

Algebra II

Lesson 8-2.B: Graphs of Exponential Functions

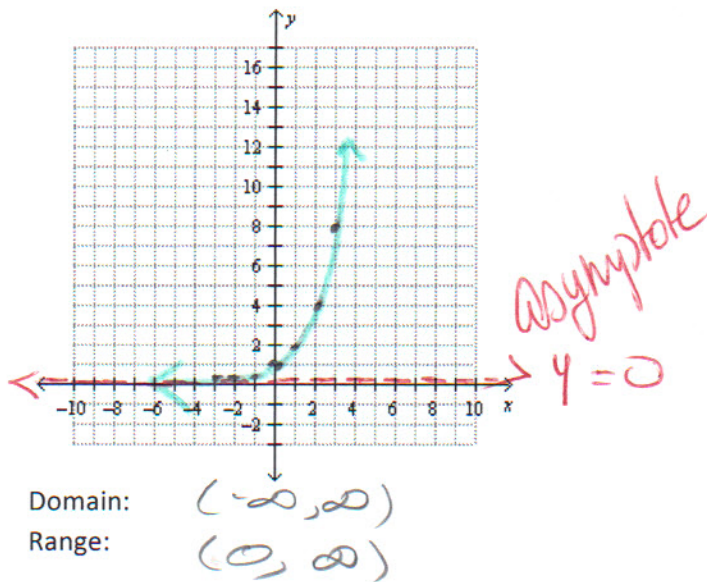
Mrs. Snow, Instructor

The exponential equation general form is: $y = ab^x$

GROWTH FUNCTION

- Base > 1
 - graph rises as x-values get larger
- Graph $y = 2^x$

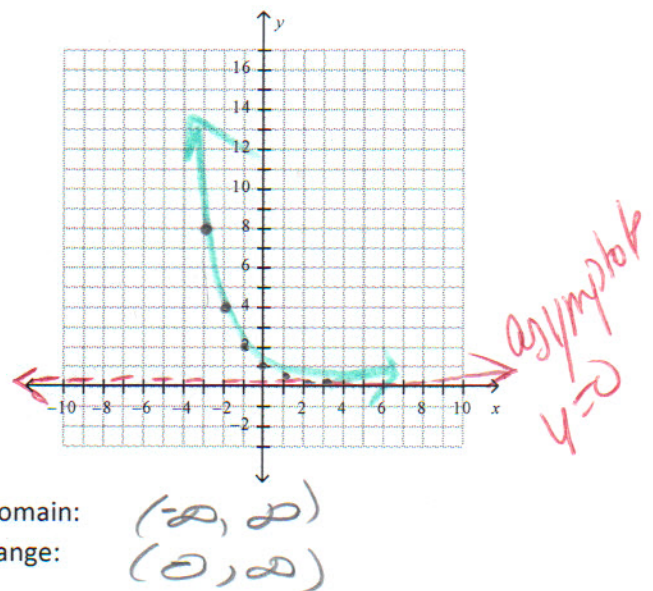
x	$2^x = y$
-3	$2^{-3} = \frac{1}{2^3} = \frac{1}{8}$
-2	$2^{-2} = \frac{1}{2^2} = \frac{1}{4}$
-1	$2^{-1} = \frac{1}{2}$
0	$2^0 = 1$
1	$2^1 = 2$
2	$2^2 = 4$
3	$2^3 = 8$



DECAY FUNCTION

- $0 < \text{base} < 1$
 - graph falls as x-values get larger
- Graph $y = \left(\frac{1}{2}\right)^x$

x	$\left(\frac{1}{2}\right)^x = y$
-3	$\left(\frac{1}{2}\right)^{-3} = 2^3 = 8$
-2	$\left(\frac{1}{2}\right)^{-2} = 2^2 = 4$
-1	$\left(\frac{1}{2}\right)^{-1} = 2$
0	$\left(\frac{1}{2}\right)^0 = 1$
1	$\left(\frac{1}{2}\right)^1 = \frac{1}{2}$
2	$\left(\frac{1}{2}\right)^2 = \frac{1}{4}$
3	$\left(\frac{1}{2}\right)^3 = \frac{1}{8}$



Notice that the graphs of both types of exponentials get infinitely close to but **do not touch or cross** the x-axis.

Asymptote – a line that a graph approaches as x or y increases in absolute value. It is like an invisible boundary that a graph cannot cross or touch.

