financialalgebra

6.3 Graphing Exponential Functions

Student Activity Packet

UNIT: INVESTING STRATEGIES & EXPONENTIAL FUNCTIONS

Name:

IN THIS LESSON, YOU WILL:

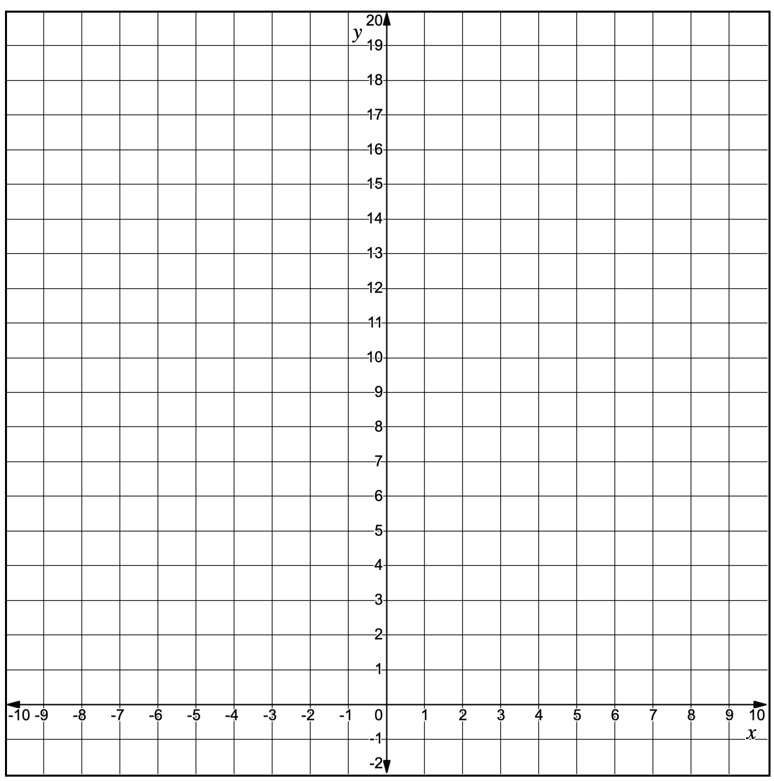
- Identify and graph asymptotes for exponential functions
- Describe end behavior from a graph, function, or table
- Understand how changing coefficients changes the graph of an exponential function
- Understand how changing the base changes the graph of an exponential function
- Understand how adding constants changes the graph of an exponential function
- Graph exponential functions from equations and tables
- Compare the growth of savings and investment accounts by looking at their graphs
- Predict anticipated compound growth from a graph
- Understand the concept of annualized rate of return on investments

INTRO

Predicting the graph

Use the data table to answer the questions.

x	y
-4	.0625
-3	.125
-2	.25
-1	.5
0	1
1	2
2	4
3	8
4	16



1. **Plot the points on the graph.**

2. **Would a linear function be a good fit for these points? Why or why not?**

3. **Sketch a smooth curve that best fits the data.**

4. **Describe the shape of the sketch and how it is different from a straight line.**

5. **What do you predict the function value to be when x=-100? When x=-1000? Why do you say this?**

EXPLORE IT

DESMOS: Marbleslides: Exponentials
An exponential function has the general form $y = ab^x + c$ Manipulating these variables will alter the function graph. Follow your teacher's instructions to complete this exploratory Desmos activity. Then, answer the summary questions.

1. **How does the graph change as the base, b, increases above 1?**

2. **How does the graph change when the base, b, decreases below 1 but above 0?**

3. **How does the graph change when you add or subtract a constant in the exponent, x?**

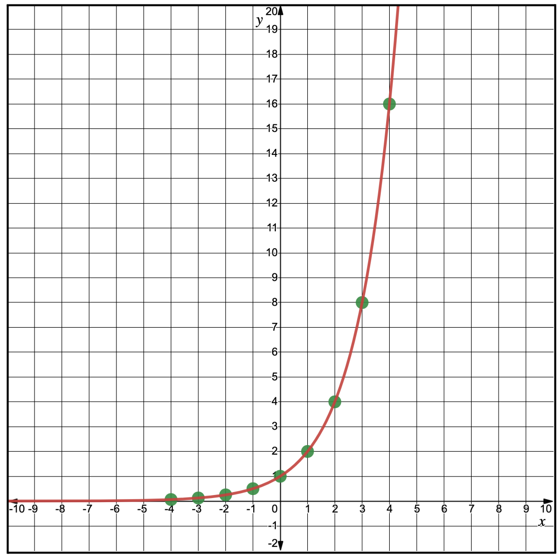
LEARN IT

Asymptotes
You likely have noticed some similarities in all of the exponential graphs you looked at in that activity. One unique feature is that for every exponential graph, one end will go on toward positive or negative infinity and the other end will approach, but not cross a certain, specific y value. This value that the function approaches is called an **asymptote**. In the case of exponential functions, they will have a horizontal asymptote (y = some value).

