

6.2

Exponential Functions

For use with Exploration 6.2

Essential Question What are some of the characteristics of the graph of an exponential function?

1 EXPLORATION: Exploring an Exponential Function

Work with a partner. Complete each table for the exponential function $y = 16(2)^x$. In each table, what do you notice about the values of x ? What do you notice about the values of y ?

x	$y = 16(2)^x$
0	
1	
2	
3	
4	
5	

x	$y = 16(2)^x$
0	
2	
4	
6	
8	
10	

2 EXPLORATION: Exploring an Exponential Function

Work with a partner. Repeat Exploration 1 for the exponential function $y = 16\left(\frac{1}{2}\right)^x$.

x	$y = 16\left(\frac{1}{2}\right)^x$
0	
1	
2	
3	
4	
5	

x	$y = 16\left(\frac{1}{2}\right)^x$
0	
2	
4	
6	
8	
10	

Do you think the statement below is true for *any* exponential function? Justify your answer.

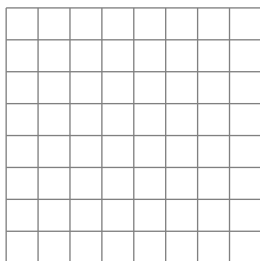
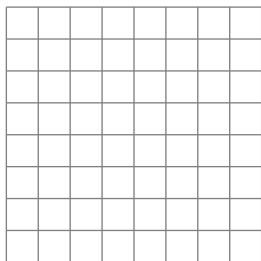
“As the independent variable x changes by a constant amount, the dependent variable y is multiplied by a constant factor.”

6.2 Exponential Functions (continued)

3 EXPLORATION: Graphing Exponential Functions

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Sketch the graphs of the functions given in Explorations 1 and 2. How are the graphs similar? How are they different?

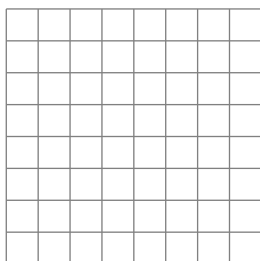


Communicate Your Answer

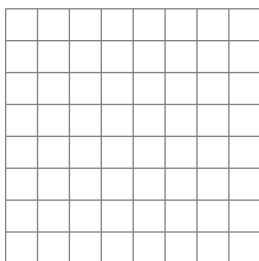
4. What are some of the characteristics of the graph of an exponential function?

5. Sketch the graph of each exponential function. Does each graph have the characteristics you described in Question 4? Explain your reasoning.

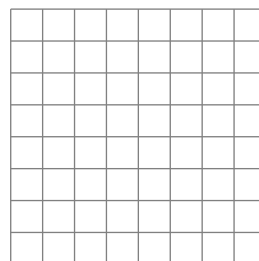
a. $y = 2^x$



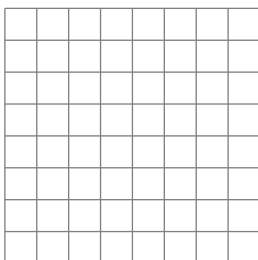
b. $y = 2(3)^x$



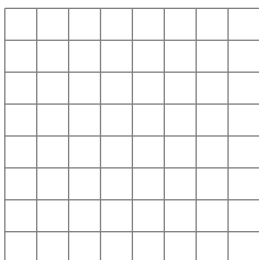
c. $y = 3(1.5)^x$



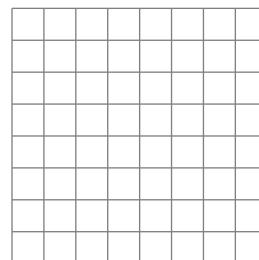
d. $y = \left(\frac{1}{2}\right)^x$



e. $y = 3\left(\frac{1}{2}\right)^x$



f. $y = 2\left(\frac{3}{4}\right)^x$



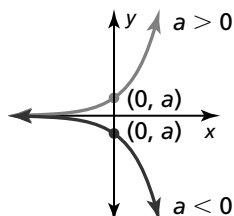
6.2

Practice

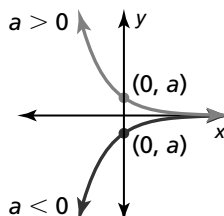
For use after Lesson 6.2

Core Concepts

Graphing $y = ab^x$ When $b > 1$



Graphing $y = ab^x$ When $0 < b < 1$



Notes:

Worked-Out Examples

Example #1

Evaluate the function for the given value of x .

$$y = \frac{1}{4}(4)^x; \quad x = 5$$

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

$$y = \frac{1}{4}(4)^5$$

$$= \frac{1}{4}(1024)$$

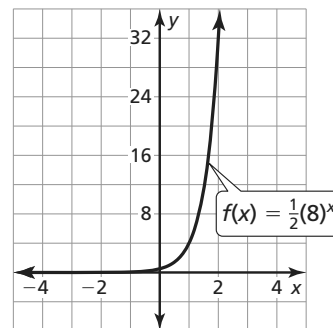
$$= 256$$

Example #2

Graph the function. Compare the graph to the graph of the parent function. Describe the domain and range of f .

$$f(x) = \frac{1}{2}(8)^x$$

x	-2	-1	0	1	2
$\frac{1}{2}(8)^x$	$\frac{1}{2}(8)^{-2}$	$\frac{1}{2}(8)^{-1}$	$\frac{1}{2}(8)^0$	$\frac{1}{2}(8)^1$	$\frac{1}{2}(8)^2$
$f(x)$	$\frac{1}{128}$	$\frac{1}{16}$	$\frac{1}{2}$	4	32



The parent function is $g(x) = 8^x$. The graph of f is a vertical shrink of the graph of g by a factor of $\frac{1}{2}$. The y -intercept of the graph of f , $\frac{1}{2}$, is below the y -intercept of the graph of g , 1. From the graph of f , you can see that the domain is all real numbers and the range is $y > 0$.

6.2 Practice (continued)

Practice A

In Exercises 1–4, determine whether the table represents an exponential function.

Explain.

1.

<i>x</i>	<i>y</i>
1	8
2	4
3	2
4	1

2.

<i>x</i>	<i>y</i>
1	3
2	7
3	11
4	15

3.

<i>x</i>	<i>y</i>
-1	12
0	9
1	6
2	3

4.

<i>x</i>	<i>y</i>
-1	0.125
0	0.5
1	2
2	8

In Exercises 5–7, evaluate the function for the given value of *x*.

5. $y = 3^x; x = 5$

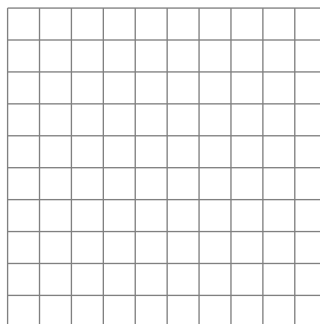
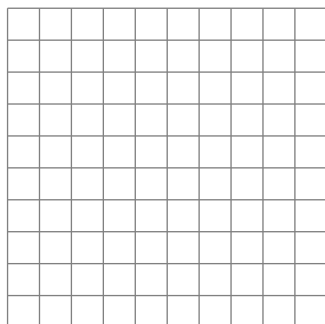
6. $y = \left(\frac{1}{4}\right)^x; x = 3$

7. $y = 3(4)^x; x = 4$

In Exercises 8 and 9, graph the function. Compare the graph to the graph of the parent function. Describe the domain and range of *f*.