Let's take a look at how the coefficients affect the parent function $y = b^x$:

Graph the following

How does the coefficient change the look of the parent function?

$$y = 2^x$$

$$y = (.3)2^x$$

little coefficient it shrinks

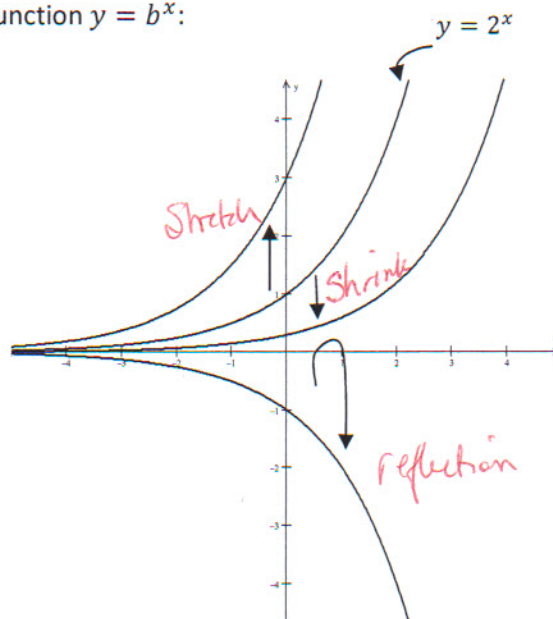
$$y = (3)2^x$$

big coefficient gets it stretches

$$y = (-1)2^x$$

negative flips it across x-axis

****remember you are expected to make a "T" table with x and y values on it along with usage of calculator for solving these problems.**



Graph, what are the horizontal asymptotes?

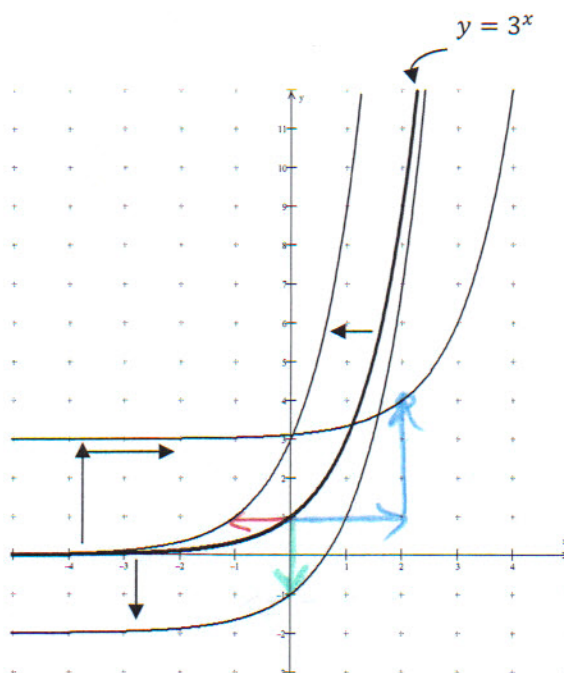
$$y = 3^x$$

Asymptote $y=0$

① $y = (3)^{x+1}$
shifts left 1 unit (*x lies, see + go left*)
asymptote $y=0$

② $y = (3)^x - 2$
down 2 units (*y is honest, see -2 go down*)
Asymptote $y=-2$

③ $y = (3)^{x-2} + 3$
right 2 and up 3
asymptote $y=3$



Summary:

Combined translation form of the Exponential Function:

$$y = ab^{x-h} + k$$

$h \Rightarrow$ horizontal $a \Rightarrow$ Stretch
 $k \Rightarrow$ vertical $\Rightarrow$ Shrink

The number e

Like π , e is a widely used constant, and both numbers are irrational numbers.

$$\pi \approx 3.14159...$$

$$e \approx 2.71828...$$

The constant π is used in applications involving circles, while e is found in applications involving growth and decay.

Why do we call this value "e"? It is in honor of its discoverer, Leonard Euler (1701-1783), a Swiss mathematician.

Euler noticed that living things and many mathematical quantities grew or decayed at a constant rate of 2.718. Thus the word "natural" was attached to this type of exponent. The number 2.718 is found when we graph the

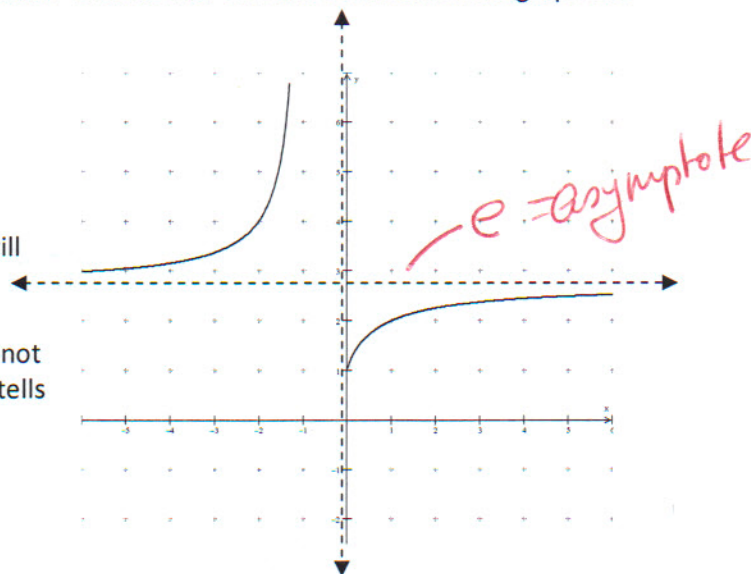
exponential function $= \left(1 + \frac{1}{x}\right)^x$.

