Exponents

EQ: How do you use properties of exponents to simplify algebraic expressions?

Properties of Exponents - GO

EXPONENTS

A^x

A is called the ___________

x is called the ___________

PROPERTIES OF EXPONENTS

Multiplication Properties

When multiplying two bases that are the same, you __________ the exponents.
Ex: $x^9 \bullet x^6 \bullet x^2 =$

When raising a power to another power you __________ the exponents.
Ex: $(x^2)^5 =$ _______

To find the power of a product you ____________ the exponents.
Ex: $(2x^2y^5)^3 =$

Division Properties

When dividing two bases that are the same, you _________ the exponents.
Ex: $\frac{x^{10}}{x^7} =$

When raising a quotient to a power, you __________ the exponents.
Ex. $\left(\frac{2}{5}\right)^3 =$

Zero and Negative Exponents

Any nonzero number raised to the "0" power is equal to __________
Ex: $(2x)^0 =$ ______

How do negative exponents become positive?
____
____
____
____
____

Exponential Functions

EQ: What is an exponential function?

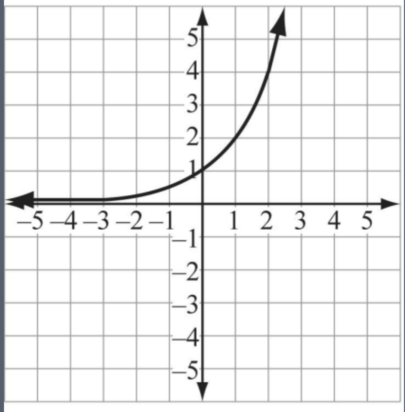
EQ: How do exponential functions relate to real-world phenomena?

Exponential Functions

- An exponential function with a base b is written $f(x)=ab^x$, where b is a positive number other than 1.
- This is easy to identify because the variable is in the place of (or part of) the exponent.

Exponential Growth

- An exponential growth function can be written in the form of $y = ab^x$ where $a > 0$ (positive) and $b > 1$.



- The function increases from $(-\infty, +\infty)$
- When looking at real-world data, we are often given the percent rate of growth (r).
- We can then make our own function by using the formula

$$y = a(1+r)^x$$

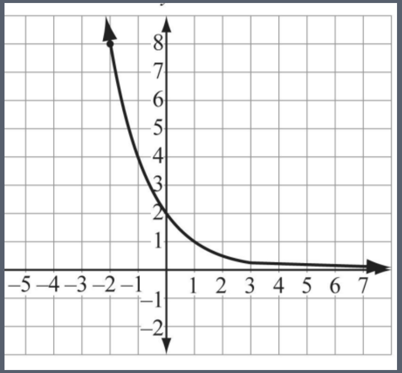
a is the starting value

r is the percent growth rate (changed to a decimal)

x is time

Exponential Decay

- An exponential decay function can be written in the form of $y = ab^x$ where $a > 0$ (positive) and $0 < b < 1$.
- The graph decreases from $(-\infty, +\infty)$.
- When looking at real-world data, we are often given the percent rate that it decreases (r).



- We can then make our own function by using the formula

$$y = a(1-r)^x$$

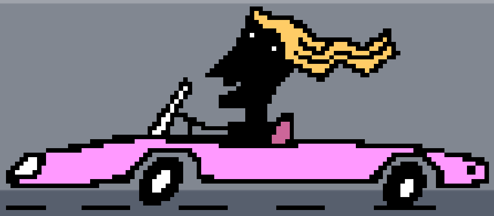
a is the starting value

r is the percent decrease/decay rate

(changed to a decimal)

x is time

Example 1:



You have purchased a car for \$19,550. This car will depreciate at a rate of 12% each year.

- Is this an example of a growth or decay?
- Write a formula to represent the amount the car is worth after x number of years.
- What is the value of the car after 2 years?

Example 2:

In the year 2005, a small town had a population of 15,000 people. Since, then it is growing at a rate of 3% each year.

- Is this an example of a growth or decay?
- Write a formula that represents the population after x years.
- What is the population after 7 years?

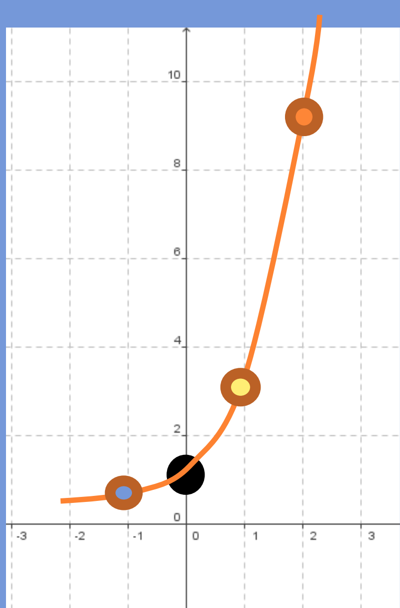
Graphing Exponential Functions

EQ:
How do transformations of exponential equations affect the function analytically and graphically?

