Key

Algebra II 6-1 Interpret key features of Exponential models

Obj: Graph exponential functions; model exponential growth and decay

Exponential Functions

- General Form: $y = ab^x$ $a \neq 0$
- b is the base and is a positive number $b > 0$ $b \neq 1$ ↑ why?
- The exponent is x (variable)
  - It is the independent variable
  - Domain is: all real #s $(-\infty, \infty)$

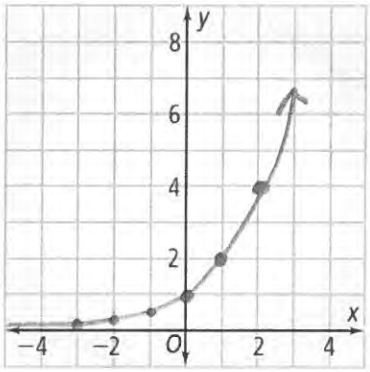
Example 1: Graphing an Exponential Function Growth

Got It? What is the graph of $y = 2^x$

Complete the following table of values.

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

Graph the points from your table. Then connect the points with a smooth curve.



what happened as x goes − Does it go to 0?

Domain: $(-\infty, \infty)$ Range: $(0, \infty)$ y intercept: $(0, 1)$

Asymptote: $y = 0$ End Behavior: $x \to -\infty$ $y \to 0$; $x \to \infty$ $y \to \infty$

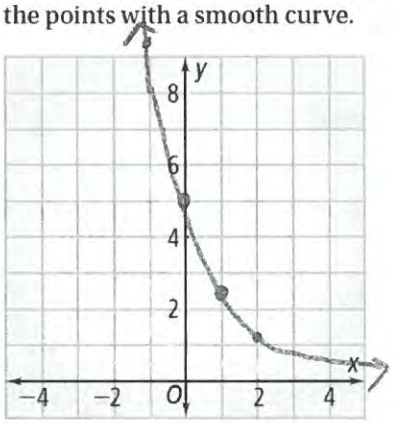
Decay

Got it? What is the graph of $y = 5(\frac{1}{2})^x$ Decay

Complete the following table of values.

x	$5(\frac{1}{2})^x$	y
−3	$5(\frac{1}{2})^{-3}$	40
−2	$5(\frac{1}{2})^{-2}$	20
−1	$5(\frac{1}{2})^{-1}$	10
0	$5(\frac{1}{2})^{0}$	5
1	$5(\frac{1}{2})^{1}$	2.5
2	$5(\frac{1}{2})^{2}$	1.25

Graph the points from your table. Then connect the points with a smooth curve.



Domain: $(-\infty, \infty)$ Range: $(0, \infty)$ y intercept: $(0,5)$

Asymptote: $y = 0$ End Behavior:. $x \to -\infty \quad y \to \infty$ $x \to \infty \quad y \to 0$

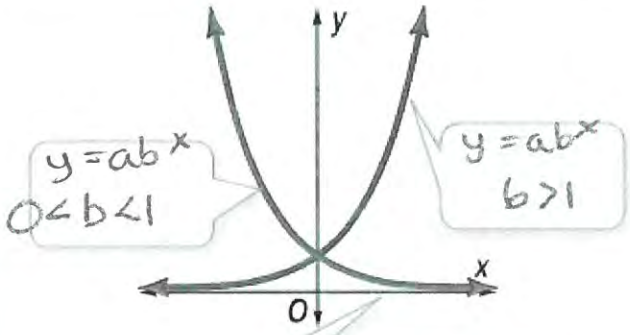
Two Types of Exponential Behavior

Exponential Growth $y = ab^x$

$b > 1$

Exponential Decay $y = ab^x$

$0 < b < 1$



The x-axis is horizontal asymptote

Key Concepts: Exponential Functions $y = ab^x$

- If a>0 and b> 1, the function represents growth
- If a>0 and 0<b<1, the function represents Decay
- Domain is $(-\infty, \infty)$
- Horizontal asymptote: $y = 0$
- Range: $(0, \infty)$ Y-intercept: $(0, a)$ unless translated

Identifying Exponential Growth and Decay

Identify each function or situation as an example of exponential growth or decay. What is the y-intercept?

a. $y = 3(4^x)$ Growth (0,3)

b. $y = 11(0.75^x)$ Decay (0,11)

Graph of transfomations

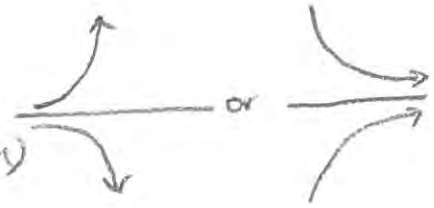
$y = ab^{x-h} + k$

a stretch

a < 0 reflects over x axis

h horizontal shift (opp. direction)

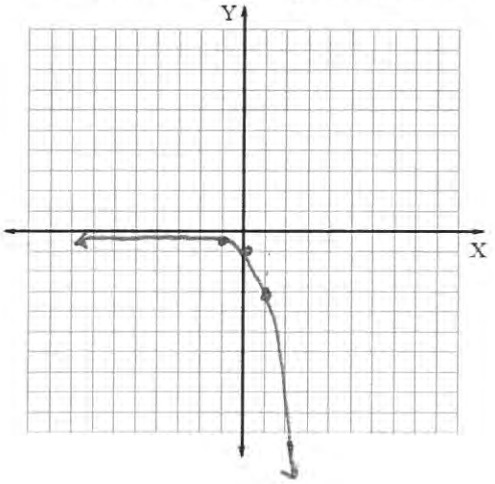
K vertical shift



NOTE: A vertical translation also shifts the horizontal asymptote to $y = K$.

