GRAPHING EXPONENTIAL FUNCTIONS

We are now going to examine the exponential function $y = b^x$ and see how changing the value of b affects the graphs of these functions.

Graphing exponential functions where b>1

Using a table of values, we are going to graph the following three functions on the same axis: $y = 2^x$, $y = 5^x$, and $y = 10^x$

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A. $y = 2^x$

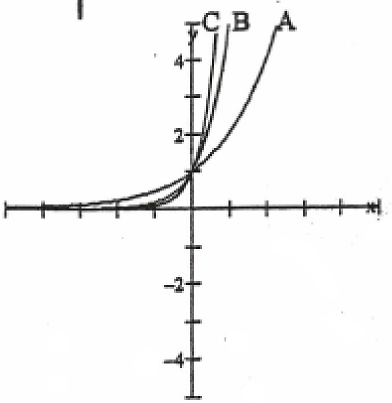
x	y
-5.0	0.03125
-4.0	0.0625
-3.0	0.125
-2.0	0.25
-1.0	0.5
0.0	1.0
1.0	2.0
2.0	4.0
3.0	8.0
4.0	16.0
5.0	32.0

B. $y = 5^x$

x	y
-5.0	0.00032
-4.0	0.0016
-3.0	0.008
-2.0	0.04
-1.0	0.2
0.0	1.0
1.0	5.0
2.0	25.0
3.0	125.0
4.0	625.0
5.0	3125.0

C. $y = 10^x$

x	y
-5.0	0.00001
-4.0	0.0001
-3.0	0.001
-2.0	0.01
-1.0	0.1
0.0	1.0
1.0	10.0
2.0	100.0
3.0	1000.0
4.0	10000.0
5.0	100000.



Exponential Growth: Each function is increasing from left to right.

- The **domain** of these exponential functions is the set of all real numbers, $x \in \Re$.
- For b > 1, the function $y = b^x$ is *increasing*, that is, as x increases, y increases.

  These graphs represent **exponential growth.**

  Each of these graphs pass through the point (0, 1), that is, the y-intercept is 1.
- A *horizontal asymptote* is a horizontal line which the graph of the function **approaches but never actually touches.** The horizontal asymptote for all three of these graphs is the x-axis, whose equation is $y = 0$.
- The **range** of these functions are all values greater than 0, $y > 0$.
- As the value of b increases, the graphs grow faster. The result is a graph that is closer to the y-axis. In the examples above, $y = 10^x$ is the steepest graph.

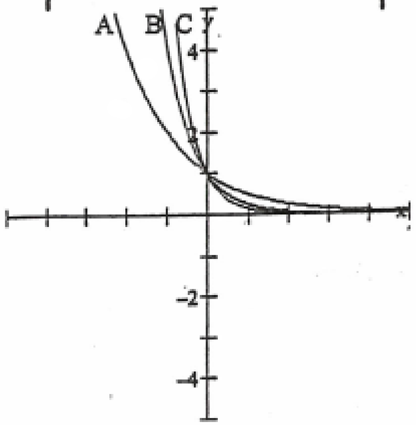
Graphing exponential functions where $0 < b < 1$

Using a table of values, we are going to graph the following three functions on the same axis: A. $y=\left(\frac{1}{2}\right)^x=2^{-x}$, B. $y=\left(\frac{1}{4}\right)^x=4^{-x}$, C. $y=\left(\frac{1}{7}\right)^x=7^{-x}$

x	y
-5.0	32
-4.0	16.0
-3.0	8.0
-2.0	4.0
-1.0	2.0
0.0	1.0
1.0	0.5
2.0	0.25
3.0	0.125
4.0	0.0625
5.0	0.03125

x	y
-5.0	1024
-4.0	256.0
-3.0	64.0
-2.0	16.0
-1.0	4.0
0.0	1.0
1.0	0.25
2.0	0.0625
3.0	0.0156
4.0	0.003
5.0	0.00098

x	y
-5.0	16807.0
-4.0	2401.0
-3.0	343.0
-2.0	49.0
-1.0	7.0
0.0	1.0
1.0	0.143
2.0	0.020
3.0	0.003
4.0	0.0004
5.0	0.00006



Exponential Decay: Each function is decreasing from left to right.

- The **domain** of these exponential functions is the set of all real numbers, $x \in \Re$.
- The **range** of these functions are all values greater than 0, $y > 0$.
- For $0 < b < 1$, the function $y = b^x$ is *decreasing*, that is, as x increases, y decreases. These graphs represent **exponential decay.**
- Each of these graphs pass through the point (0, 1), that is, the y-intercept is 1.
- A *horizontal asymptote* is a horizontal line which the graph of the function **approaches but never actually touches.** The horizontal asymptote for all three of these graphs is the x-axis, whose equation is $y = 0$.
- As the value of b **decreases,** the graphs decay faster. The result is a graph that is closer to the y-axis. In the examples above, $y = \left(\frac{1}{7}\right)^x$ is the steepest graph.

It should be noted that the graph of $y = 1^x$ is a horizontal line passing through the y-axis at $y = 1$. This is true, since no matter what the x value is, $1^x = 1$. As we have seen in the two examples above, as the base b gets larger than 1, the graph rises from left to right. And, as the value of b gets smaller than 1, the graph falls from left to right.