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

What is the asymptote?

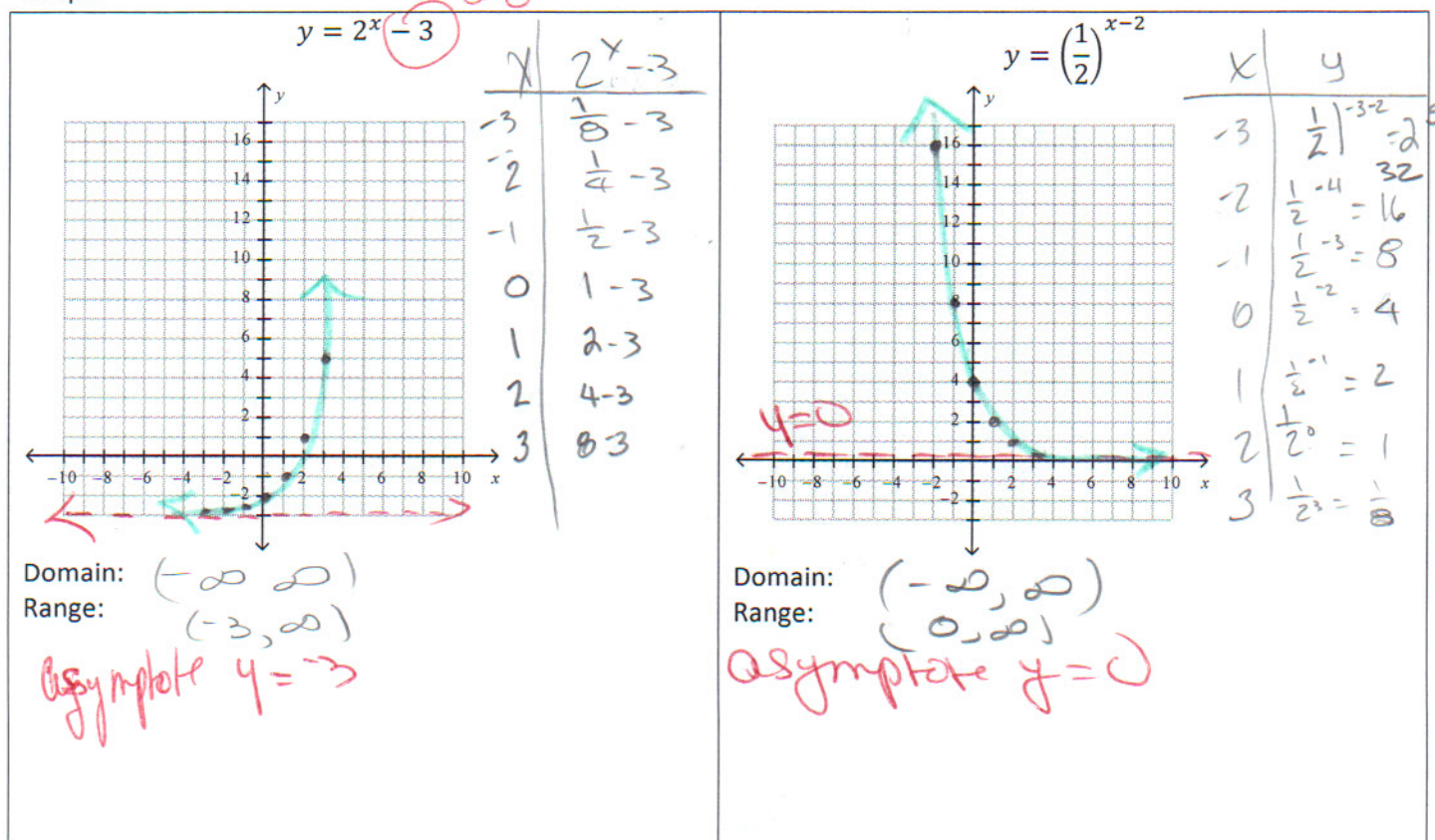
Looking at the table or extending the graph out we will find that the horizontal asymptote is $y=2.71828$

