Math-2
Lesson 12-1

Exponential Function

The "Parent" Exponential Function

$$y = b^x$$

exponent

base

$y = 2^x$ **(base 2 exponential function)**

$y = 3^x$ **(base 3 exponential function)**

$y = \left(\frac{1}{2}\right)^x$ **(base 1/2 exponential function)**

The base MUST BE positive and CANNOT equal 1.

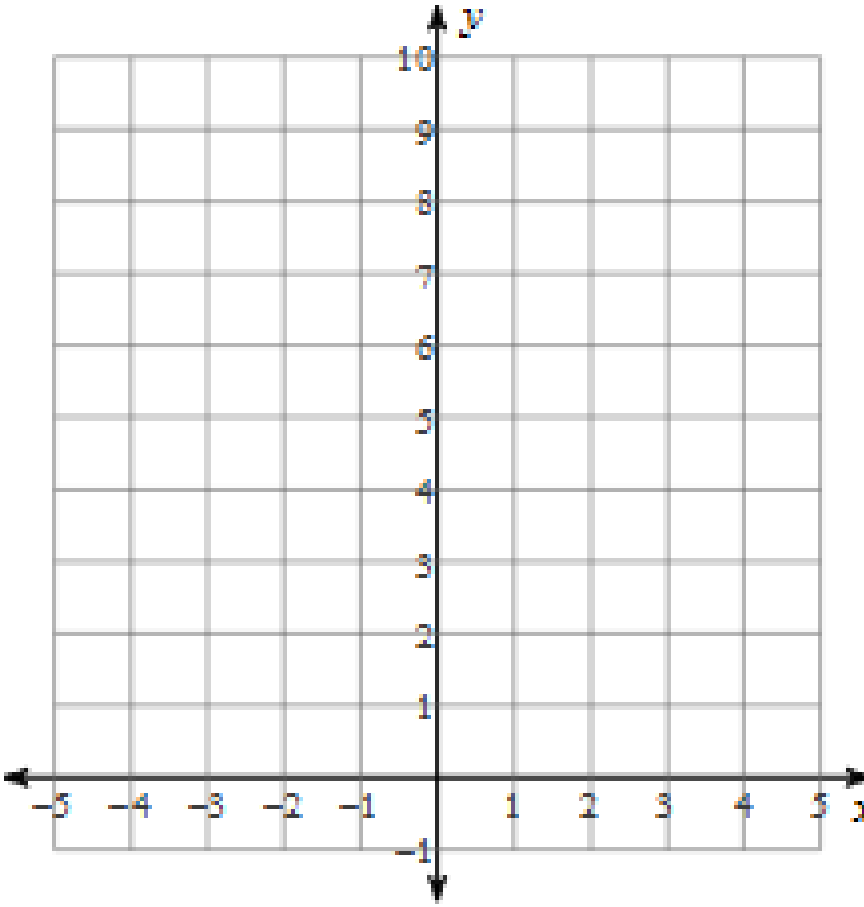
$$b = (0, 1) \cup (1, \infty)$$

What shape does it have?

$$f(x) = 2^x$$

Build a table of values for the "nice" domain elements: -2, -1, 0, 1, 2.

x	$2^{(\ )}$	y
-2	2^{-2}	0.25
-1		
0		
1		
2		



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

"_____ exponent property"

