6.3 Exponential Functions

add same amount

multiply same amount

Does each table represent a *linear* or an *exponential* function? Explain.

a.

x	0	1	2	3
y	2	4	6	8

+1 +1 +1

+2 +2 +2

$\frac{2}{1} = \frac{2}{1} = \frac{2}{1}$

Linear

b.

x	0	1	2	3
y	4	8	16	32

+1 +1 +1

+4 +8 +16

+4 +8

Not linear

Not Quadratic

4 8 16 32

×2 ×2 ×2

Exponential

Evaluate each function for the given value of x.

a. $y = -2(5)^x$; $x = 3$

$y = -2(5)^3$

$= \boxed{-250}$

b. $y = 3(0.5)^x$; $x = -2$

$y = 3(0.5)^{-2}$

$= \boxed{12}$

Does the table represent a *linear* or an *exponential* function? Explain.

1.

x	0	1	2	3
y	8	4	2	1

+1 +1 +1

×½ ×½ ×½

Exponential

2.

x	−4	0	4	8
y	1	0	−1	−2

+4 +4 +4

−1 −1 −1

Linear

Evaluate the function when $x = -2$, 0, and $\frac{1}{2}$.

3. $y = 2(9)^x$

$y = 2(9)^{-2} = \frac{2}{9^2} = \boxed{\frac{2}{81}}$

$y = 2(9)^0 = \boxed{2}$

$y = 2(9)^{\frac{1}{2}} = 2(\sqrt{9}) = 2 \cdot 3 = \boxed{6}$

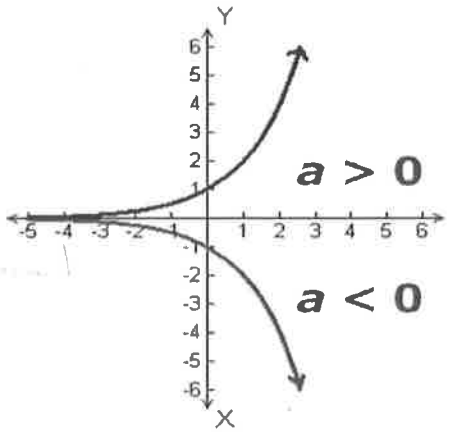
4. $y = 1.5(2)^x$

$y = 1.5(2)^{-2} = \frac{1.5}{2^2} = \frac{1.5}{4} = \boxed{\frac{3}{8}}$

$y = 1.5(2)^0 = \boxed{1.5}$

$y = 1.5(2)^{\frac{1}{2}} = \boxed{2.12}$

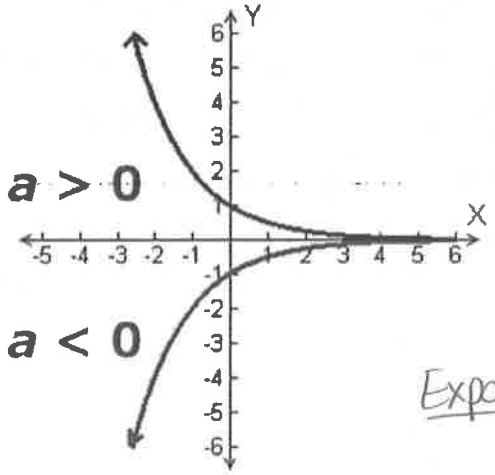
Exponential Growth



For $y = ab^x$, if $b > 1$, then the graph will have one of these shapes.

Exponential Growth: $b > 1$

Exponential Decay



Exponential Decay: $0 < b < 1$

* Remember, not negative

For $y = ab^x$, if $0 < b < 1$, then the graph will have one of these shapes.

Determine whether each table represents an *exponential growth function*, an *exponential decay function*, or *neither*.

a.

x	y
0	270
1	90
2	30
3	10

$\times\frac{1}{3}$ $\times\frac{1}{3}$ $\times\frac{1}{3}$

Exponential decay

b.

x	0	1	2	3
y	5	10	20	40

×2 ×2 ×2

Exponential Growth

2.

x	0	1	2	3
y	64	16	4	1

$\times\frac{1}{4}$ $\times\frac{1}{4}$ $\times\frac{1}{4}$

Expo. Decay

3.

x	1	3	5	7
y	4	11	18	25

+2 +2 +2

+7 +7 +7

Neither

Now write the equation of each function.

a. $y = 270\left(\frac{1}{3}\right)^x$

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

2. $y = 64\left(\frac{1}{4}\right)^x$

For an exponential function of the form $y = ab^x$, the y-values change by a factor of *b* as *x* increases by 1. You can use this fact to write an exponential function when you know the y-intercept, *a*. The table represents the exponential function $y = 2(5)^x$.

