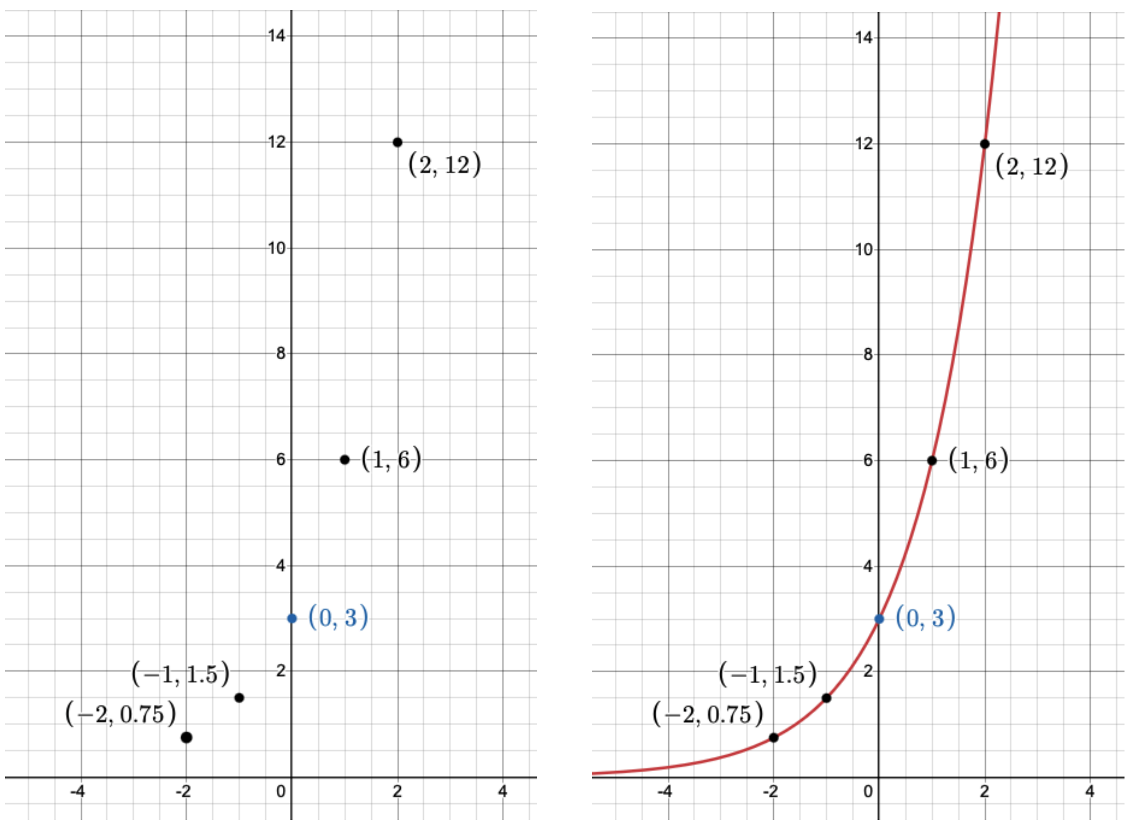
Precalculus 5.1 Key Points

Exponential Functions:

Exponential functions are written in the form $y = a \bullet b^x$, where a is the initial value and b is the factor of growth/decay

Unlike a linear equation, $y = mx + b$, where the rate (m) is constant, exponential functions have a rate that changes as x changes.

To graph an exponential function, begin by locating your y-intercept, which will be located at $(0, a)$. Then, plug in a few points around there to draw the graph.