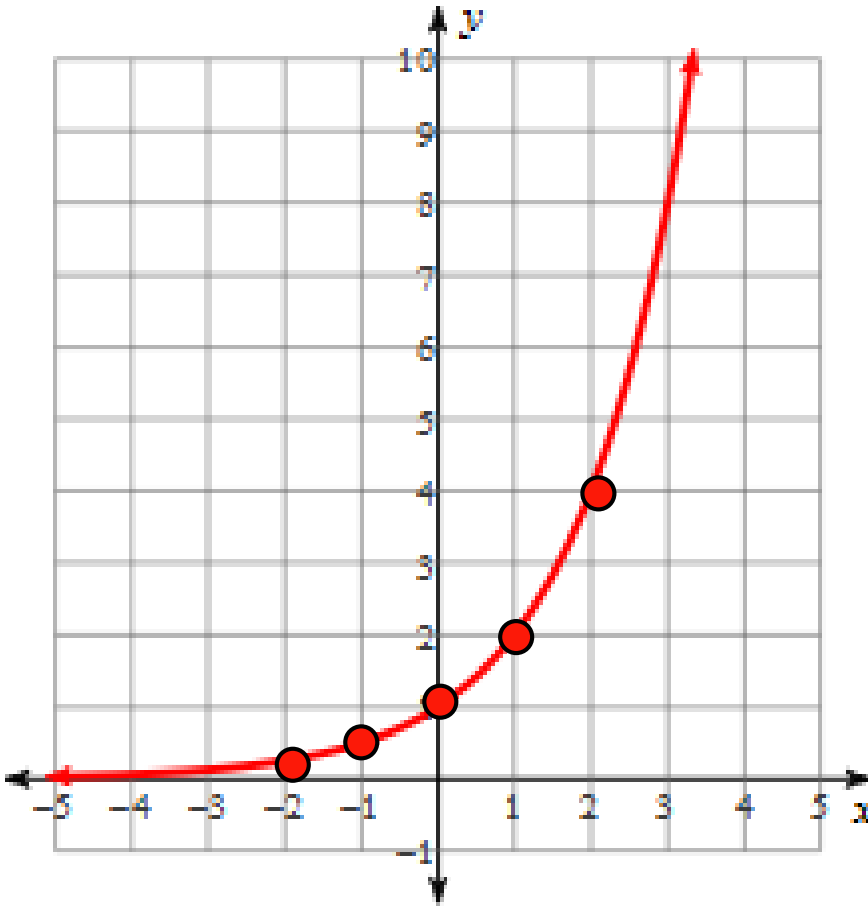
$$2^0 = 1$$

"_____ exponent property"

Why does it have this shape? $f(x) = 2^x$

Build a table of values for the "nice" domain elements: -2, -1, 0, 1, 2.

x	$2^{(\ )}$	y
-2	2^{-2}	0.25
-1	2^{-1}	0.5
0	2^{0}	1
1	2^{1}	2
2	2^{2}	4



$$\left(\frac{2}{1}\right)^{-2} = \left(\frac{1}{2}\right)^{2} = \frac{1}{4} = 0.25$$

"negative exponent property"

$$2^0 = 1$$

"zero exponent property"

Growth Factor is the base of the exponential

$f(x) = 2^x$

x	$2^{(\ )}$	y
-2	2^{-2}	0.25
-1	2^{-1}	0.5
0	2^{0}	1
1	2^{1}	2
2	2^{2}	4

$* 2$

$* 2$

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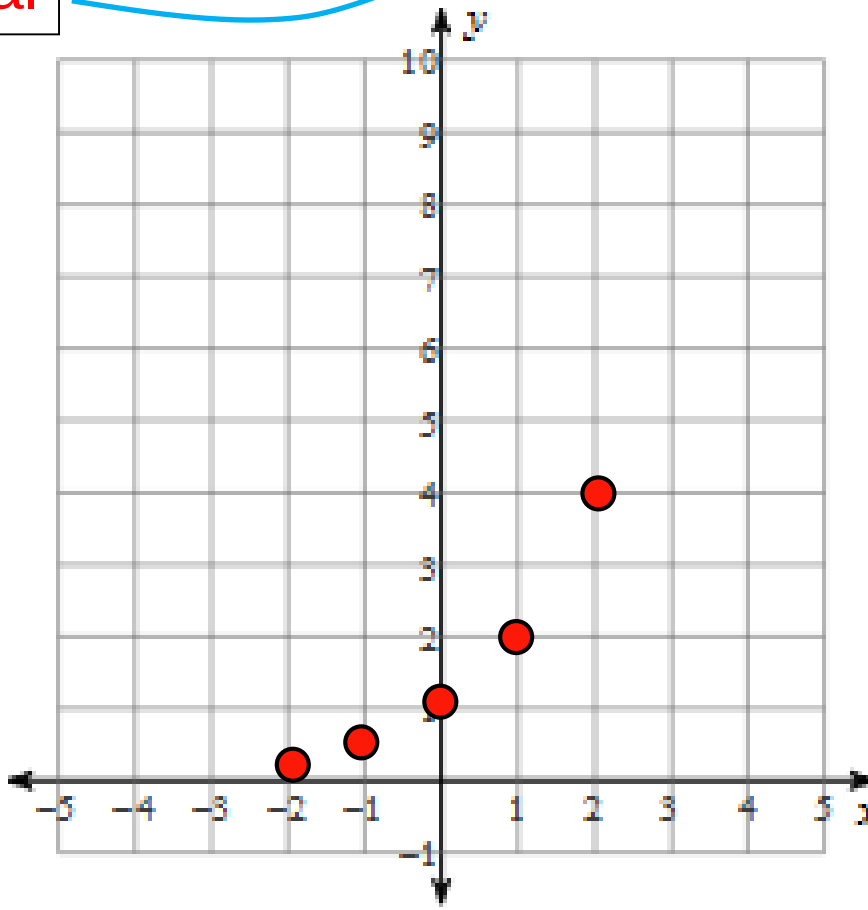


