ALGEBRA UNIT 9 EXPONENTIAL FUNCTIONS

EXPONENTIAL GROWTH

$$y = a \cdot b^x$$

a →

b →

x →

Example:

Suppose your school has 4512 students this year. The student population is growing 2.5% each year.

a) Write an equation to model the student population.

b.) What will the population be in 3 years?

EXPONENTIAL DECAY

$$y = a \cdot b^x$$

a →

b →

x →

WHAT IS THE DIFFERENCE BETWEEN GROWTH AND DECAY EQUATIONS?

Example:

The value of a $1200 computer decreases 27% annually. What will be the value of the computer after 3 years?

Graphing Exponential Functions

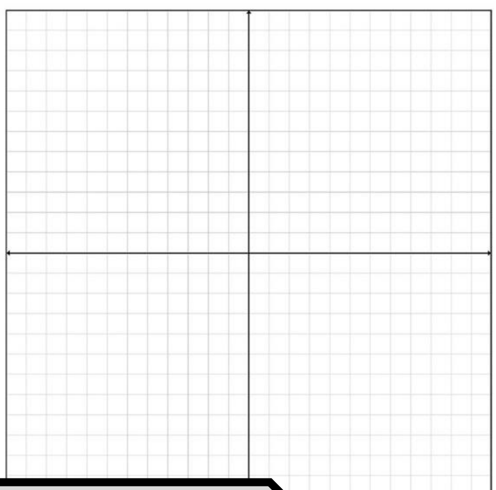
$$f(x) = b^x$$

Domain:

Range:

EXPONENTIAL DECAY:

EXPONENTIAL GROWTH:



EXAMPLE:

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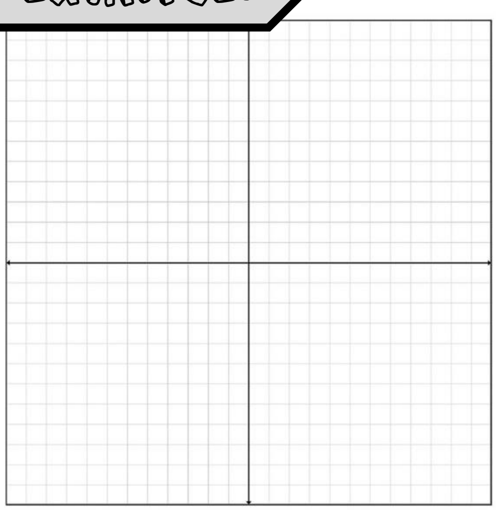

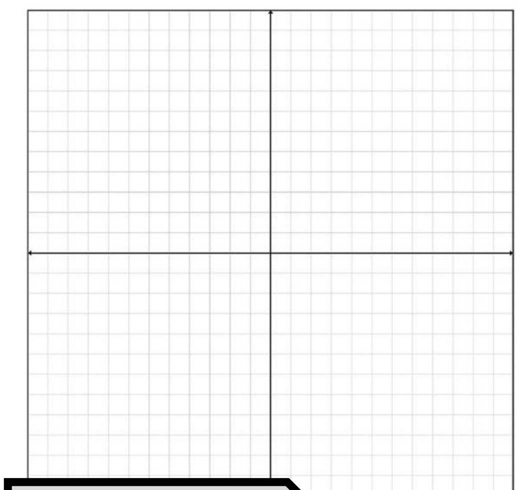

EXAMPLE:

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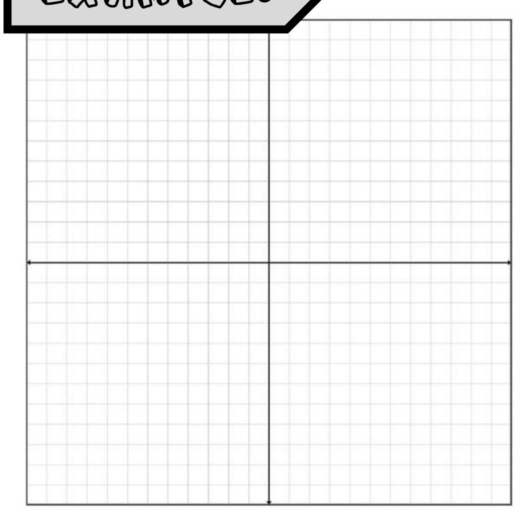