(0, y)

+1 +1 +1 +1

x	0	1	2	3	4
y	2	10	50	250	1250

×5 ×5 ×5 ×5

Graphing $y = ab^x$

Step 1: Set up a table. Pick at least 4 points for the x-values.

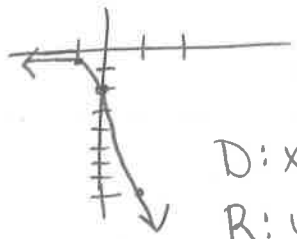
Step 2: Evaluate the function to get the y-values.

Step 3: Plot the points and graph the ~~line~~ exponential.

Graph the function. Describe the domain and range of the function.

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

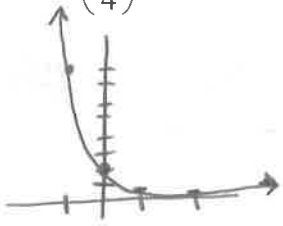
x	y
-1	$-\frac{1}{2} = -2(4)^{-1}$
0	$-2 = -2(4)^0$
1	$-8 = -2(4)^1$
2	$-32 = -2(4)^2$



D: $x \in \mathbb{R}$
R: $y < 0$

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

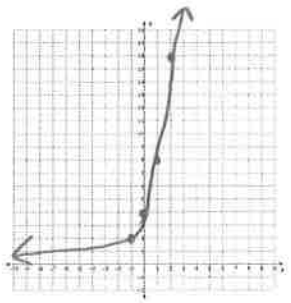
x	y
-1	8
0	2
1	$\frac{1}{2}$
2	$\frac{1}{8}$



D: $x \in \mathbb{R}$
R: $y > 0$

3. $y = 4(2)^x$

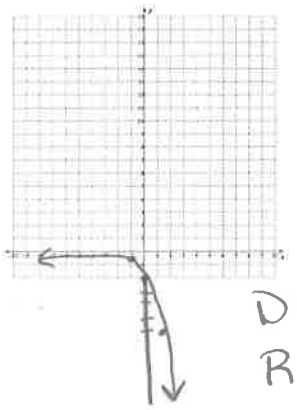
x	y
-1	2
0	4
1	8
2	16



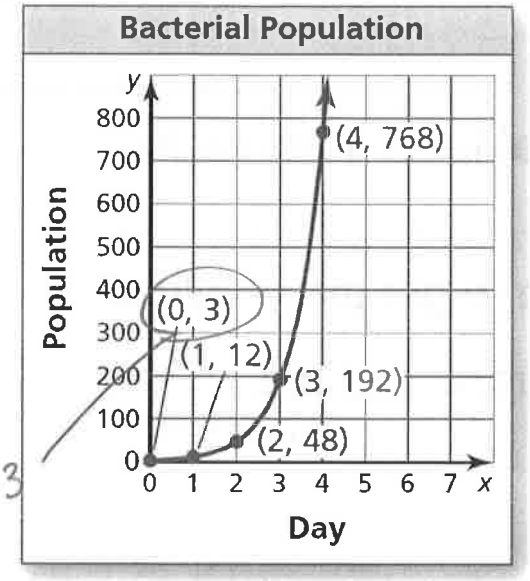
D: $x \in \mathbb{R}$
R: $y > 0$

4. $y = -2(3)^x$

x	y
-1	$-\frac{2}{3}$
0	-2
1	-6
2	-18



D: $x \in \mathbb{R}$
R: $y < 0$



a = 3

The graph represents a bacterial population y after x days.

1. Write an exponential function that represents the population.

2. Find the population after 12 hours and after 5 days.

$y = a(b)^x$

a: y-int. b: change in y

1. $y = 3(4)^x$

x	y	
0	3	×4
1	12	×4
2	48	×4
3	192	×4
4	768	

+1 +1 +1 +1

$b = 4$

2. 12 hours = $\frac{1}{2}$ day

$x = \frac{1}{2}$

$y = 3(4)^{\frac{1}{2}} = \boxed{6}$

$x = 5 \quad y = 3(4)^5 = \boxed{3072}$

Homework

Pg. 310 #5 - 16, 21 - 26