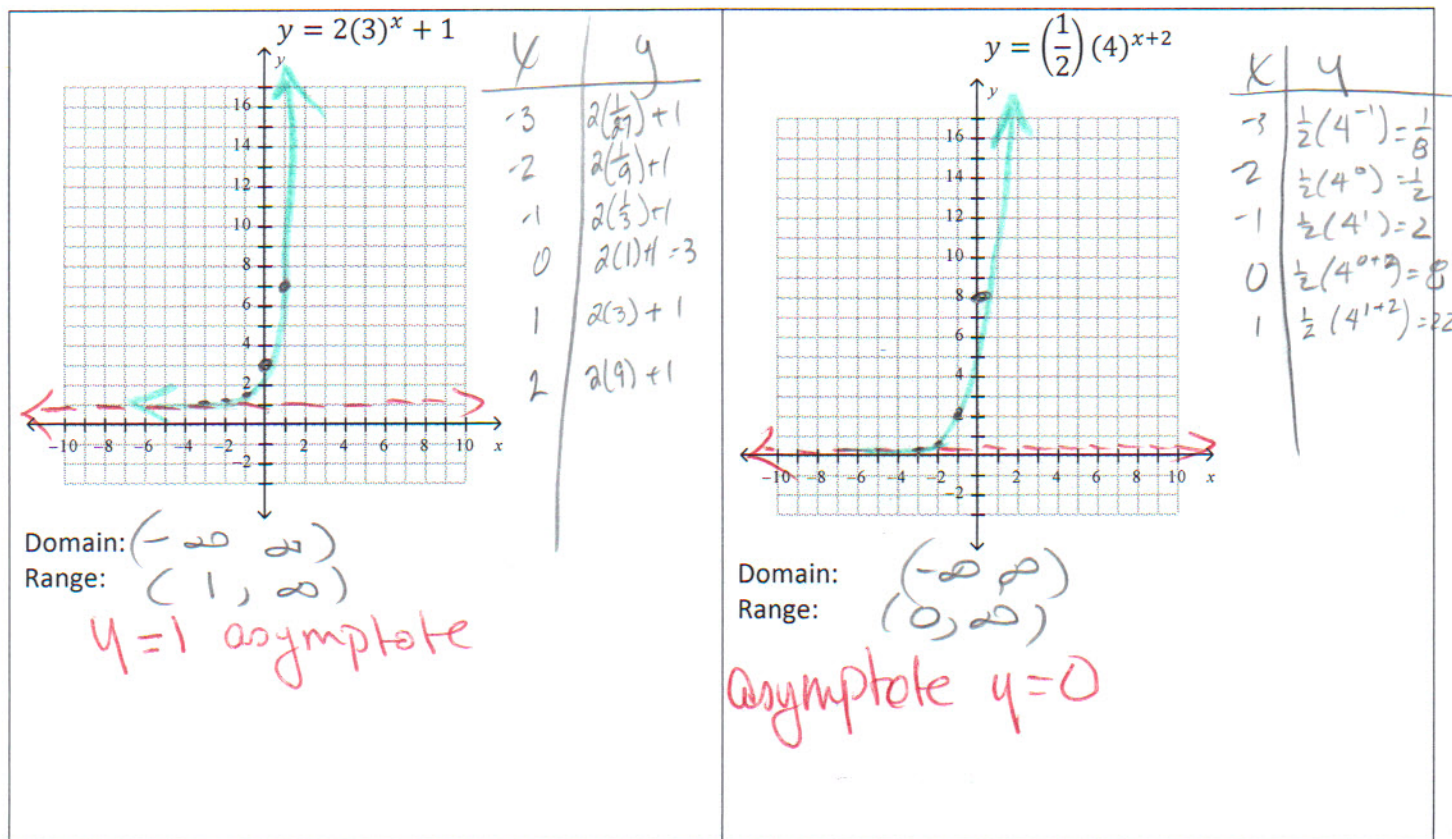
Notice that there also is a vertical asymptote as x cannot be equal to 0. What do we see on the equation that tells us this fact?



We can evaluate e^x just as we evaluate any other exponential function. To evaluate e^6 , to 4 decimal places: hit 2nd e^x , type 6 ENTER ANS=403.4288

Graph:





Note: With a table of values, we can enter the data into the calculator STAT program, following the directions given in the fall. Once the data is entered via STAT-EDIT, you can go into the STAT-CALCULATE and scroll down until you find the item "A" ExpReg. This will generate the values for the exponential coefficient and base. Using VARS, the equation may be sent to the y-plot.