When determining the equation of an exponential equation from a scenario, be mindful of how b values are determined from percentages. For example, if a population grows by 5% every x minutes, the b-value is 1.05. If a population grows by at a rate of 100% every x minutes (aka it doubles), then the b-value is 2

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Transforming Exponential Functions:

Here are a few ways to transform exponential functions:

- Horizontal Shift

$y = a \bullet b^{(x-c)}$, where the function is shifted c units to the right

<table>
<tr><th>$y = 2 \bullet 1.5^{x}$</th><th>$y = 2 \bullet 1.5^{(x-2)}$</th></tr>
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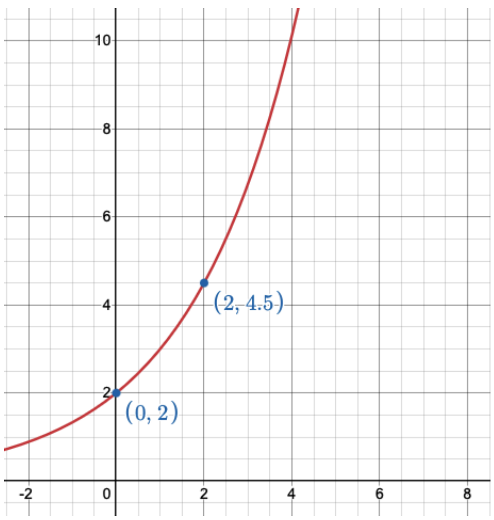

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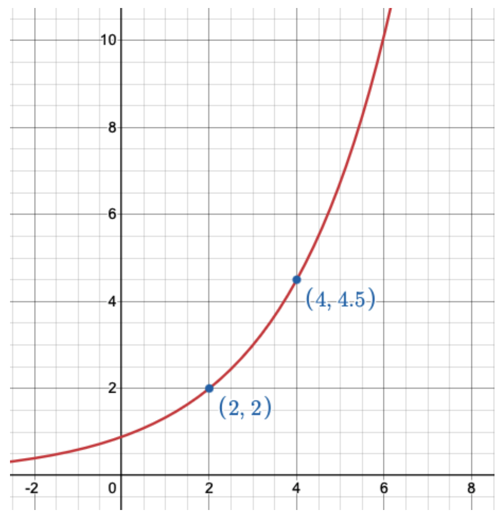

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- Vertical Shift

$y = a \bullet b^{x} + c$, where the function is shifted c units up

<table>
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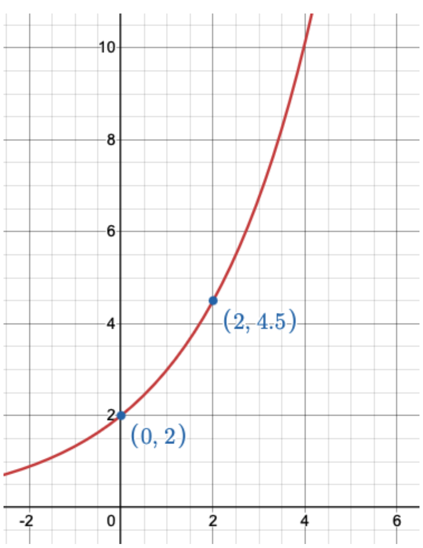

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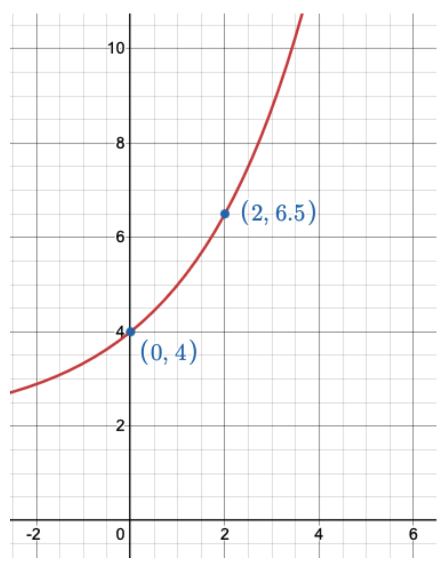

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- Horizontal Compression/Stretch

$y = a \bullet b^{(c \bullet x)}$, where the function is horizontally compressed/stretched by a factor of c

<table>
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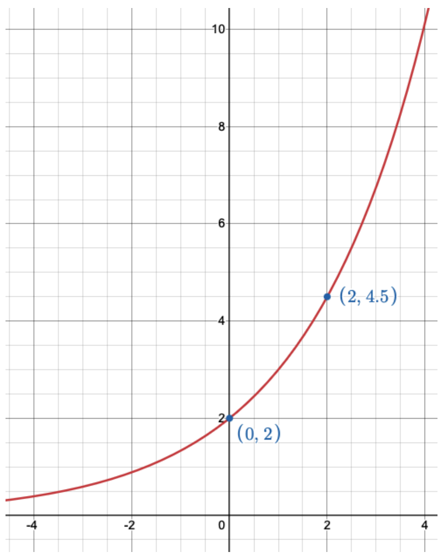
<tr><td>