Exponential Function $f(x) = 2^x$

Will the 'y' value ever reach zero (on the left end of the graph)?

As the denominator gets bigger and bigger, the decimal version of the fraction gets smaller and smaller.

x	$2^{(\ )}$	y
-1	$2^{(-1)}$	$^1/_2$
-2	$2^{(-2)}$	$^1/_4$
-3	$2^{(-3)}$	$^1/_8$
-4	$2^{(-4)}$	$^1/_{16}$
-5	$2^{(-5)}$	$^1/_{32}$

'y' gets closer and closer to zero but never reaches zero.

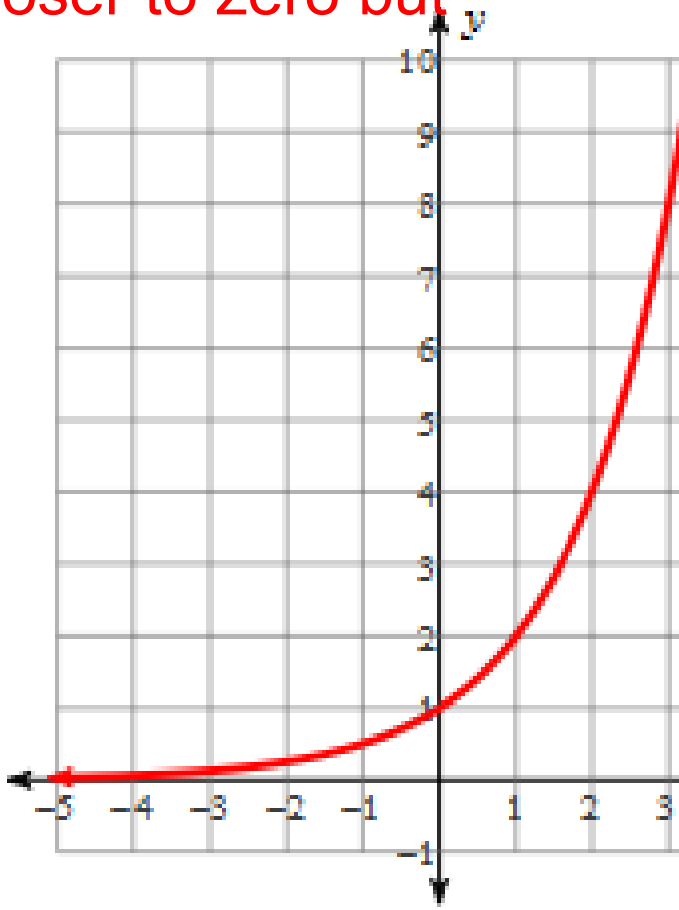
$f(-1) = {}^1/_2$

$f(-2) = {}^1/_4$

$f(-3) = {}^1/_8$

$f(-4) = {}^1/_{16}$

$f(-5) = {}^1/_{32}$



Horizontal Asymptote: a horizontal line the graph approaches but never reaches.