Example 1
Let's take a look back at the problem from the intro to explain some key features. The data was from the function $y = 2^x$. You can get this information from either the table or the graph of an exponential function.

Oftentimes you can use the information about the asymptote to sketch a more accurate graph!

x	y
-4	.0625
-3	.125
-2	.25
-1	.5
0	1
1	2
2	4
3	8
4	16



1 **Identify the Infinity:**
Figure out which end is getting larger and whether it's toward +∞ or -∞

As x get larger, y approaches +∞, so the right side of the graph increases

2 **Identify the asymptote value:**
What value does the function approach

As x get smaller, y approaches zero, so the left side of the graph gets close to, but doesn't cross, zero

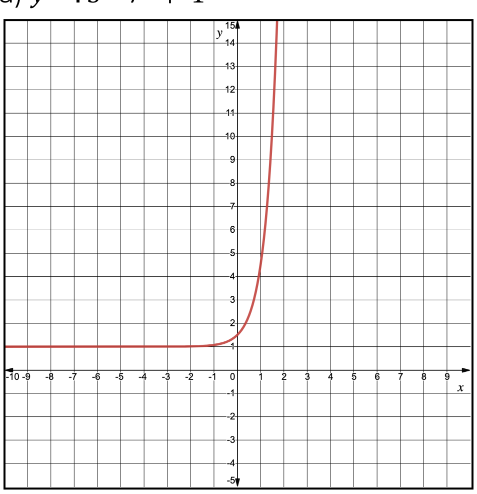
3 **Write the asymptote equation:**
The asymptote will always be y = _____

There is an asymptote at y = 0

Example 2

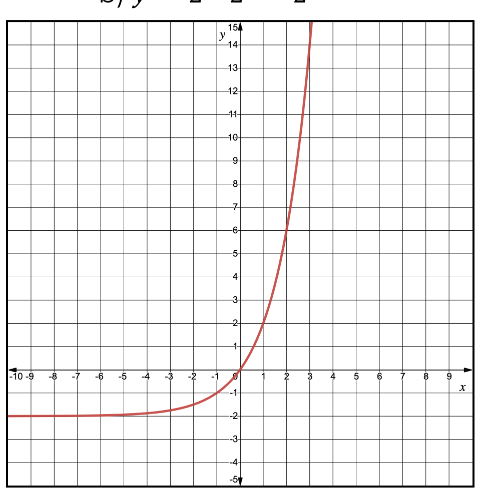
Here are a few more graphs of exponential functions. For each function, predict the value shown below.

a) $y = .5 \cdot 7^{x} + 1$



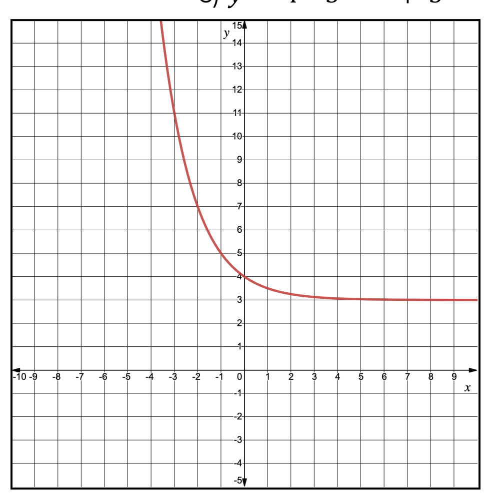
f(-20) = ____

b) $y = 2 \cdot 2^{x} - 2$



f(-20) = ___

c) $y = 4 \cdot 5^{(x+2)} + 3$



f(20) = ____

Coefficient and the constant terms

Changing the constant term affects the y-intercept of an exponential function, just as it does a linear function. You may have noticed that changing the coefficient changes the y-intercept as well. This is because b^0 is always 1, so the function at x = 0 becomes y = a + c.