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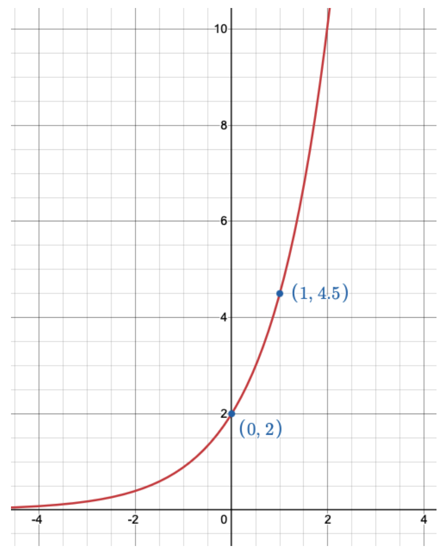

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- Vertical Compression/Stretch

$y = c \bullet a \bullet b^{x}$, where the function is vertically compressed/stretched by a factor of c

<table>
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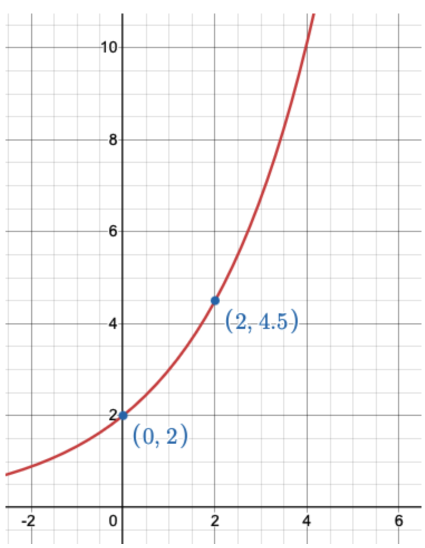
<tr><td>



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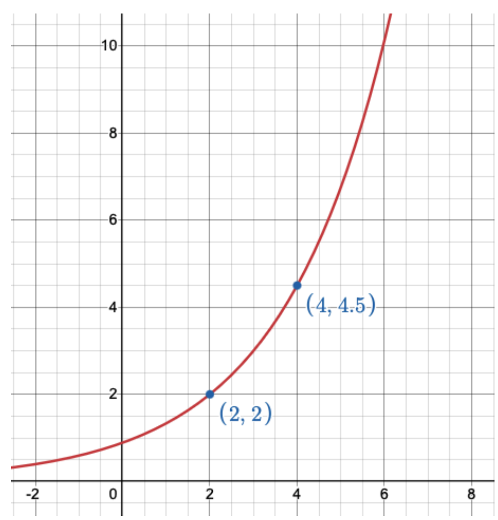

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Notice that a horizontal shift can transform a graph in the same way that a vertical compression/stretch transforms it.

If the function is "pulled apart," the transformation is a stretch. If the function is "squished together," then it is a compression.

Let's use exponent properties to write the same exponential function using a horizontal shift or a vertical stretch:

Horizontal Shift: $y = a \bullet b^{(x-j)}$

Vertical Stretch: $y = k \bullet a \bullet b^{x}$

$a \bullet b^{(x-j)} = k \bullet a \bullet b^{x}$

$b^{(x-j)} = k \bullet b^{x}$

$\frac{b^{x}}{b^{j}} = k \bullet b^{x}$

$\frac{1}{b^{j}} = k$

Since b is a constant, we could take an equation and plug in b along with either j or k (whichever one you are given) to convert an equation between a horizontal shift or a vertical stretch.

e:

The mathematical value of e is a constant approximately equal to 2.718
If you see e in an equation, treat it just like any other constant, such as 3 or -4.5

You might see e in an exponential equation like $A = Pe^{rt}$, where e is the growth rate (b-value) of the function

e is useful for many real world scenarios because of its ability to model them.