$f(x) = 2^x$

$y = 0$

$Domain = ?$

$x = (-\infty, \infty)$

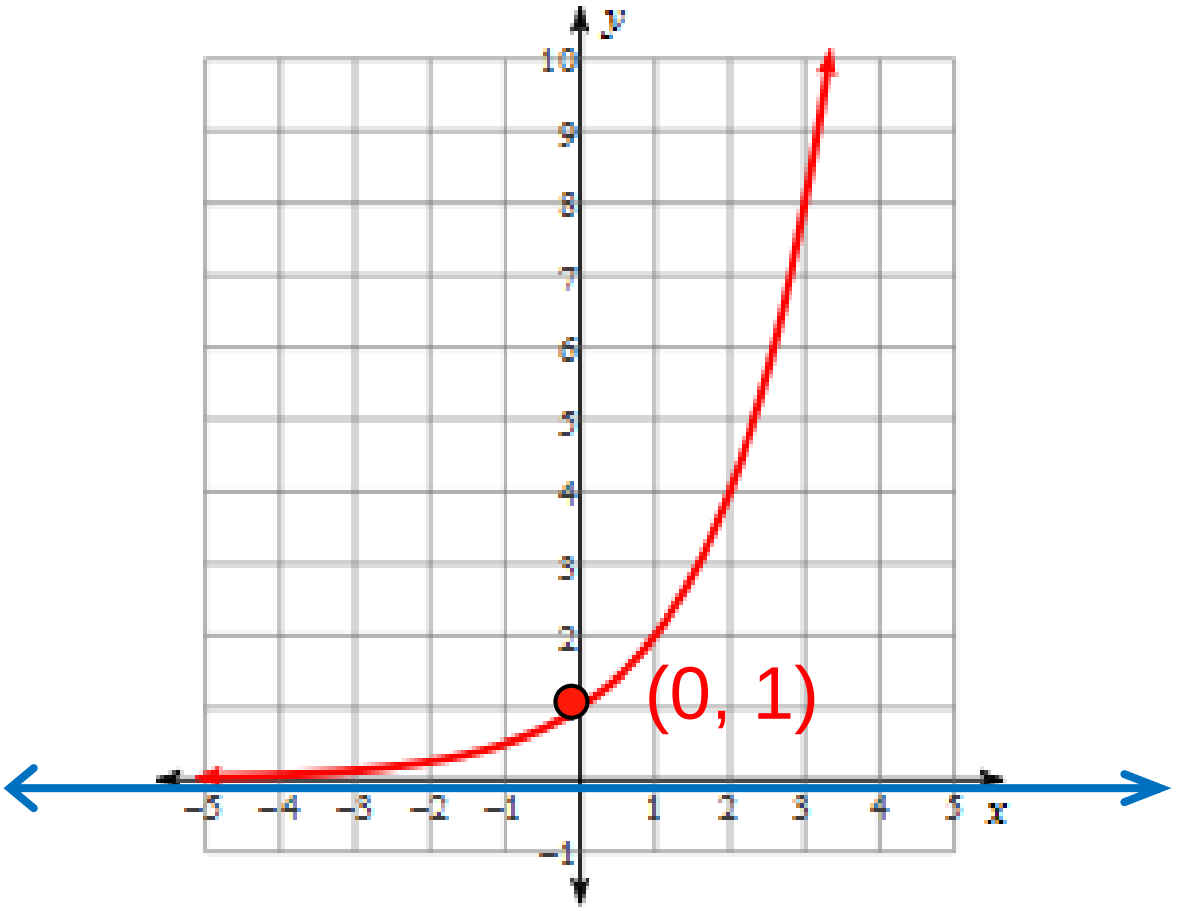
$range = ?$

$y = (0, \infty)$

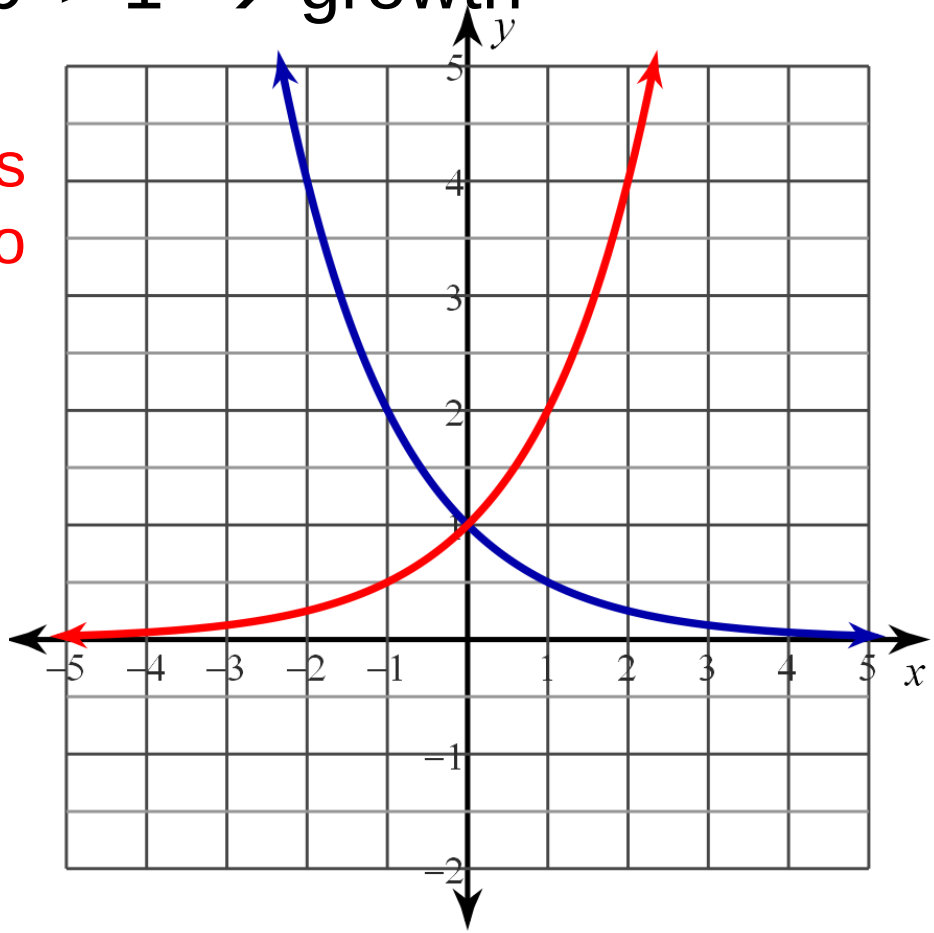
y-intercept = ?

$f(0) = y\ intercept$

$f(0) = 2^0 = 1$



$y = b^x$ $\boxed{y_1 = 2^x}$ 'b' > 1 → growth



