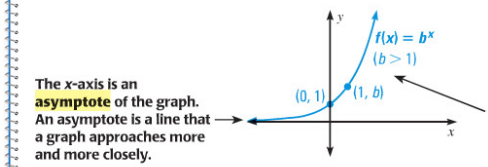
Exponential Functions

An **exponential function** has the form $y = ab^x$ where $a \neq 0$ and the base b is a positive number other than 1. If $a > 0$ and $b > 1$, then the function $y = ab^x$ is an **exponential growth function**, and b is called the **growth factor**. The simplest type of exponential growth function has the form $y = b^x$.

KEY CONCEPT *For Your Notebook*

Parent Function for Exponential Growth Functions

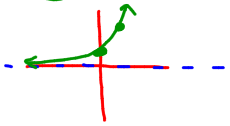
The function $f(x) = b^x$, where $b > 1$, is the parent function for the family of exponential growth functions with base b. The general shape of the graph of $f(x) = b^x$ is shown below.



The *x*-axis is an **asymptote** of the graph. An asymptote is a line that a graph approaches more and more closely.

The graph rises from left to right, passing through the points (0,1) and (1,b).

The domain of $f(x) = b^x$ is all real numbers. The range is $y > 0$.



$y = 2^x$

Parent: $y = 2^x$

(0, 1) (1, 2)

D: Real R: $y > 0$

$y = 2^{x+3} - 7$

New points: (-3, -6)
(-2, -5)

D: Real R: $y > -7$

Parent: $y = 2^x$

(0, 1) (1, 2)

$x+3$: 3 units left

-7: 7 units down

$y = 4 \cdot 3^{x-1} + 5$

New points: (1, 9)
(2, 17)

D: Real R: $y > 5$

Parent: $y = 4 \cdot 3^x$

(0, 4) (1, 12)

$x-1$: 1 unit right

$+5$: 5 units up

$y = -\frac{1}{2} \cdot 4^{x+1} - 2$

New points

$(-1, -2\frac{1}{2})$

$(0, -4)$

D: Real R: $y < -2$

Parent: $y = -\frac{1}{2} \cdot 4^x$

(takes the reflection into account)

$(0, -\frac{1}{2})$ $(1, -2)$

$x+1$: 1 unit left

-2: 2 units down