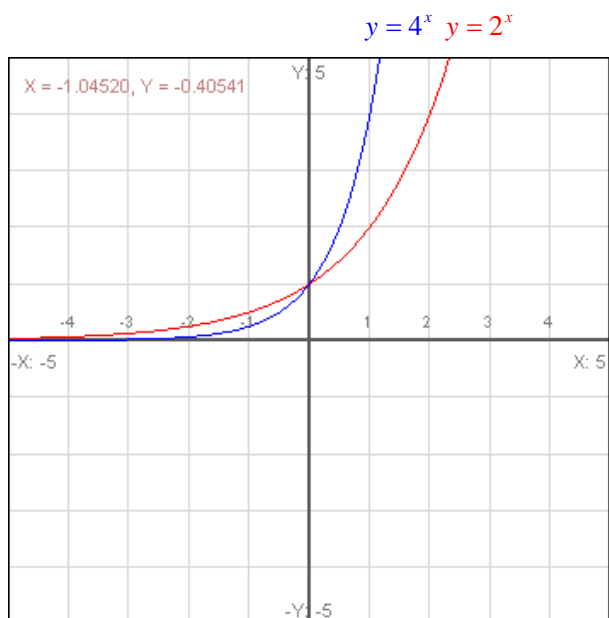


# Graphs of Exponential Functions

$y = a^x$  represents the graph of an exponential function where  $a > 0$  and  $a \neq 1$



### Properties of $y=2^x$

- Domain: All Real Numbers
- Range:  $y > 0$
- y-intercept:  $(0, 1)$
- Horizontal Asymptote:  $y = 0$
- The function is increasing.

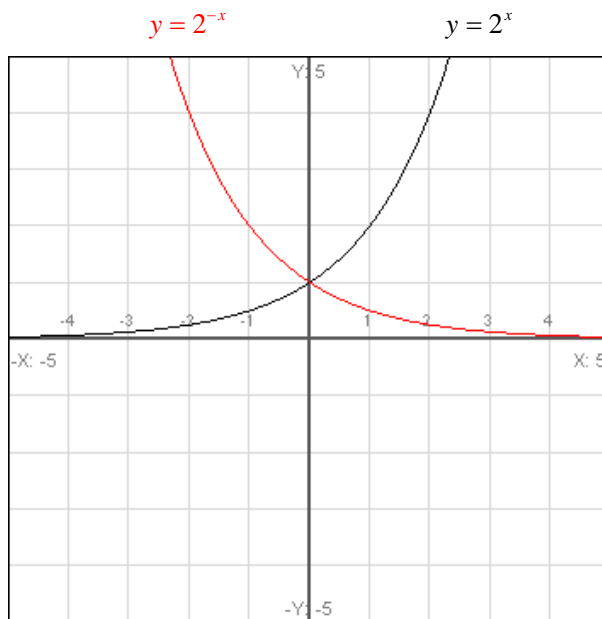
### Properties of $y=4^x$

- Domain: All Real Numbers
- Range:  $y > 0$
- y-intercept:  $(0, 1)$
- Horizontal Asymptote:  $y = 0$
- The function is increasing.
- The graph of  $y = 4^x$  increases faster and is closer to the horizontal asymptote.**

## Transformations of the Graph of the Exponential Function

$y=a^{-x}$

- Reflected over the known point.
- Domain: All Real Numbers
- Range:  $y > 0$
- y-intercept:  $(0, 1)$
- Horizontal Asymptote:  $y = 0$
- The function is decreasing.

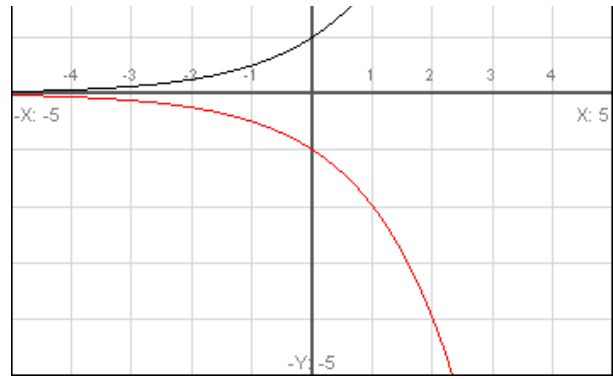


$y=-a^{-x}$

- Reflected over the horizontal asymptote
- Domain: All Real Numbers
- Range:  $y < 0$
- y-intercept:  $(0, -1)$



Horizontal Asymptote:  $y = 0$   
 The function is decreasing.