Exponential Growth: the graph is increasing (as you go from left to right the graph goes upward.

$$y_2 = \left(\frac{1}{2}\right)^x$$

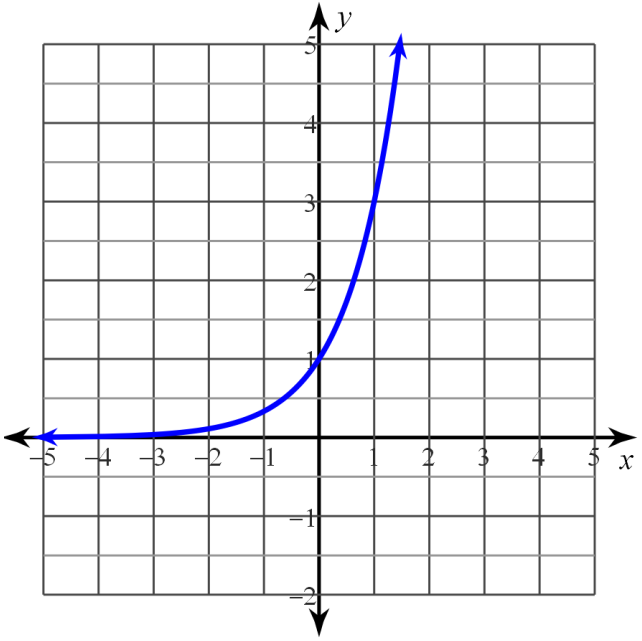
0 < 'b' < 1 → decay

Exponential Decay: the graph is decreasing (as you go from left to right the graph goes downward.