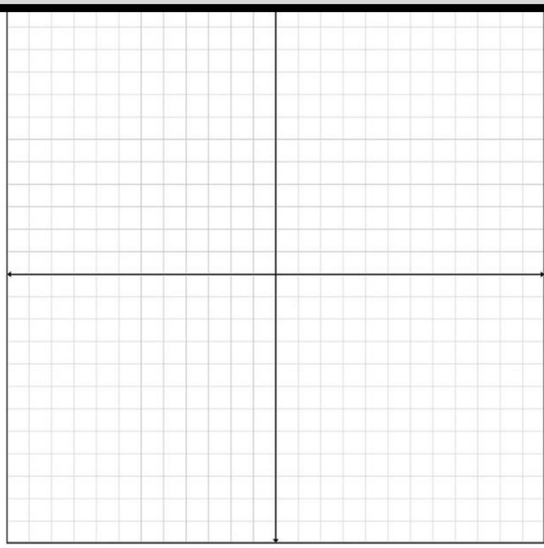
Domain and Range

DOMAIN:

RANGE:

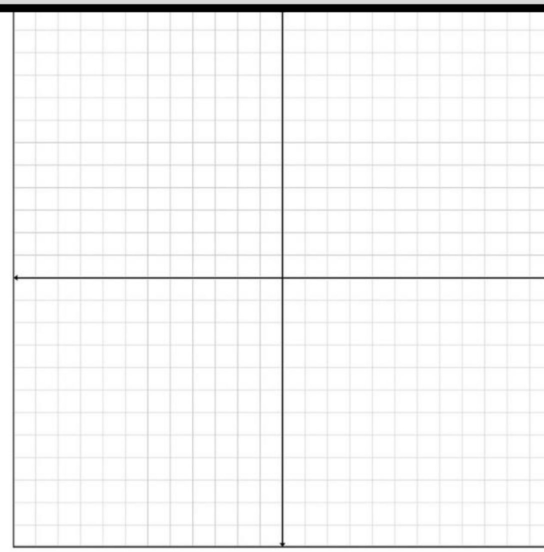
ASYMPTOTE:

$F(X) = 0.5^x$



x-intercept:
y-intercept:
domain:
range:

$F(X) = 2^x$



x-intercept:
y-intercept:
domain:
range:

TABLES

EQUATIONS

SITUATIONS

GRAPHS

COORDINATES

Linear

versus

Exponential

TABLES

EQUATIONS

SITUATIONS

GRAPHS

COORDINATES

EXPONENTIAL GROWTH

1. In 1990, the cost of tuition at a state university was \$4300. The tuition increases at a rate of 4% each year.
    a. How much would it cost to attend the university in 2010?

    b. How much would it cost to attend in 2025?

2. You buy a house for \$130,000. It appreciates 6% per year. How much is it worth in 10 years?

3. If you invest \$40 in an account for 10 years at a 3% interest rate how much money will you have?

4. If you invest \$2040 in an account with 5% interest rate for 15 years how much money will you have?

5. You invested \$475 in an account with 8.5% interest for 12 years. How much money will you have at the end of 12 years?

6. A population of 100 frogs increases at an annual rate of 22%. How many frogs will there be in 5 years?

7. A type of bacteria has a very high exponential growth rate at 80% *every hour*. If there are 10 bacteria, determine how many there will be in 5 hours, in 1 day and in 1 week?

8. A species of extremely rare, deep water fish has an extremely long lifespan and rarely have children. If there are a total 821 of this type of fish and their growth rate is 2% *each month*, how many will there be in half of a year? What will be the population be in 10 years and in 100 years?

9. $1000 invested with compound interest at a rate of 15% per year for 9 years.

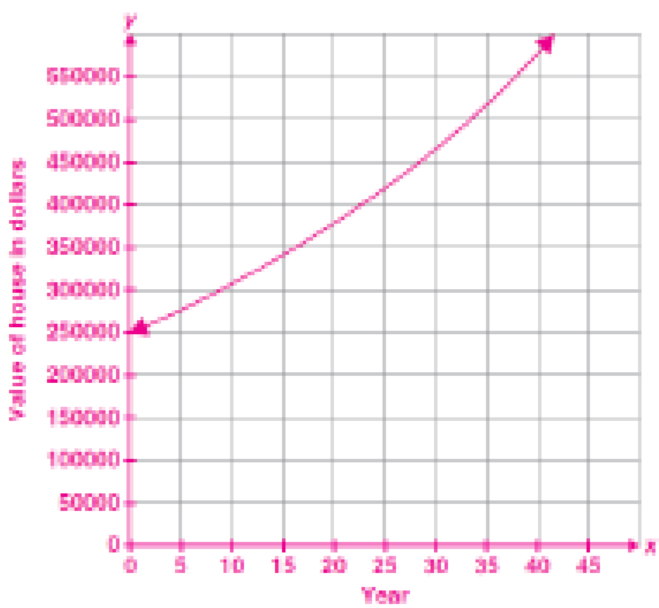
10. $400 invested with compound interest at a rate of 3% per year for 2 years.

