General Form of an Exponential Function

$$y = a \cdot b^x$$

Allowed value for each:

x	a	b
any real number	$a \neq 0$	$b > 0$ but $b \neq 1$

$$y = a \cdot b^x$$

what does b do to the graph?

Use the following window:

$X_{min} = -5$ $X_{max} = 5$ $Y_{min} = -5$ $Y_{max} = 10$

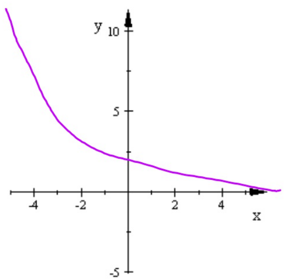
In Y_1, Y_2, and Y_3 graph $Y=b^x$ for three different positive values of b

Sketch the graphs and put the equations next them. What does the value of b do to the graph?

You should have noticed two basic shapes depending on the value of b.

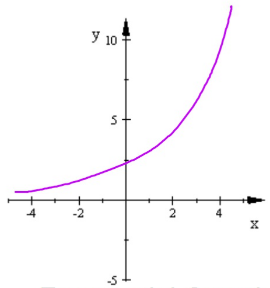
Describe these two shapes and for what values of b they occur.

$0<b<1$



Exponential Decay

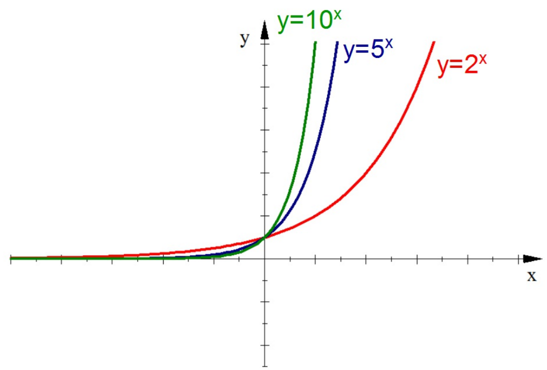
$b>1$



Exponential Growth

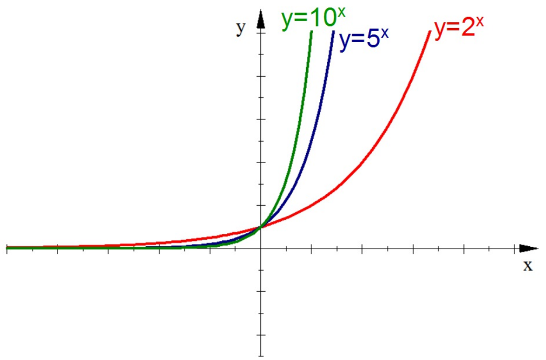
When $b>1$ the graph represents Exponential Growth.

As b gets larger the graph increases faster ("steeper")



What do these three graphs have in common?

Same y-intercept → 1

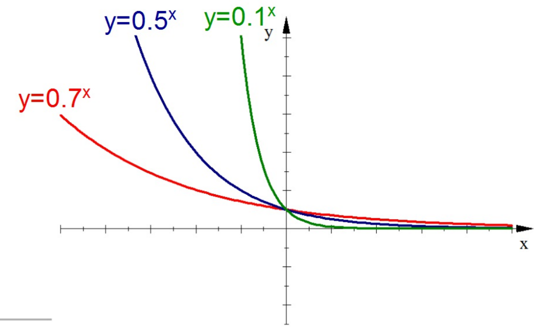


Why do they all have the same y-intercept?

You find a y-int by replacing x with zero and when you do this all three equations equal 1.

When $0<b<1$ the graph represents Exponential Decay.

As b gets smaller, but still positive, the graph decreases faster ("steeper")

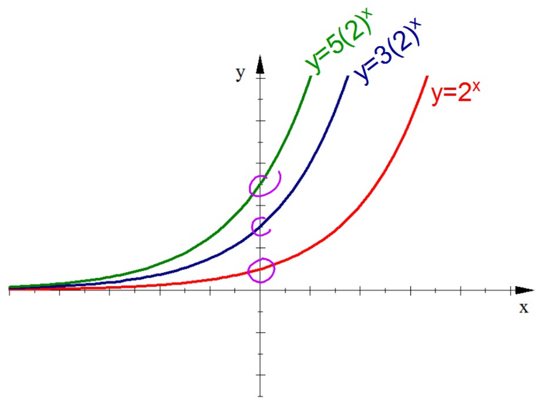


$y = a \cdot b^x$ What does a do to the graph?

Enter $Y_1 = 2^x$ What is the value of a? 1

Enter in Y_2 and Y_3 $= a(2)^x$ for different positive values of a and notice what happens to the graph

What does a do to the graph?