Decay: Graphs with bases between 0 and 1 → Base = (0, 1)

$$y = b^x$$

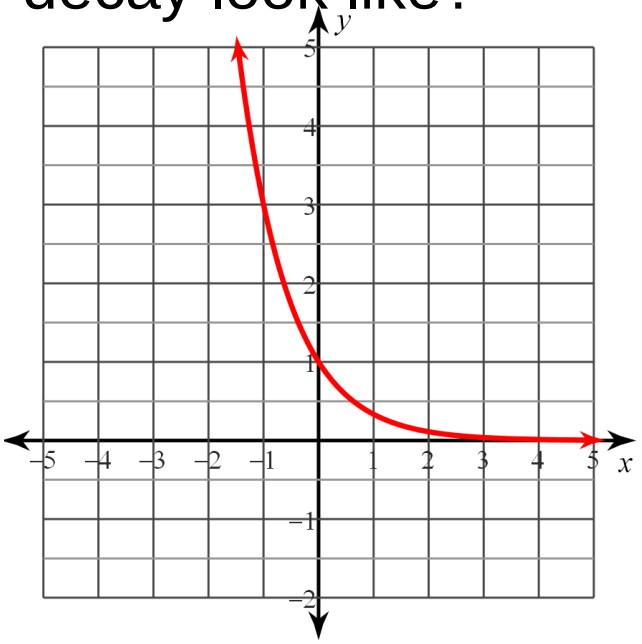
What does exponential growth look like?



b > 1

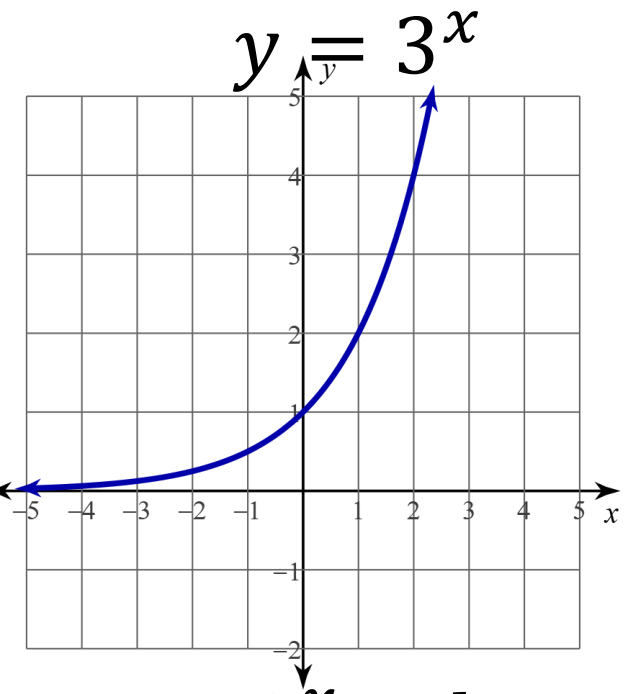
For what range of values of ‘b’ will result in <u>exponential growth</u> ?

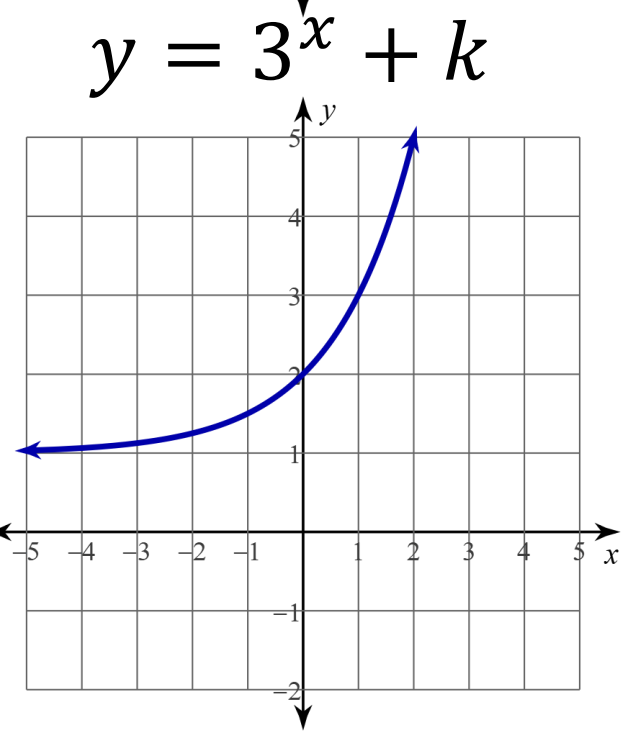
What does exponential decay look like?



