WARM UP

Evaluate each expression for the given value of x.

1) when x = 3, find the value of: 2^x $2^3 = 8$

2) when x = -1, find the value of: 4^{x+1} $4^{-1+1} = 4^0 = 1$

3) when x = 2, find the value of: $3^x \cdot 3^{x-2}$ $3^2 \cdot 3^{2-2} = 9 \cdot 3^0 = 9 \cdot 1 = 9$

4) when x = 3, find the value of: $\left(\frac{1}{2}\right)^x$ $\left(\frac{1}{2}\right)^3 = \frac{1}{8}$

5) when x = -2, find the value of: 2^x $2^{-2} = \frac{1}{2^2} = \frac{1}{4}$

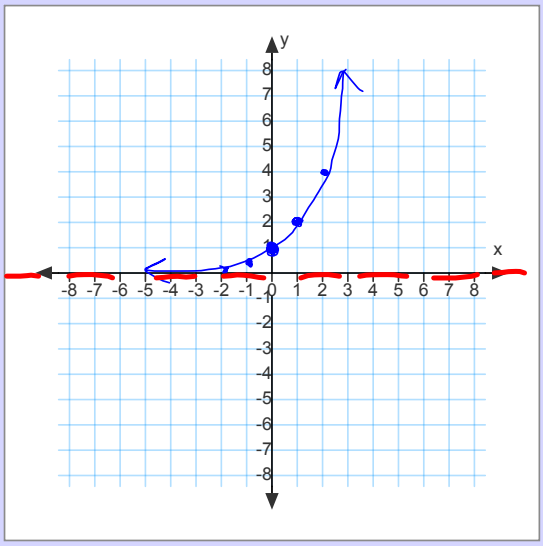
8.1 Exploring Exponential Models

- The Internet is growing faster than all other technologies that have preceded it
- Radio existed for 38 years before it had 50 million listeners
- Television took 13 years to reach that mark
- The internet reached 50 million users in just four years

For some data, the best model is an exponential function in the form:

$y = ab^x$

where x is a real number, $a \neq 0$, $b > 1$, $b \neq 0$.



Pull

Let's graph $y = 2^x$

x	y
-2	1/4
-1	1/2
0	1
1	2
2	4

Pull

$2^0 = 1$ $2^1 = 2$

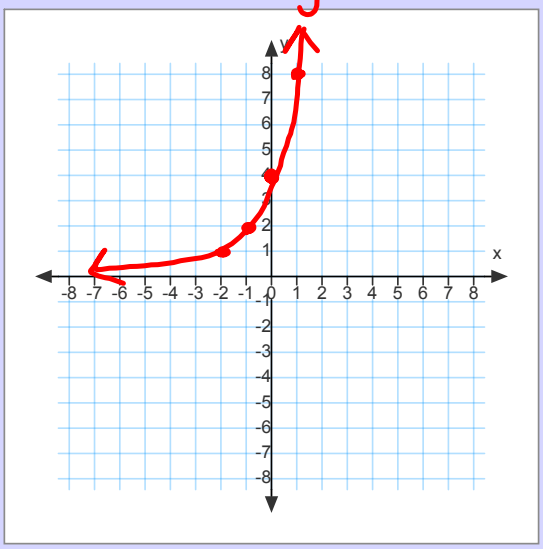
$2^2 = 4$ $2^{-1} = \frac{1}{2^1}$

$2^{-2} = \frac{1}{2^2} = \frac{1}{4}$

$2^{-700} = \frac{1}{2^{700}}$

Now let's graph $y = 4(2)^x$

$y = a(b)^x$



$4(2)^0 = 4$ $4(2)^2 = 16$

$4(2)^1 = 8$

Pull

Notice the y-intercept is now (0,4).

x	y
-2	1
-1	2
0	4
1	8
2	16

Pull

Given $y = ab^x$, the y-intercept will always be (0,a)

$y = 6(3)^x$

(0,6)

$y = 1(3^x)$

(0,1)

Pull

The graph will never hit the x-axis (y = 0). This is called the horizontal asymptote.

graph will never touch or cross an asymptote

Exponential Growth Model

You can use an exponential function to model population growth

$y = ab^x$ where $b = 1+r$

Initial amount

growth or decay factor

rate of ↑ or ↓ expressed as a decimal

10% → .1

06% → .06

.012 → 1.2%

.0382 → 3.82%

$y = ab^x$ where $b = 1+r$

From 2000-2005 the annual rate of increase in Brazil's population was about 1.16%. In 2000, the population of Brazil was about 170 million. Suppose the rate of increase continues to be 1.16%. Predict the population in 2016, when the Olympics will be held in Brazil.

$y = a(b)^x$

$a = 170$

$b = 1 + r$

$r = 1.16\% = .0116$

$b = 1 + .0116$

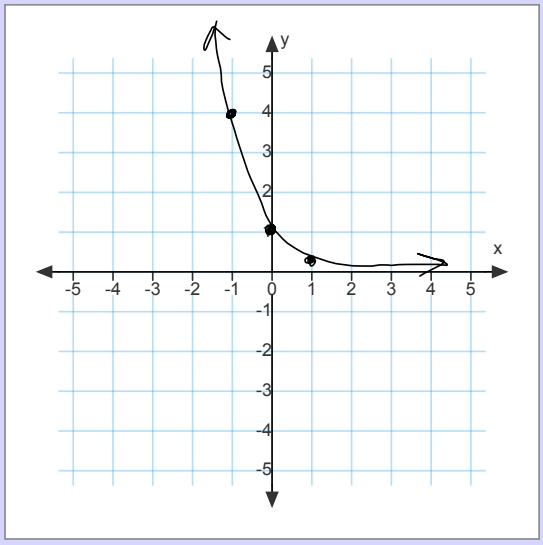
$b = 1.0116$

$y = 170(1.0116)^x$

$y = 170(1.0116)^{16}$

20445 million people

You can use an exponential function with $0<b<1$ to model exponential decay: $y = ab^x$ where $b<1$



Pull

Let's graph $y = (0.25)^x$

$(\frac{1}{4})^x$

x	y
-2	16
-1	4
0	1
1	1/4

Pull

Th

Pull

Without graphing, determine whether each function represents exponential growth or exponential decay.

$y = 125(1.6)^x$ $y = \frac{1}{4}\left(\frac{1}{2}\right)^x$ $y = 2(0.3)^x$ $f(x) = \left(\frac{5}{2}\right)^x$

growth decay decay growth

$b > 1$ Exp. Growth

$0 < b < 1$ Exp. Decay

For each function,
find the percent increase or decrease.

$y = 125(1.6)^x$

$b = 1 + r$

$1.6 = 1 + r$

$-1 \quad -1$

$.6 = r$

60% ↑

$y = 2(0.3)^x$

$b = 1 + r$

$.3 = 1 + r$

$-1 \quad -1$

$-.7 = r$

70% ↓

HOMEWORK 8.1

p. 434 # 1-9 all 17-31 odd and #35-41 odd, #65, 66, 68, 69

y-intercept
(2 other points)

$y = 3(10)^x$