

Exponential Functions, Growth, and Decay
Warm-up
1.8.16

1) What is the equation for a linear function?

2) Is this set of data linear? How can you tell?

x	0	1	2	3
y	4	7	10	13

$a > 0$ $b > 1$ $y = 2(3)^x$	$a > 0$ $b < 1$ $y = 2\left(\frac{1}{2}\right)^x$
$a < 0$ $b > 1$ $y = -2(3)^x$	$a < 0$ $b < 1$ $y = -2\left(\frac{1}{2}\right)^x$

An **exponential function** has a variable as an exponent. The parent exponential function is $f(x) = b^x$ where the base “b” is a constant and the exponent “x” is the independent variable.



The diagram shows the equation $f(x) = b^x$ with the text "where $b > 0, b \neq 1$ ". A blue arrow points from the word "Base" to the variable b . A red arrow points from the word "Exponent" to the variable x . The entire equation and condition are highlighted with a light blue background.

$$f(x) = b^x, \text{ where } b > 0, b \neq 1$$

A function of the form $f(x) = a(b)^x$ with $a > 0$ and $b > 1$ is an **exponential growth function**.

Decay rate is 10%

Decay factor is .9

Growth Rate of 50%

Growth Factor 1.5

An **Asymptote** is the horizontal line that the graph's end behavior approaches.

Examples:

I do:

Is this an exponential growth or decay function?

Where is the asymptote?

$$f(x) = 10 \left(\frac{1}{2}\right)^x$$

Function	$f(x) = 10 \left(\frac{1}{2}\right)^x$
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Identify b	$b = \frac{1}{2}$
Identify growth or decay	$0 < \frac{1}{2} < 1$ Decay

We Try:

Is this an exponential growth or decay function?

Where is the end behavior?

$$f(x) = 2(1.5)^x$$

Function	$f(x) = 2(1.5)^x$
Identify b	b=1.5
Identify growth ($b > 1$) or decay	growth

$0 < b < 1$	
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You Try With your partner:

Is this an exponential growth or decay function?

Where is the end behavior?

$$f(x) = 5(.5)^x$$

Function	$f(x) = 5(.5)^x$
Identify b	
Identify growth ($b > 1$) or decay $0 < b < 1$	

You Try SOLO:

Is this an exponential growth or decay function?

Where is the end behavior?

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

Function	$f(x) = 2(-10)^x$
Identify b	
Identify growth	

$(b > 1)$ or decay $0 < b < 1$	
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GROWTH DECAY BOX

	+a	-a
$b > 1$		
$1 > b > 0$		

Exponential Function transformations

I do:

What are the parent functions?

$$y = 2(.4)^{x+2}$$

$$y = -3(4)^{x-3} + 5$$

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

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

Parent Formula $y = b^x$

We Do:

What are the parent functions?

$$y = -2(3)^{x+2}$$

$$y = -3(.5)^{x+3} + 5$$

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

$$y = -2(4)^x + 5$$

You Do Solo:

What are the parent functions?

$$1) y = 12(.4)^x$$

$$y = a(b)^{x-h} + k$$

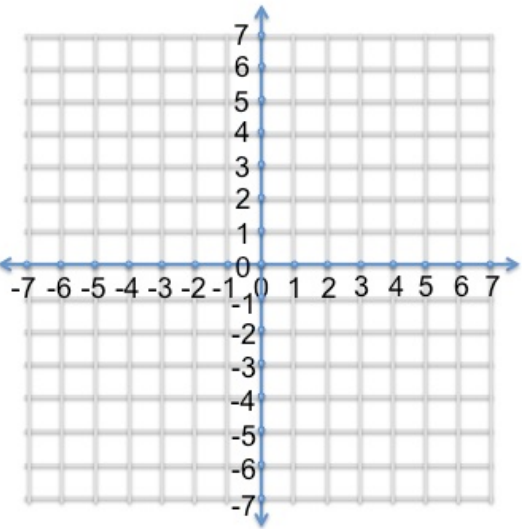
What do you think the h does?

What do you think the k does?