0 < b < 1

For what range of values of ‘b’ will result in <u>exponential decay</u> ?





Up and down shifts of the exponential function.

How far up has the graph been shifted?

Up 1

What is the value of “k” in the equation?

k = 1

What is the equation of the graph?

$y = 3^x + 1$

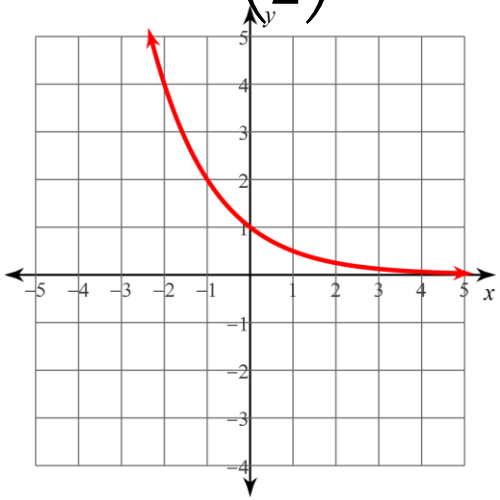
What is the equation of the horizontal asymptote?

y = 1

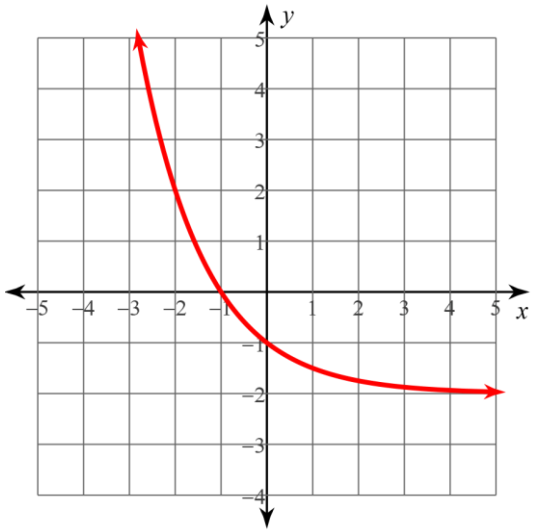
What is the range of the function?

y = (1, ∞)

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



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



Up and down shifts of the exponential function.

How far has the graph been shifted?

Down 2

What is the value of “k” in the equation?

k = -2

What is the equation of the graph?

$$y = 3^x - 2$$

What is the equation of the horizontal asymptote?

y = -2

What is the range of the function?

y = (-2, ∞)

Can the base be 1?