Troy and Gabriella are students at East High School, which has a population of 2374 students. They met at registration and immediately fell in love. However, their relationship was doomed to fail. By the first day of school they were both dating someone new. By day two both of those relationships had failed and each person involved had found someone new. This unfortunate breakup pattern continued each day until everyone at the school was in a relationship. The breakups were so traumatic that the students involved only paired up with those who had not yet been in a relationship.

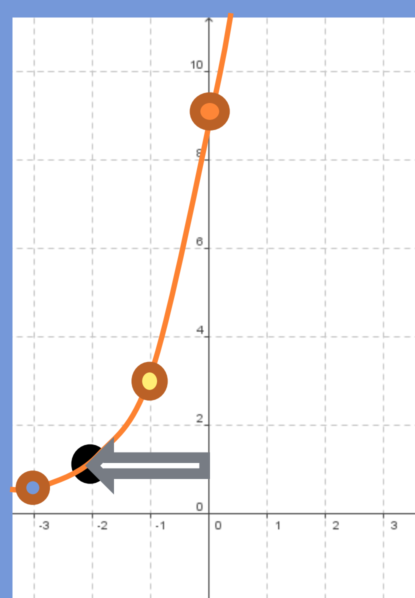
$y = 3^{x}$

x	f(x)
-1	1/3
0	1
1	3
2	9



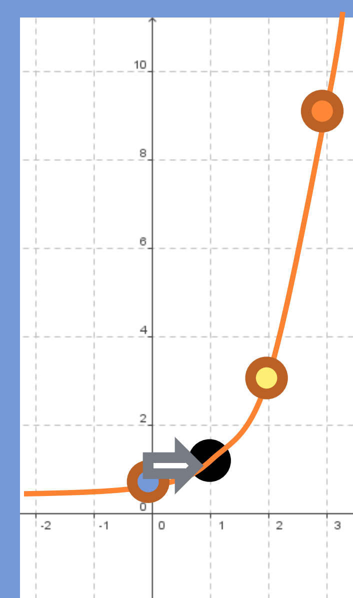
$y = 3^{x+2}$

x	f(x)
-3	1/3
-2	1
-1	3
0	9



$y = 3^{x-1}$

x	f(x)
0	1/3
1	1
2	3
3	9



$y = 3^x$

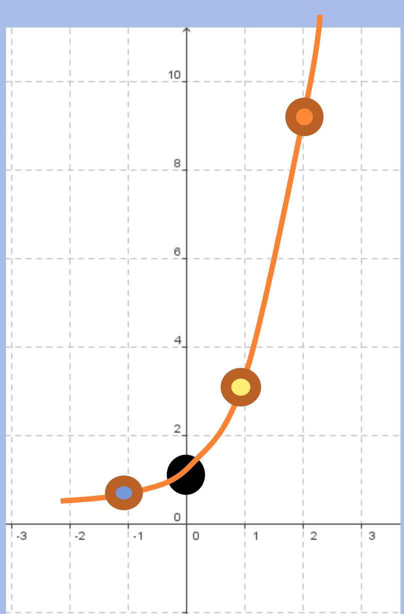
x	f(x)
-1	1/3
0	1
1	3
2	9

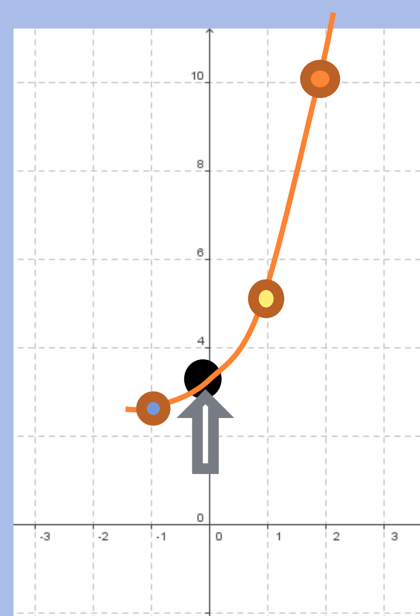
$y = 3^x + 2$

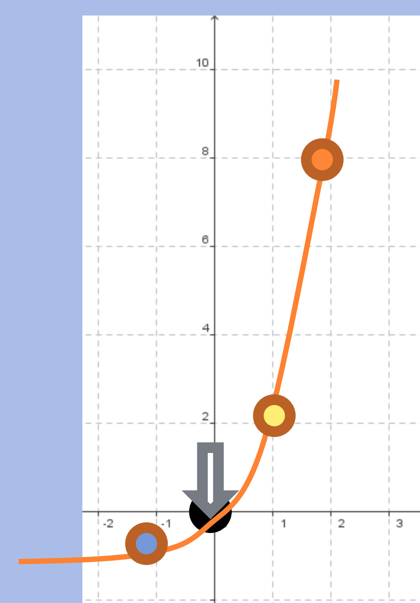
x	f(x)
-1	$2\frac{1}{3}$
0	3
1	5
2	10

$y = 3^x - 1$

x	f(x)
-1	-2/3
0	0
1	2
2	8







Asymptotes…

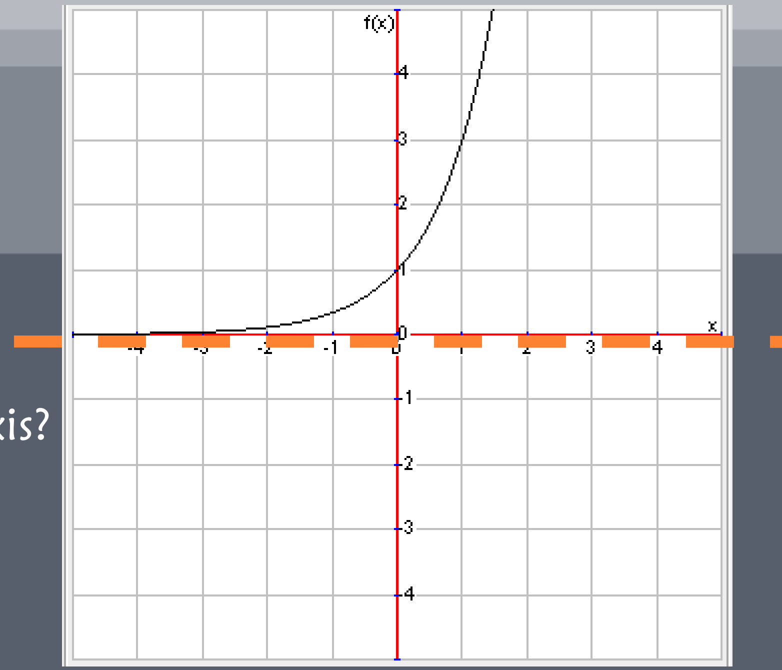
- What is happening to the graph of $y = 3^x$

  as it gets closer to the x-axis?

- Does it eventually cross and continue below the axis?