11. $1250 invested with compound interest at a rate of 5% per year for 4 years.

12. $1400 invested with compound interest at a rate of 9% per year for 6 months.

13. $600 invested with compound interest at a rate of 4% per year for 10 years.

14. Use the graph to determine when ....



a. The house will be worth $350,000.

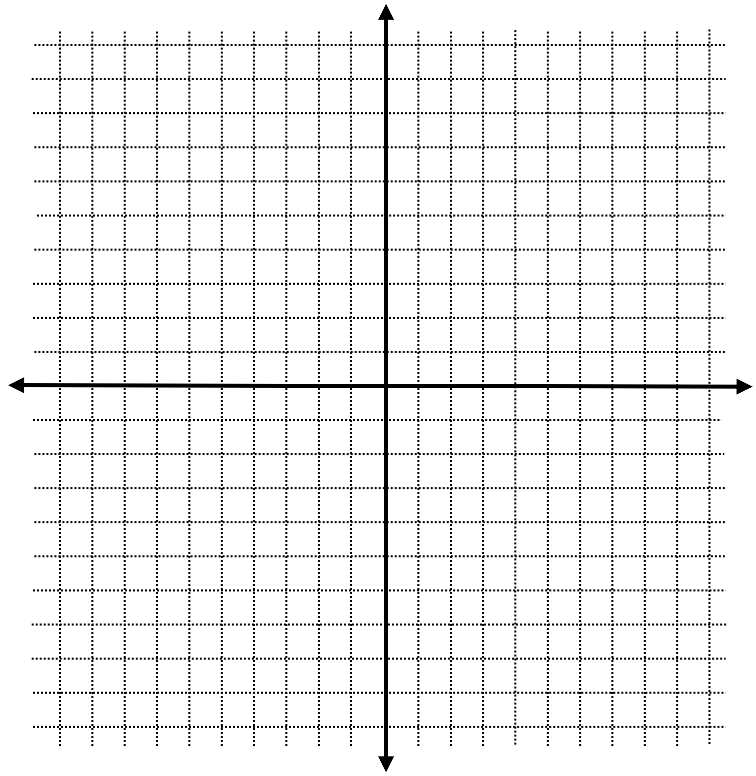
b. The house will be worth $400,000.

c. The house will be worth $520,000.