$f(x) = ab^x$

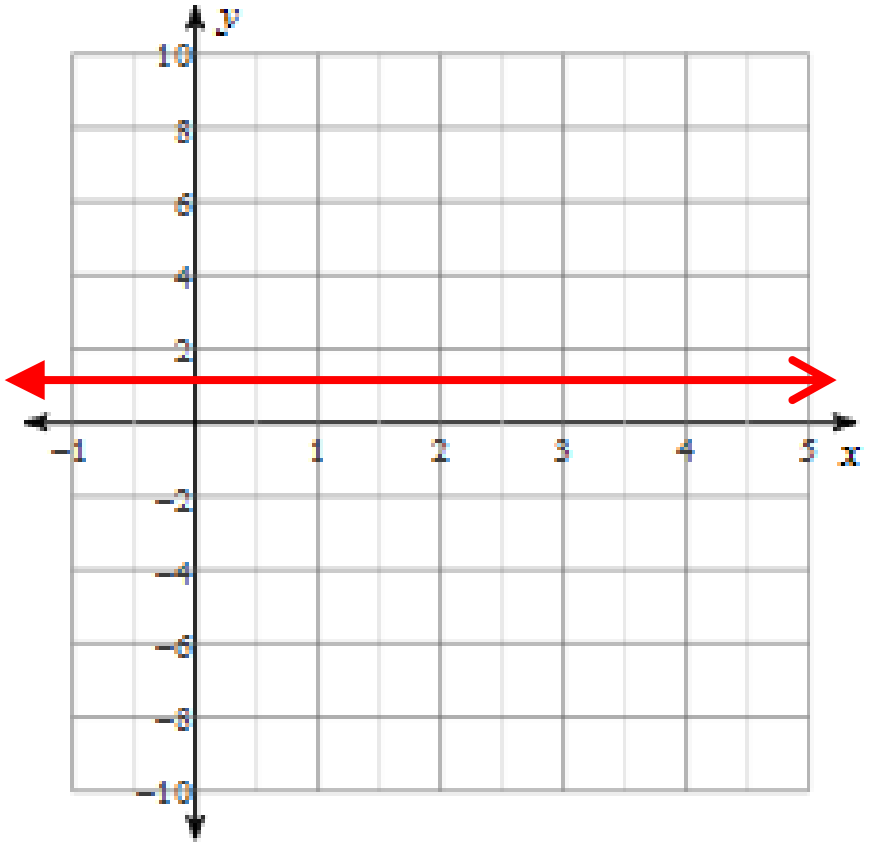
$g(x) = (1)^x$ b ≠ 1

x	y
-1	1
0	1
1	1

$(1)^{-1}$

$(1)^0$

1^1



$0 < b < 1$, OR $b > 1$

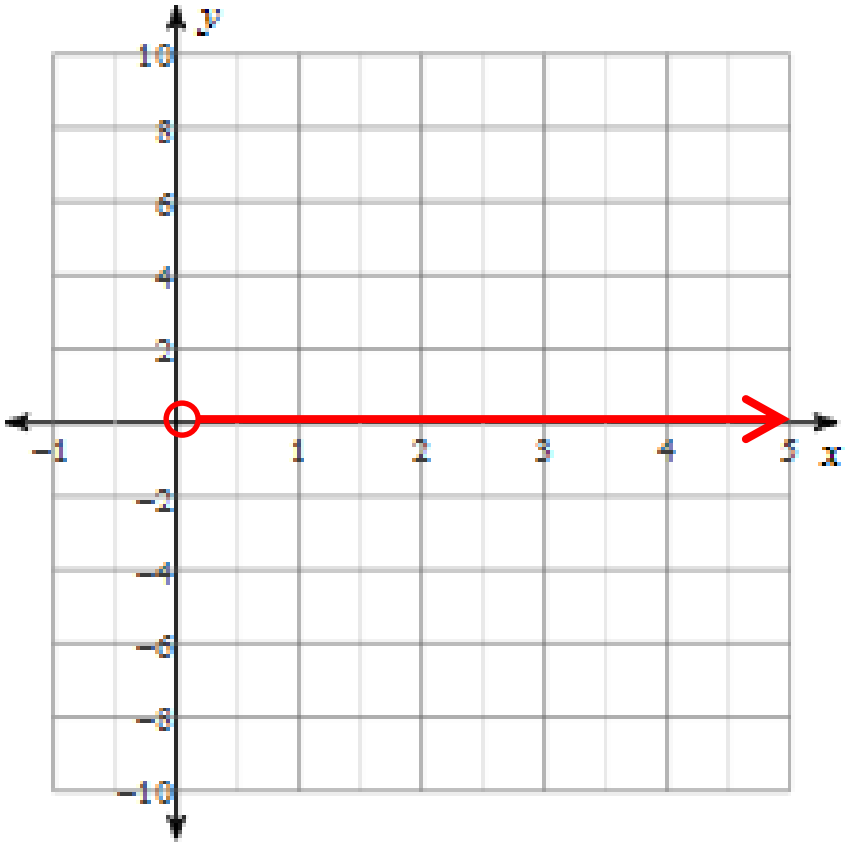
$b = (0,1) \cup (1,\infty)$

Can the base be <u>zero</u>?

$$f(x) = ab^x$$

$$g(x) = (0)^x$$

b ≠ 0



Can the ‘base’ be negative?

$$f(x) = ab^x$$

$$g(x) = (-2)^x$$

‘b’ > 1 → growth

0 < ‘b’ < 1 → decay

b ≠ negative numbers