Example 2: Graphing translations of $y=3^x$

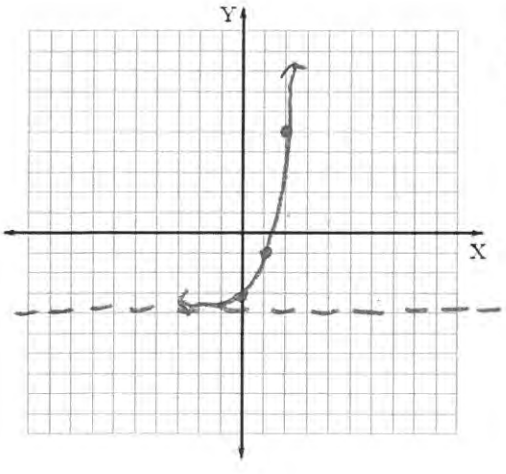
How does the graph of $y = -3^x$ compare to the graph of the parent function? reflected



Domain: $(-\infty, \infty)$ Range: $(-\infty, 0)$

y intercept: $(0,-1)$ Asymptote: $y=0$

End Behavior:. $x \to -\infty$ $y \to 0$; $x \to \infty$ $y \to -\infty$



How does the graph of $y = 3^x - 4$ compare to the graph of the parent function? down 4

Domain: $(-\infty, \infty)$ Range: $(-4, \infty)$

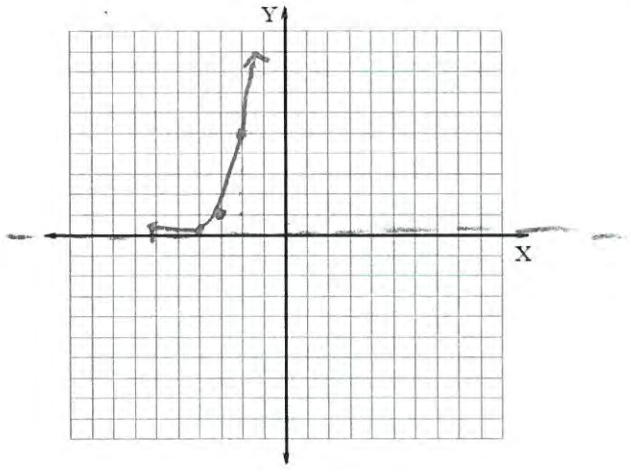
y intercept: $(0,-3)$ Asymptote: $y = -4$

End Behavior: $x \to -\infty$ $y \to -4$; $x \to \infty$ $y \to \infty$

You try: Translating the Parent Function $y = b^x$

How does the graph of each function compare to the graph of the parent function?

a. $y = 5^{x+3}$ Left 3



Growth or decay?
Reflected: no

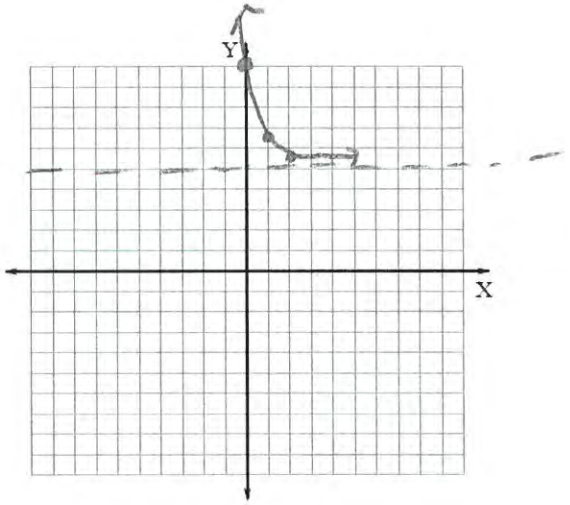
Asymptote: $y = 0$

Y intercept: (0, 125)

Points:

x	y
0	125
-1	25
-2	5
-3	1

b. $y = 5 \cdot 0.25^x + 5$ stretch 5 up 5



Growth or decay? b = .25
Reflected: no

$5\left(\frac{1}{4}\right)^x + 5$

Asymptote: $y = 5$

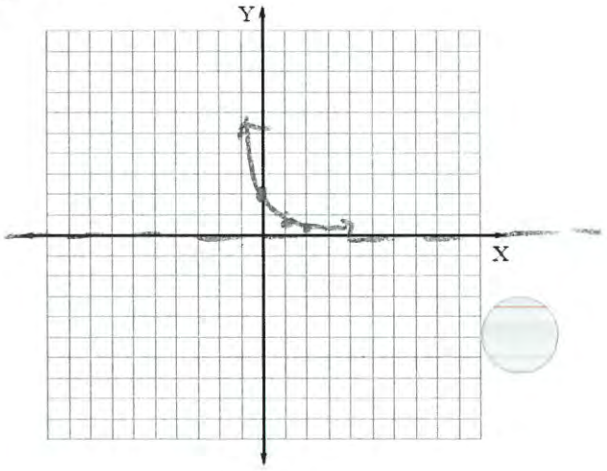
Y intercept: (0, 10)

Points:

x	y
1	6 1/4
2	5 5/16
0	10

C. Dealing with a negative exponent. $y = 2 \cdot 4^{-x}$ $= 2\left(\frac{1}{4}\right)^x$

Growth or decay? Be careful
Reflected: NO



Asymptote: $y = 0$

Y intercept: (0, 2)

Points:

x	y
1	1/2
2	1/8
-2	32
-1	8