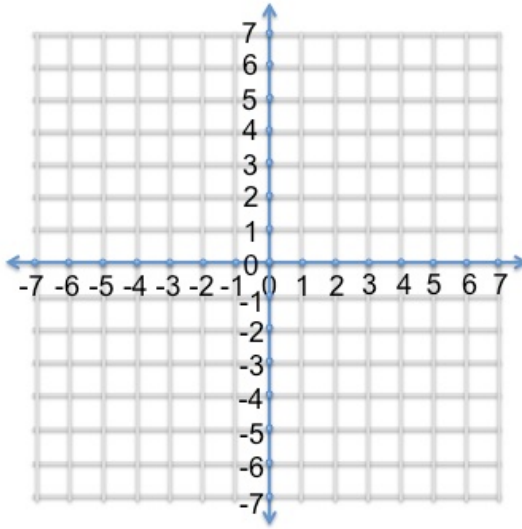
What if a was negative?

a also affects the y intercept.

$$f(x) = (3)^{x-2} + 4$$

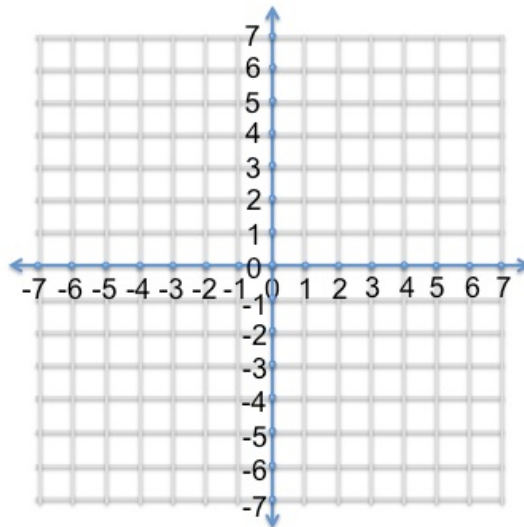
Function	$f(x) = 2(3)^{x-2} + 3$
Find the parent function	
Plot the parent function points.	$(0, \frac{1}{b})(-1, 0)(1, b)$
Apply transformations.	

Function	$f(x) = -1(2)^x + 3$
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Find the parent function	
Plot the parent function points. Apply transformations.	$\left(0, \frac{1}{b}\right)(-1, 0)(1, b)$ 

Function	$f(x) = (3)^{x-2} - 1$
Find the parent function	
Plot the parent function points.	$\left(0, \frac{1}{b}\right)(-1, 0)(1, b)$

Apply transformations.

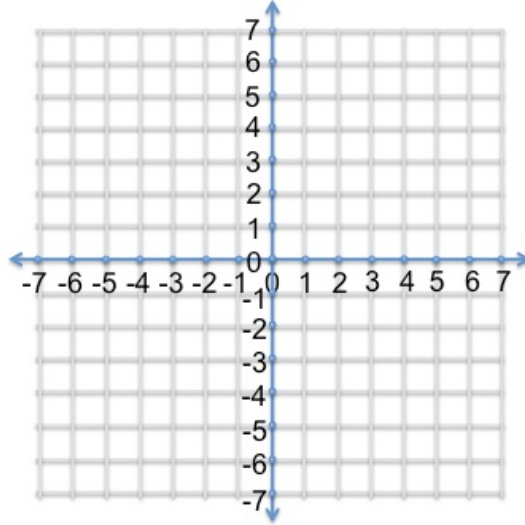


Graphing exponential inequalities.

Function	$f(x) > (3)^{x-2} - 1$
Find the parent function	
Plot the parent function points.	$(0, \frac{1}{b})(-1, 0)(1, b)$

Apply transformations.

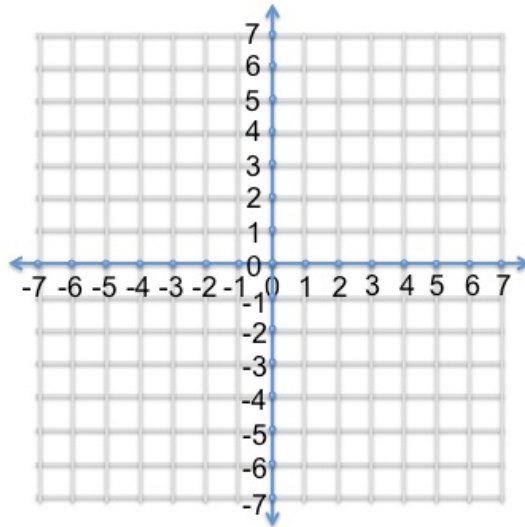
Do the (0,0) test and shade.



Function	$f(x) \leq -(2)^{x-1} + 3$
Find the parent function	
Plot the parent function points.	$(0, \frac{1}{b})(-1, 0)(1, b)$
Apply	

transformations.