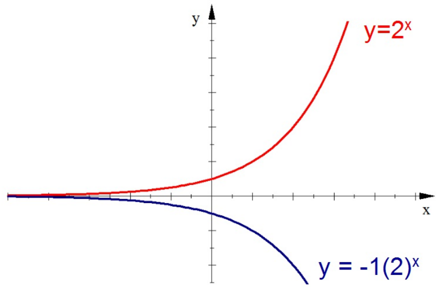
a is the y-intercept

Delete Y_3 and enter $Y_2 = -1(2)^x$

What does a negative value of a do to the graph?

x-axis reflection

Upside Down



Graphs of $y = a \cdot b^x$

a: the y-intercept. If a is negative graph is upside down (x-axis reflection)

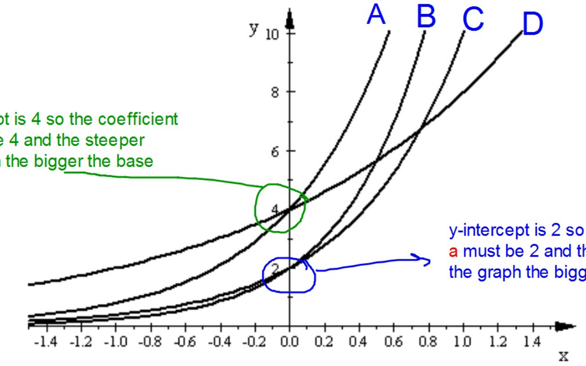
b: Growth or Decay Factor

Growth Factor: The larger the value of b the faster the graph increases.
$b>1$

Decay Factor: The smaller the value of b the faster the graph decreases
$0<b<1$

You should be able to match an equation with its graph.

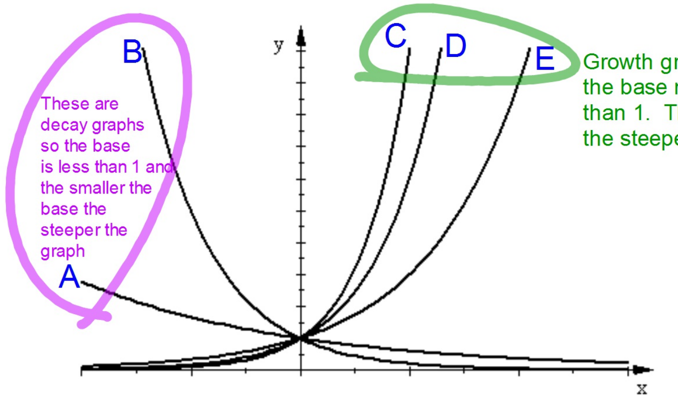
D $y = 4(2)^x$ C $y = 2(5)^x$ B $y = 2(8)^x$ A $y = 4(5)^x$



y-intercept is 4 so the coefficient a must be 4 and the steeper the graph the bigger the base

y-intercept is 2 so the coefficient a must be 2 and the steeper the graph the bigger the base

D $y = 6^x$ B $y = 0.5^x$ A $y = 0.8^x$ C $y = 10^x$ E $y = 3^x$



Growth graphs, therefore, the base must be greater than 1. The bigger the base the steeper the graph.

For Exponential Growth - the bigger the base (b) the steeper the graph

For Exponential Decay - the smaller the base (b) the steeper the graph

OR

The closer b is to 1 the flatter the graph

The farther b is from 1 the steeper the graph

Does each exponential equation represent growth or decay?

1. $y = 4500(0.9983)^x$

   Decay because 0<b<1

2. $y = 0.045(1.00201)^x$

   Growth because b>1

3. $y = 7\left(\frac{12}{13}\right)^x$

   Decay because 0<b<1

4. $y = 12.06\left(\frac{42}{39}\right)^x$

   Growth because b>1

5. $y = 145(1.33)^{-x}$

   Even though b>1 the negative exponent means to take the reciprocal of the base and thus is becomes a value less than 1. Therefore, this equation represents Decay.

The cost of a new car in 2009 was $21,400. The cost increased 9% in 2010. Find the cost of a new car in 2010.

this method works but it won't really help you for Sec 8-1

9% → .09

(.09)(21,400) = 1926

21,400 + 1926
= $23,326

this method is how you need to be able to do it for Sec 8-1

100% + 9%

109%

(1.09)(21,400)
= 23,326

Last year the price of a TV was $320. This year the price has been decreased by 15%. Find the new price.

$100\% - 15\% = 85\%$

$(.85)(320) = \$272$