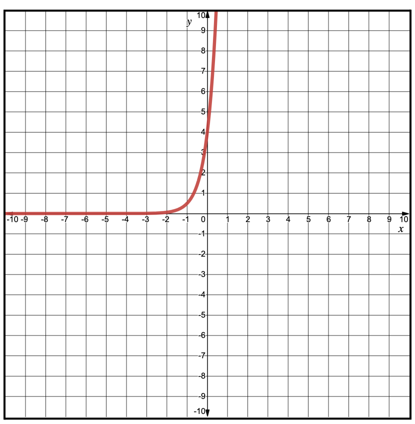
The coefficient is important in another way though! You can tell the value of the asymptote because it is the same value as the constant term that is added. For example, in the equation $y = 3^x - 4$, the asymptote would be at y = -4. Take a look at the previous three examples and their equations to see how the constant term matches your predicted asymptotic values.

PRACTICE IT

5-Point Practice: Writing a Linear Equation From a Table

Complete any number of problems that add up to 5 points. Identify how the graph behaves when x is very large and when x is very small: does it approach ∞, -∞, or a specific value. Then give the equation of the asymptote.

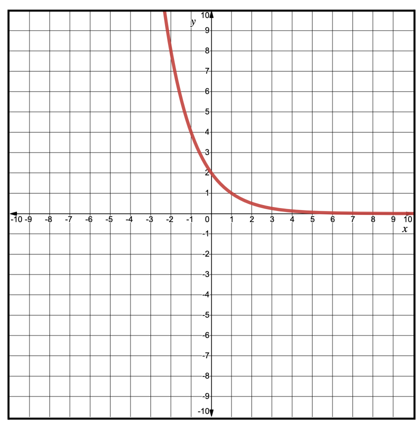
1 point each



As x gets large, y → ______

As x gets small, y → ______

Asymptote: y = _____



As x gets large, y → _____

As x gets small, y → ______

Asymptote: y = _____

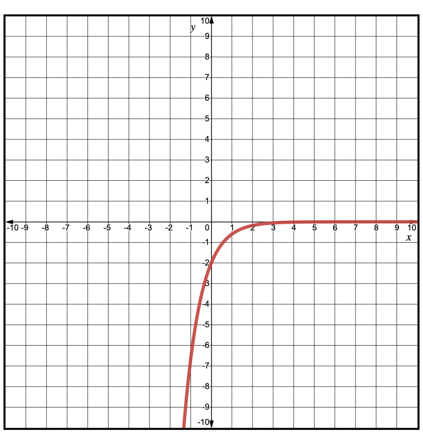
x	y
-3	1.500
-2	1.501
-1	1.510
0	1.571
1	2
2	5
3	26

As x gets large, y → ______

As x gets small, y → ______

Asymptote: y = ______

2 points each



x	y
-3	-1.93
-2	-1.78
-1	-1.33
0	0
1	4
2	16
3	52

x	y
-3	1.001
-2	1.01
-1	1.07
0	1.5
1	4.5
2	25.5
3	172.5

As x gets large, y → ______

As x gets small, y → ______

Asymptote: y = ______

As x gets large, y → ______

As x gets small, y → ______

Asymptote: y = ______

As x gets large, y → ______

As x gets small, y → ______

Asymptote: y = ______

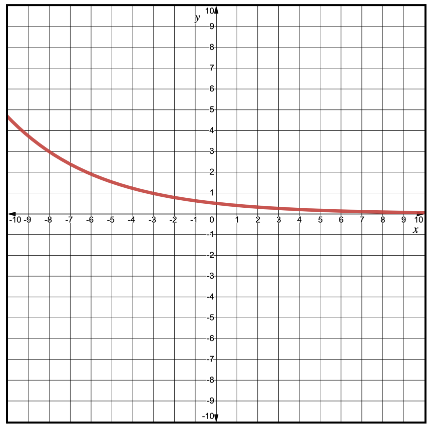
3 points each

x	y
-3	2
-2	2.5
-1	2.75
0	2.88
1	2.94
2	2.97
3	2.98

As x gets large, y → ______

As x gets small, y → ______

Asymptote: y = ______



As x gets large, y → ______

As x gets small, y → ______

Asymptote: y = ______

APPLY IT

Follow your teacher's directions to complete the Application Problems.

Teachers, you can find the Application problems linked in the Lesson Guide.