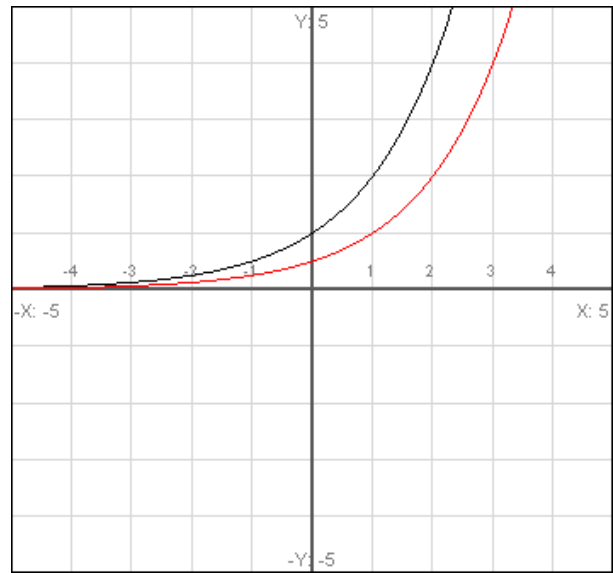


$$y = -2^x$$

$$y = a^{(x-h)}$$

Shifted  $h$  units to the right  
 Domain: All Real Numbers  
 Range:  $y > 0$   
 Horizontal Asymptote:  $y = 0$   
 The function is increasing.

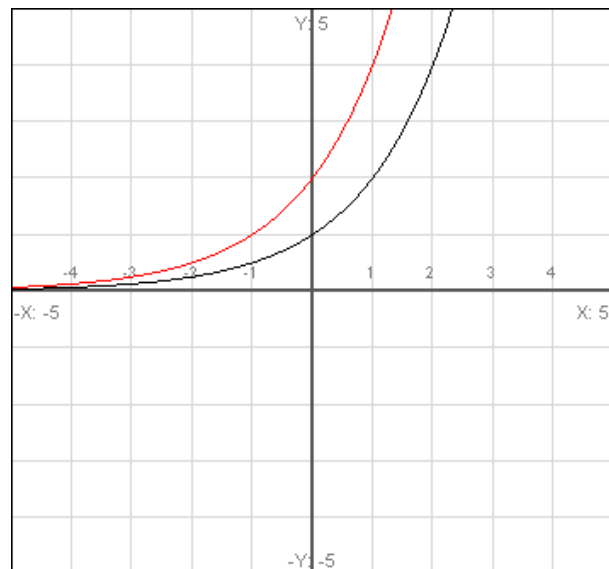
$$y = 2^x \quad y = 2^{x-1}$$



$$y = a^{(x+h)}$$

Shifted  $h$  units to the left  
 Domain: All Real Numbers  
 Range:  $y > 0$   
 Horizontal Asymptote:  $y = 0$   
 The function is increasing.

$$y = 2^{x+1} \quad y = 2^x$$



$$y = a^x + k$$

Shifted  $k$  units up

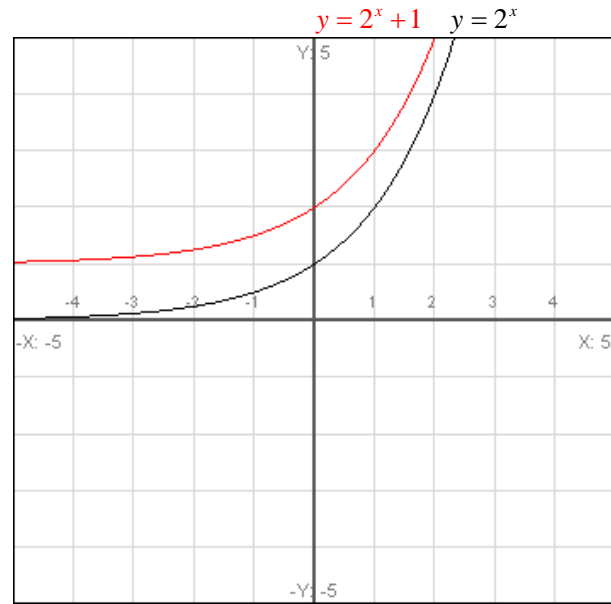
Domain: All Real Numbers

Range:  $y > k$

$y$ -intercept:  $(0, 1 + k)$

Horizontal Asymptote:  $y = k$

The function is increasing.



$$y = a^x - k$$

Shifted  $k$  units down

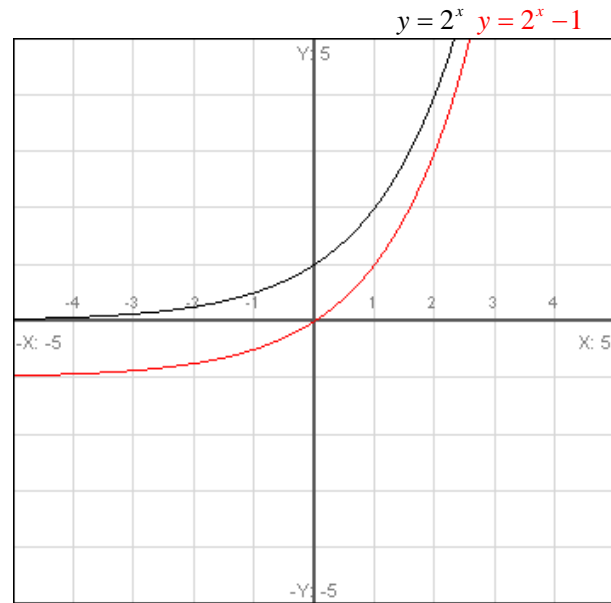
Domain: All Real Numbers

Range:  $y > k$

$y$ -intercept:  $(0, 1 + k)$

Horizontal Asymptote:  $y = k$

The function is increasing.