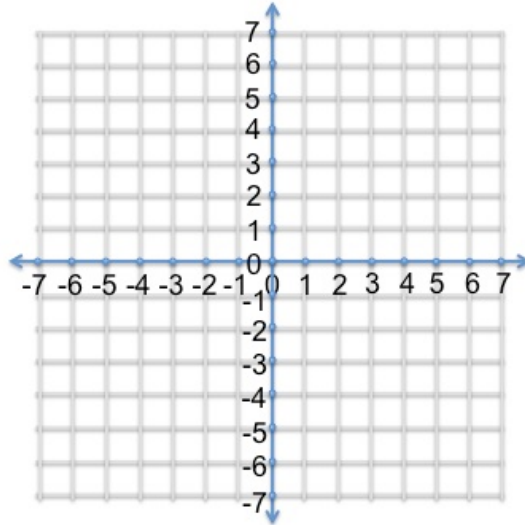
Do the (0,0) test
and shade.



Function	$f(x) \geq 3(4)^x - 2$
Find the parent function	
Plot the parent function points.	$(0, \frac{1}{b})(-1, 0)(1, b)$

Apply
transformations.

Do the (0,0) test
and shade.



2.29.16

Compound and continuous Interest

Warm-up

Solve for x

1) $5 = 3^x$

2) $6 = 2e^x$

Compound
Quarterly , Monthly

$$A = P \left(1 + \frac{r}{n} \right)^{nt}$$

P= Principal- the starting amount

R=*annual interest Rate*

N=Number of interest periods in a
year

T= Time

Continuously

$$A = Pe^{rt}$$

P= Principal- the starting
amount

R=*annual interest Rate*

T= Time

A= Amount after years

A= Amount after years

Jason recently inherited \$30,000. He has a couple of savings plans to choose from.

Plan 1

5.5% interest

Compounded Quarterly for 13 years

How much money would he earn using this plan?
Identify all the variables. Round to the nearest cent.

Plan 2

4.6% interest

Compounded Monthly for 13 years

How much money would he earn using this plan?

Identify all the variables. Round to the nearest cent.

Plan 3

4.21% interest

Compounded Continuously for 13 years

How much money would he earn using this plan?

Identify all the variables. Round to the nearest cent.

Jason wants to know if he can invest \$900,000 in his lifetime with plan 3. Jason is currently 60 years old. Justify his answer.

Quarterly, Monthly

$$A = P \left(1 + \frac{r}{n} \right)^{nt}$$

P= Principal- the starting amount

Continuously

$$A = Pe^{rt}$$

P= Principal- the starting amount

R=*annual interest Rate*

T= Time

A= Amount after years

$R = \text{annual interest Rate}$

$N = \text{Number of interest periods in a year}$

$T = \text{Time}$

$A = \text{Amount after years}$

Jasona recently inherited \$15,000. She has a couple of savings plans to choose from.

Plan 1

5.2% interest

Compounded Quarterly for 12 years

How much money would he earn using this plan?

Identify all the variables. Round to the nearest cent.

Plan 2

4.1% interest

Compounded Monthly for 12 years

How much money would she earn using this plan?

Identify all the variables. Round to the nearest cent.

Plan 3

4.0% interest

Compounded Continuously for 12 years

How much money would she earn using this plan?
Identify all the variables. Round to the nearest cent.

Jasona wants to know if she can invest \$1,900,000 in her lifetime with plan 3. Justify her answer.

Sona recently inherited \$20,000. She has a couple of savings plans to choose from.

Plan 1

7.1% interest

Compounded Quarterly for 15 years

How much money would he earn using this plan?

Identify all the variables. Round to the nearest cent.

Plan 2

6.1% interest

Compounded Monthly for 15 years

How much money would she earn using this plan?
Identify all the variables. Round to the nearest cent.

Plan 3

4.51% interest

Compounded Continuously for 15 years

How much money would she earn using this plan?

Identify all the variables. Round to the nearest cent.

Sona wants to know if she can invest \$1,500,000 in her lifetime with plan 3. Justify her answer.

Ona recently inherited \$12,000. She has a couple of savings plans to choose from.

Plan 1

4.1% interest

Compounded Quarterly for 17 years

How much money would he earn using this plan?

Identify all the variables. Round to the nearest cent.

Plan 2

3.1% interest

Compounded Monthly for 17 years

How much money would she earn using this plan?

Identify all the variables. Round to the nearest cent.

Plan 3

2.51% interest

Compounded Continuously for 17 years

How much money would she earn using this plan?

Identify all the variables. Round to the nearest cent.

Ona wants to know if she can invest \$300,000 in her lifetime with plan 3. Justify her answer.

Exit Slip:
Graph

$$y < 2(3)^{x-3} + 2$$

2) Given:

3.1% interest

Compounded Monthly for 17 years

How much money would earn using this plan? Identify all the variables. Round to the nearest cent.