- Let's look at the table…
- What happens to the y-value as

  the x-value decreases?

- When will we reach zero?
- This is why there is an asymptote at y = 0.
- Asymptote: A straight line that a curve approaches more and more closely but never touches as the curve goes off to infinity in one direction.
- We draw the asymptote with a dotted/dashed line.



x	y
2	9
1	3
0	1
-1	1/3
-2	1/9
-3	1/27
-4	1/81

Step 1:
Identify left/right translations.

$y = ab^{(x+h)}$ left h units
$y = ab^{(x-h)}$ right h units

Step 2:
Identify up/down translations.

$Y = ab^x + k$ up k units
$Y = ab^x - k$ down k units

Step 3:
Identify stretch/shrink/ reflections.

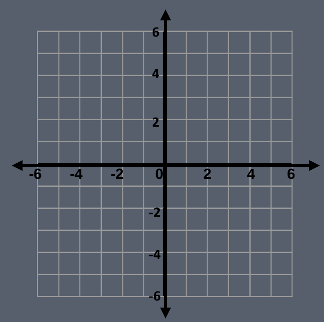
Step 4:
Take common point (0, 1) and translations from steps 1 – 3 and locate & plot the point in its new location.

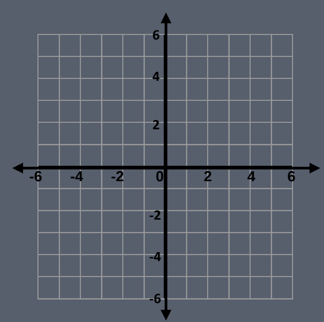
Step 5:
Identify and draw in asymptote.

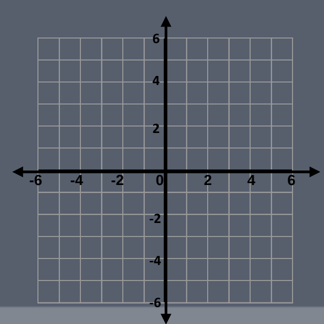
Step 6:
Identify and draw in the growth/decay exponential curve.

Graphing Exponential Functions

Examples:







Characteristics of Graph

- Domain: (-∞, +∞)
- Range: (3, +∞)
- Intercept(s): (0, 3.5)
- End behaviors: Rises to left
  Falls to the right
- Asymptote: y = 3