Directions: Graph each exponential function. Identify the domain, range, asymptotes, intercepts and determine if the function is increasing or decreasing.

$$f(x) = 3^x$$

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

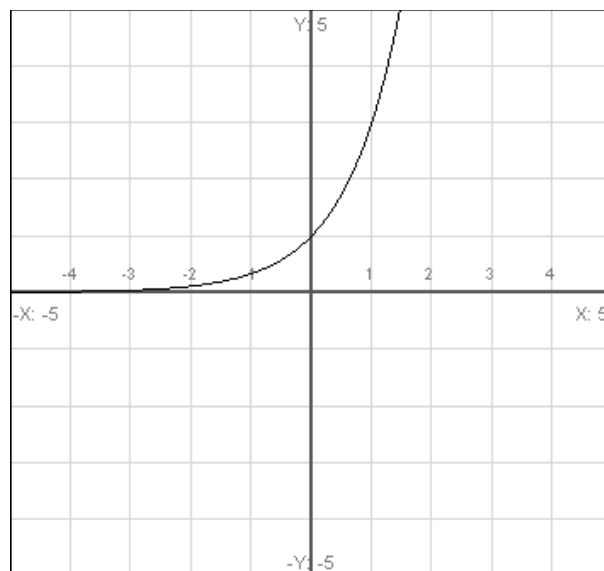
Domain:

Range:

Asymptote:

Intercept:

Increasing/Decreasing:



2.  $f(x) = -3 - 2^{x+4}$

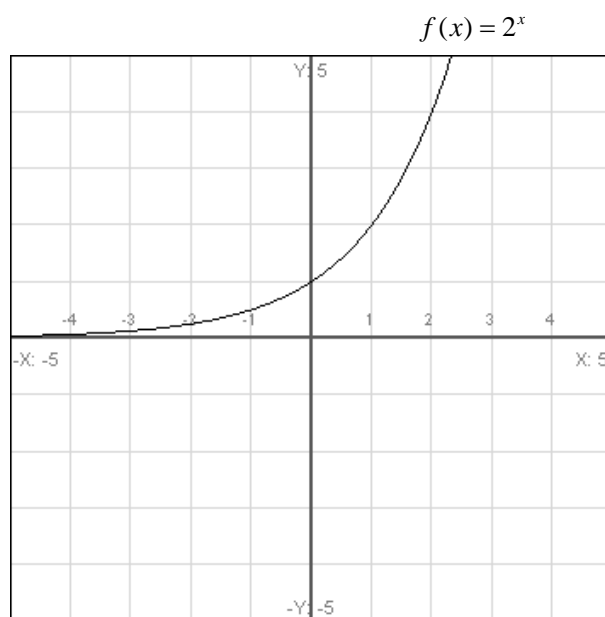
Domain:

Range:

Asymptote:

Intercept:

Increasing/Decreasing:



$f(x) = 2^x$

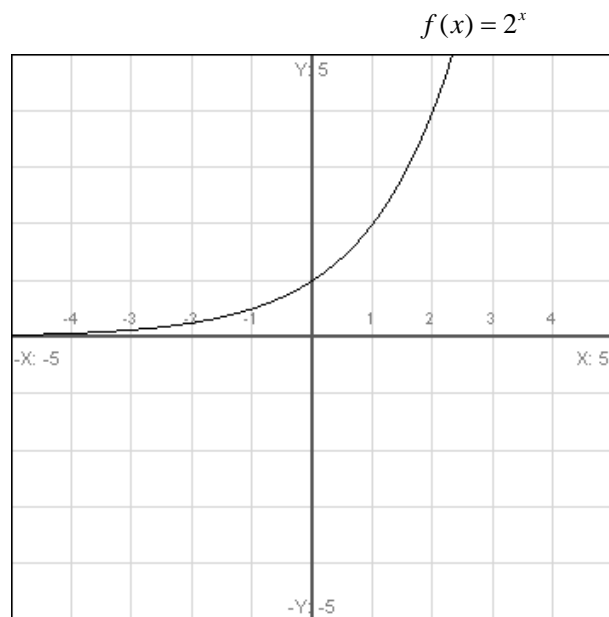
3.  $f(x) = \left(\frac{1}{2}\right)^{x+2} + 1$

Domain:

Range:

Asymptote:

Intercept:



Increasing/Decreasing: