Precalculus – Section 3.1 (1) Name _____
Class Exploration
Exponential Functions Hour _____ Date _____

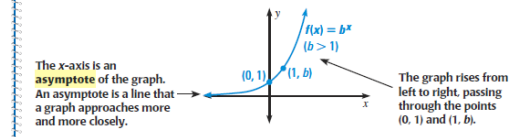
Learning Target: I can evaluate, analyze, and graph exponential functions. I can solve problems involving exponential growth and decay.

Class Exploration – We will explore these examples as a class.

KEY CONCEPT *For Your Notebook*

Parent Function for Exponential Growth Functions

The function $f(x) = b^x$, where $b > 1$, is the parent function for the family of exponential growth functions with base b. The general shape of the graph of $f(x) = b^x$ is shown below.

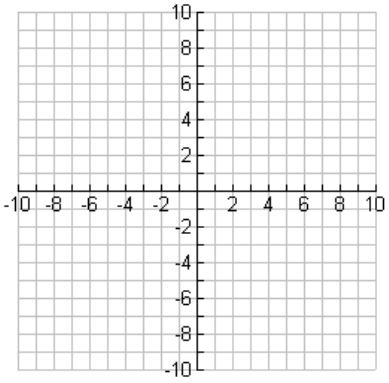


The domain of $f(x) = b^x$ is all real numbers. The range is $y > 0$.

Exponential Growth Functions: $y = a(b)^x$

- $b > 1$
- Have a horizontal asymptote (HA).
- As x values increase the graph moves away from the HA towards $\pm\infty$.

Example 1 – Graph $y = 5^x$



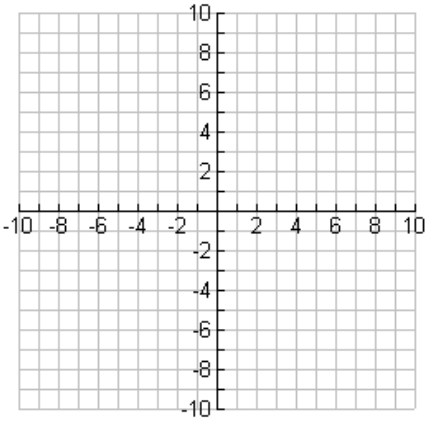
Domain_____Range_____

Asymptotes

End Behavior:

Example 2 – Graph $y = -\left(\frac{7}{2}\right)^x$

Let's make predictions before we grab our GC.



Domain_____Range_____

Asymptotes

End Behavior:

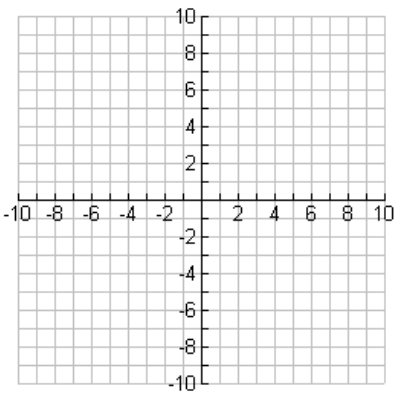
Example 3 – Graph $y = 2 \cdot 4^{x+2} + 1$. State the domain and range. (complete this example with your EB)
Let's make predictions before we grab our GC.

1. Growth or decay? Why?

2. Flipped or not flipped? Why?

3. What will the x+2 do to the graph?

4. What will the +1 do to the graph?



Domain_____

Range_____

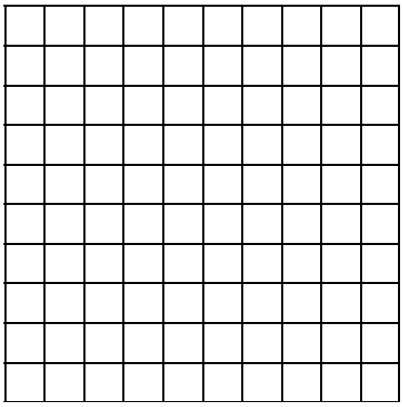
End Behavior:

Example 4 – In 1970, the population of Kern County, California, where Bakersfield is located, was about 330,000. From 1970 to 2000, the county population grew at an average annual rate of about 2.4%.

a. Write an exponential growth model giving the population P of Kern County in 1990?

b. About how many people lived in Kern County in 1990?

c. Graph the model.



KEY CONCEPT *For Your Notebook*

Compound Interest

Consider an initial principal P deposited in an account that pays interest at an annual rate r (expressed as a decimal), compounded n times per year. The amount A in the account after t years is given by this equation:

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

Formula for Continuous Compounding:

$a = Pe^{rt}$

P=principal

r=annual interest rate

t=years

Example 5 – You deposit $5,500 in an account that pays 3.6% annual interest. Find the balance after 3 years if interest is compounded with the given frequency.

a. semiannually

b. monthly (complete this with your elbow buddy)

c. Continuously

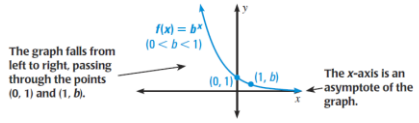
(Wait!!) If interest is compounded round-the-clock we need the shampoo formula.

Let's get to our 3:00 appointment!

KEY CONCEPT *For Your Notebook*

Parent Function for Exponential Decay Functions

The function $f(x) = b^x$, where $0 < b < 1$, is the parent function for the family of exponential decay functions with base b. The general shape of the graph of $f(x) = b^x$ is shown below.



The domain of $f(x) = b^x$ is all real numbers. The range is $y > 0$.

Exponential Growth: $y = a(b)^x$

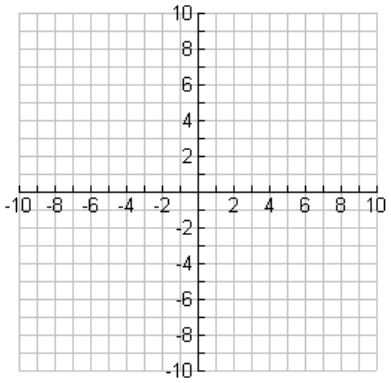
- $b > 1$
- As x values increase the graph moves away from the HA towards $\pm\infty$.

Exponential Decay: $y = a(b)^x$

- $0 < b < 1$
- As x values increase the graph moves towards the HA.

Example 6 – Graph $y = \left(\frac{1}{5}\right)^x$

Predictions?

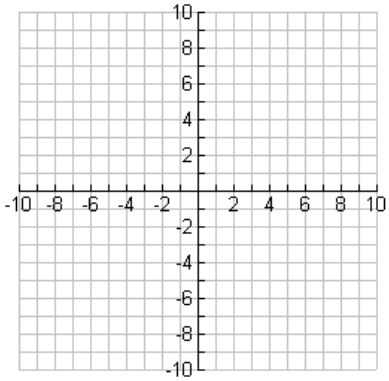


Domain_____Range_____

End Behavior:

Example 7 – Graph $y = -2\left(\frac{3}{4}\right)^x$

Predictions?



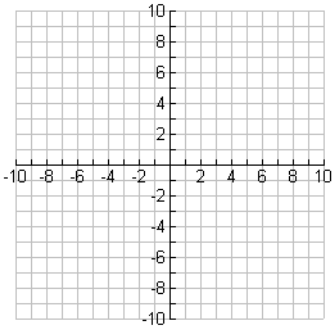
Domain_____Range_____

End Behavior:

Complete Ex. 8 & 9 in your 3:00 appointment. Remember stretching is a good thing. Feel free to stand!

Example 8 – Graph $y = 2\left(\frac{1}{3}\right)^{x-2} + 1$.

Predictions?



Domain_____

Range_____

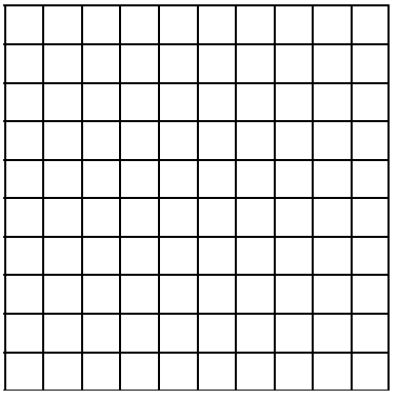
End Behavior:

Example 8: Fill in the blank: For exponential decay…

- The closer b is to 1, the _____ the decay.
- The closer b is to 0 , the _____ the decay.

Example 9 – A new car costs $25,000. The value of the car decreases by 15% each year.
a. Write an exponential decay model giving the car's value y (in dollars) after t years. Estimate the value after 4 years.

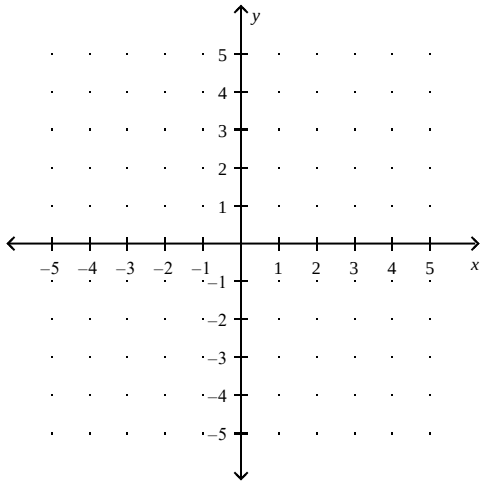
b. Graph the model.



c. Use the graph to estimate when the value of the car will be $8,000.

Make predictions for Ex. 10 in your 3:00 appointment. Feel free to stand!
Example 10 – On your appointment discuss what you think the negative exponent will do to the graph. Work on graphing the function as well as the information on the left.
$f(x) = 5^{-x}$

Table:



Domain:

Range:

Asymptotes:

End behavior:

Increasing/Decreasing? Where?

Let's Kahoot it up!

Homework: P. 166-169 #1-5 (odd), 11-15 (odd), 21-25 (odd), 35, 70-72 (all).

Sketch and analyze the graph of each function. Describe its domain, range, intercepts, asymptotes, end behavior, and where the function is increasing or decreasing.

1. $f(x) = 2^{-x}$

3. $h(x) = 0.2^{x+2}$

5. $m(x) = -(0.25)^x$

Use the graph of f(x) to describe the transformation that results in the graph of g(x). Then, sketch the graphs of f(x) and g(x).

11. $f(x) = 4^x;\ g(x) = 4^x - 3$

13. $f(x) = 3^x; g(x) = -2(3^x)$

15. $f(x) = 10^x; g(x) = 10^{-x+3}$

Copy and complete the table below to find the value of an investment A for the given principal P, rate r, and time t if the interest if compounded n times.

n	1	4	12	365	continuously
A					

21. P=$500, r=3%, t=5 years
23. P=$1000, r=5%, t=20 years

25. Brady acquired an inheritance of $20,000 at age 8, but will not have access to it until he turns 18.
a. If his inheritance is placed in a savings account earning 4.6% interest compounded monthly, how much will Brady's inheritance be worth on his 18th birthday?

b. How much will Brady's inheritance be worth if it is placed in an account earning 4.2% interest compounded continuously?

35. Jordan wrote an exponential equation to model the cost of gasoline. He found the average cost per gallon of gasoline for two years and used the data for his model.

Average Cost per Gallon of Gasoline

Year	Cost($)
1990	1.19
2007	3.86

a. If the average cost of gasoline increased at an exponential rate, identify the rate of increase. Write an exponential equation to model this situation.
b. Use your model to predict the average cost per gallon of gasoline in 2011 and 2013.
c. When will the average cost per gallon of gasoline exceed $7?
d. Why might an exponential model not be an accurate representation of average gasoline prices?

Find the domain of each function and the equations of any vertical or horizontal asymptotes.

70. $f(x) = \dfrac{3}{x^2 - 4x + 4}$

71. $f(x) = \dfrac{x-1}{x^2 + 4x - 5}$

72. $f(x) = \dfrac{x^2 - 8x + 16}{x - 4}$