8. $f(x) = -2^x$

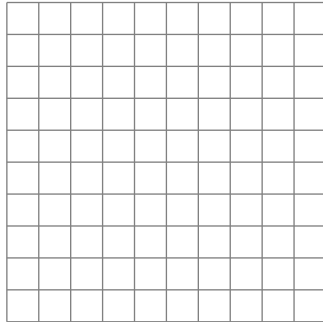
9. $f(x) = 2\left(\frac{1}{4}\right)^x$



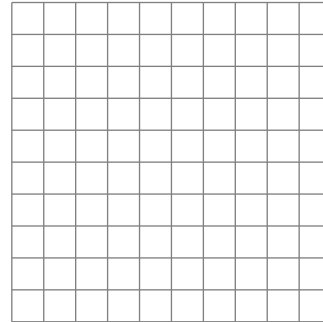
6.2 Practice (continued)

In Exercises 10 and 11, graph the function. Describe the domain and range.

10. $f(x) = 4^x - 2$



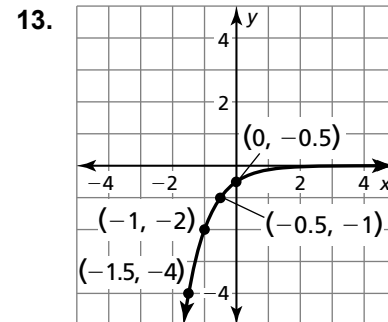
11. $f(x) = 4\left(\frac{1}{2}\right)^{x+1}$



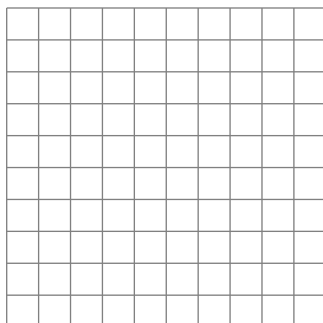
In Exercises 12 and 13, write an exponential function represented by the table or graph.

12.

x	0	1	2	3
$f(x)$	3	18	108	648



14. Graph the function $f(x) = 2^x$. Then graph $g(x) = 2^x + 3$. How are the y-intercept, domain, and range affected by the translation?



Practice B

In Exercises 1–3, determine whether the equation represents an exponential function. Explain.

1. $y = -6^x$

2. $y = 5(1)^x$

3. $y = 7x^3$

In Exercises 4 and 5, determine whether the table represents an exponential function. Explain.

4.

x	y
1	5
2	2
3	-1
4	-4

5.

x	y
1	24
2	12
3	6
4	3

In Exercises 6 and 7, evaluate the function for the given value of x .

6. $y = (1.2)^x; x = 2$

7. $f(x) = \frac{1}{2}(8)^x; x = -2$

In Exercises 8–10, graph the function. Compare the graph to the graph of the parent function. Describe the domain and range of f .

8. $f(x) = 5\left(\frac{1}{4}\right)^x$

9. $f(x) = -\frac{1}{3}(3)^x$

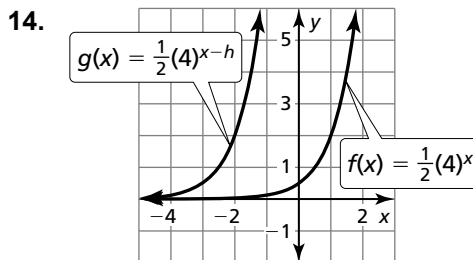
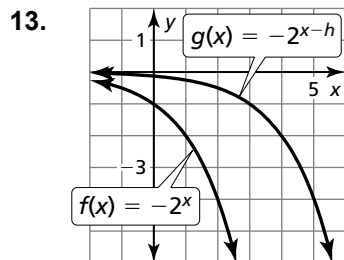
10. $f(x) = \frac{4}{3}(6)^x$

In Exercises 11 and 12, graph the function. Describe the domain and range.

11. $f(x) = -6\left(\frac{1}{3}\right)^{x-1} - 4$

12. $f(x) = 2(5)^{x+1} - 3$

In Exercises 13 and 14, compare the graphs. Find the value of h , k , or a .



15. Graph the function $f(x) = 2^x$. Then graph $g(x) = 2^{x-3}$. How are the y -intercept, domain, and range affected by the transformation?