Standards	***A1.ACE.1**** ***Create*** *and* ***solve*** *equations and inequalities in one variable that model real-world problems involving linear, quadratic, simple rational, and exponential relationships. Interpret the solutions and determine whether they are reasonable. (Limit to ~~linear; quadratic~~; exponential with integer exponents.*
Learning Targets/I Can Statements	I can solve exponential growth problems. I can solve exponential decay problems. I can solve exponential equations.
Essential Question(s)	**What real life experiences represent exponential functions?** **How do you determine if different experiences apply to exponential growth or decay?**
Resources	https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:exponential-growth-decay https://www.mathwarehouse.com/exponential-growth/exponential-models-in-real-world.php
Learning Activities or Experiences	1st: Recall questions (attached) 2nd: Watch the Khan Academy video (link above) a. Introduction to exponential functions b. Exponential vs Linear c. Exponential Growth d. Exponential Decay Alternative: Notes on Exponential functions, Growth & Decay 3rd: Growth in the Real World (link above) 4th: Assignment

Recall Questions

1. Simplify: the exponential expression
   $(2x^3y^2)^5$

2. What is 6 raised to the 3rd power?

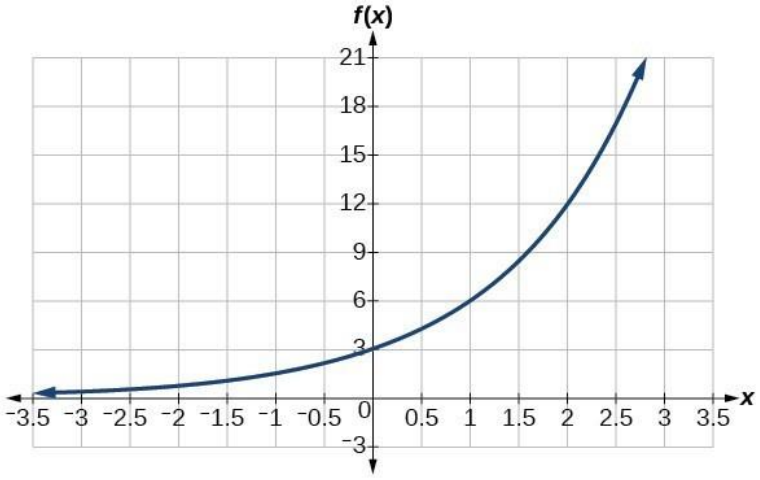
3. Simplify: $\frac{y^{17}}{y^5}$

4. Simplify: $(x^3)(x^5)$

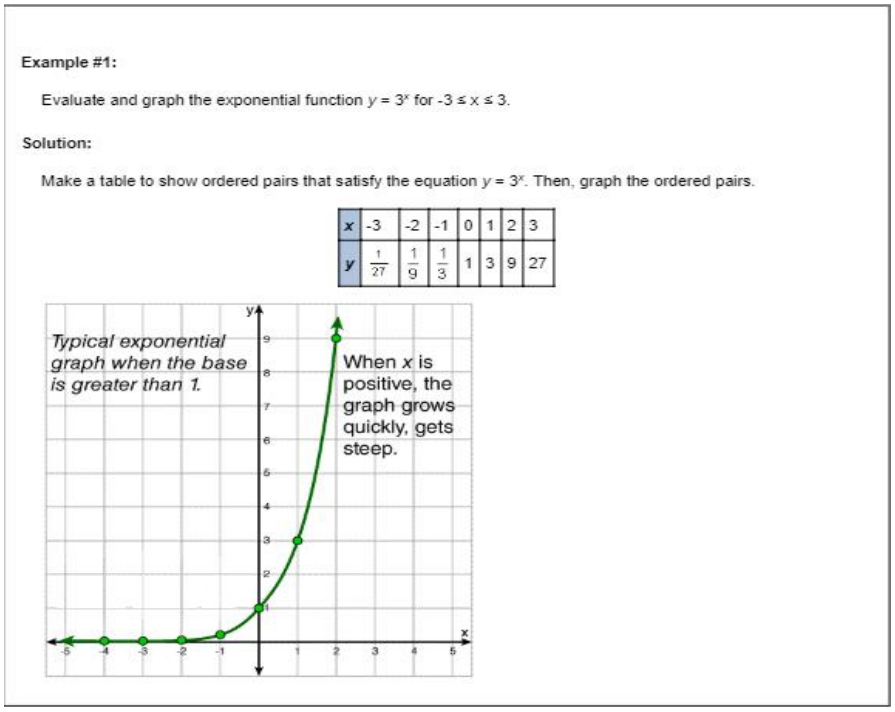
EXPONENTIAL FUNCTIONS

Exponential functions look somewhat similar to functions you have seen before, in that they involve exponents, but there is a big difference, in that the variable is now the power, rather than the base.

Ex: y = 4^x



***Exponential functions do not pass through the x intercept. They are curved lines.



Example #1:

Evaluate and graph the exponential function $y = 3^x$ for $-3 \le x \le 3$.

Solution:

Make a table to show ordered pairs that satisfy the equation $y = 3^x$. Then, graph the ordered pairs.

x	-3	-2	-1	0	1	2	3
y	$\frac{1}{27}$	$\frac{1}{9}$	$\frac{1}{3}$	1	3	9	27

Typical exponential graph when the base is greater than 1.

When x is positive, the graph grows quickly, gets steep.

Exponential Growth and Decay

Exponential growth – is the manner in which a quantity grows over a time. It occurs when the instantaneous rate of change of a quantity with respect to time is proportional to the quantity itself.

Exponential growth formula: $y = a(1 + r)^t$

a = initial amount r = growth rate (decimal) t = time

b = (1+r) growth factor

For exponential growth, the growth factor will always be greater than 1.

Always change rate from a percent to a decimal.

Ex: Thomas purchased a baseball card for 1.25 in 1980. The value of it increased by 3% each year. What is the card worth today?

$Y = 1.25(1 +.03)^{40}$

$Y = 1.25(1.03)^{40}$

= $4.08

Explanation: Change 3% to .03. Then substitute values in to formula. Type the entire formula in the calculator and solve.

Your Turn:

Jennifer worked for the Census Bureau. Columbia had 99, 000 residents in 2010. The population increased by 2% per year. What will be the population of Columbia in 2025?

Exponential Decay– is the manner in which a quantity decreases over a time. It occurs when the instantaneous rate of change of a quantity with respect to time is proportional to the quantity itself.

Exponential decay formula: $y = a(1 - r)^t$

a = initial amount r = growth rate (decimal) t = time

b = (1 - r) growth factor

For exponential decay, the growth factor will always be less than 1.

Always change rate from a percent to a decimal.

Ex: There was infestation of roaches at Mr. Ham's house. He called the exterminator to kill the roaches. There were approximately 6250 roaches in the house. After he fumigated the house, the roaches died at a rate of 15 percent per day. How many roaches were left after 13 days?

$Y = 6250(1 - .15)^{13}$

$Y = 6250(.85)^{13}$

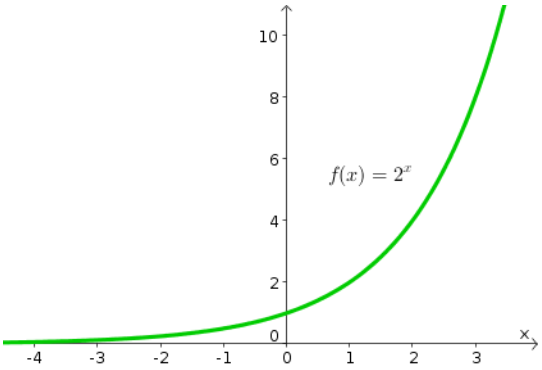
$=756$

Your Turn:

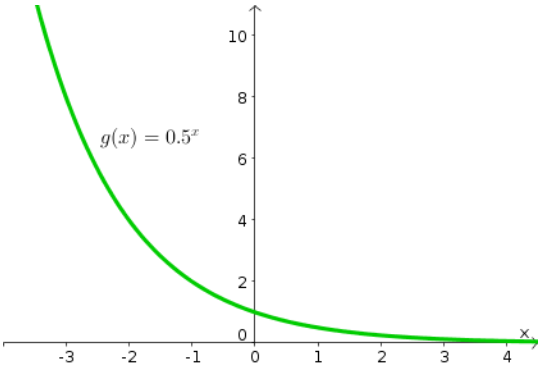
Tasha's mother purchased a car in 2013. The car cost $23500. The value of the car depreciated by 7 percent each year. What is the value of the car today?

Difference of Exponential Growth and Decay Graphs

Exponential Growth Graph below: Positive number greater than 1



Exponential Decay Graph below: Positive number less than 1



Compare and Contrast both graphs:

What do you notice?

What are similarities between positive and negative linear equations?