$$



$$y = 3^x$$



$$y = \left(\frac{1}{2}\right)^x$$



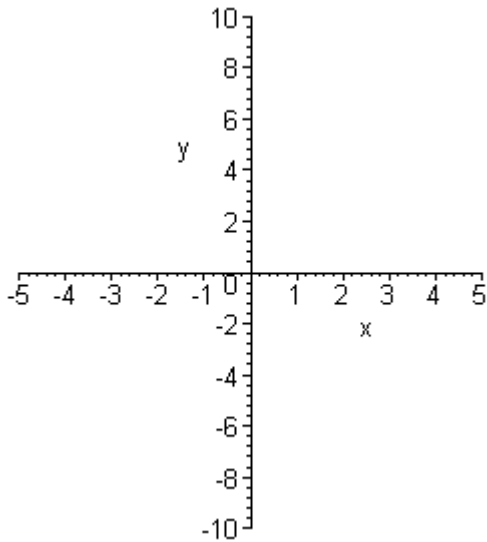
Properties of Exponential Functions

1. Graph contains the point $(0, 1)$
2. Domain all reals
3. Range $y > 0$
4. x -axis is horizontal asymptote.
5. One-to-One.
6. Increasing for $a > 1$.
Decreasing for $0 < a < 1$.

The number e is an irrational number called Euler's number.
 $e \approx 2.718$

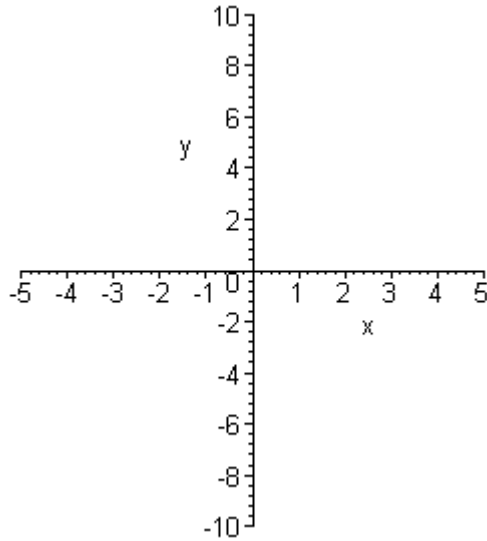
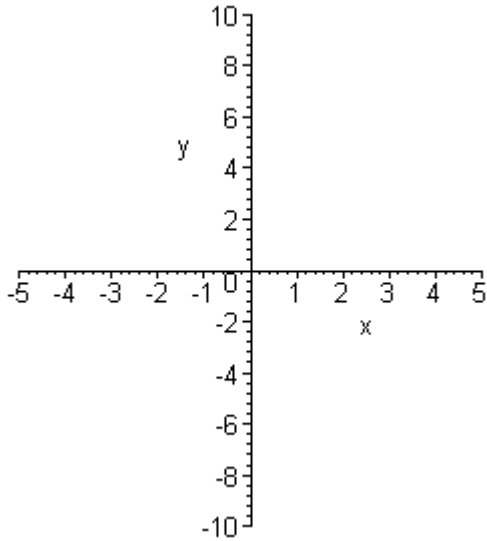
Use the axes below and draw a graph of the natural exponential function
 $f(x) = e^x$

$$y = e^x$$

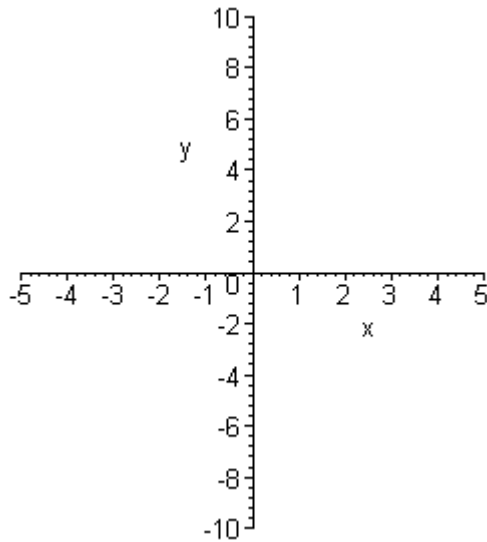
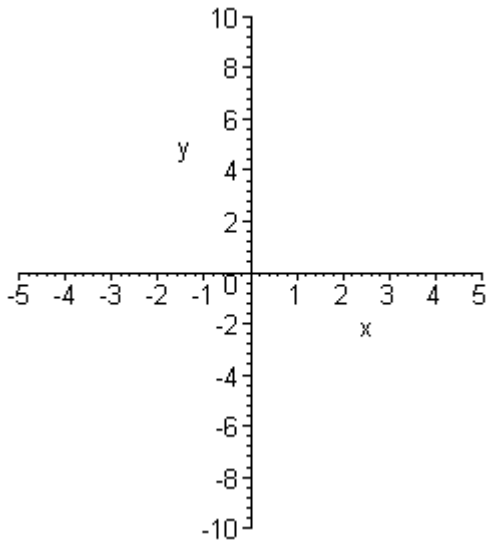


Use Transformations to write the graph of the following functions.

$$y = 3^{x+1} - 2$$



$$y = e^{2-x} + 3$$



Solve the elementary exponential equations:

$$2^{4x+1} = 8^{3x-2}$$

$$100^{3-x} = 1000^{2x+1}$$

$$16^{3x-1} = \left(\frac{1}{4}\right)^{1-2x}$$