Graphing Exponential Functions

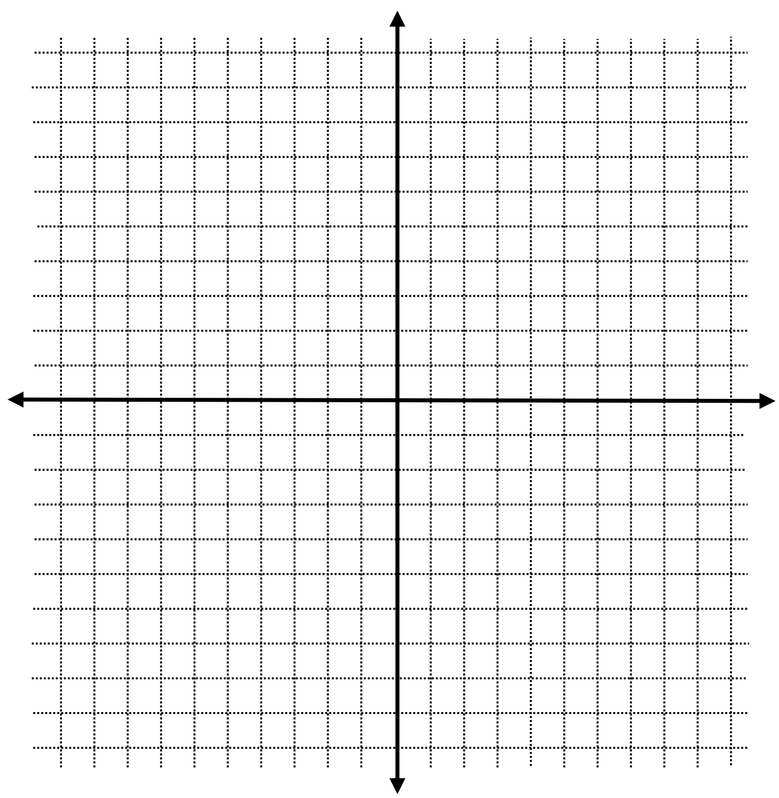
1. $f(x) = 4^x$

x	y
- 3	
- 2	
- 1	
0	
1	
2	
3	



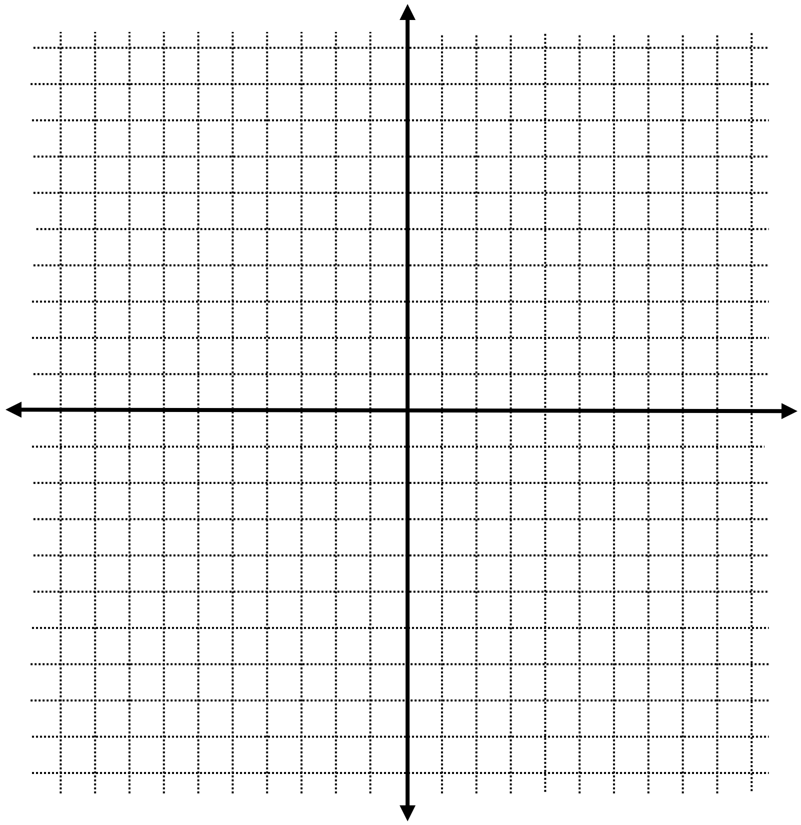
2. $f(x) = 0.5^x$

x	y
- 3	
- 2	
- 1	
0	
1	
2	
3	



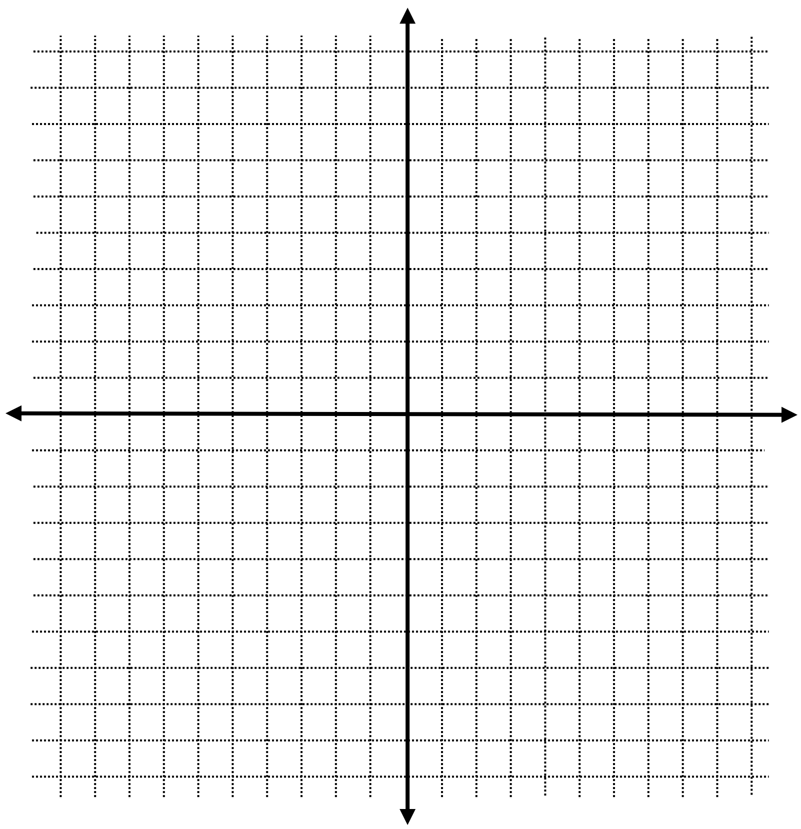
3. $f(x) = 1.25^x$

x	y
- 3	
- 2	
- 1	
0	
1	
2	
3	



4. $f(x) = 2^{\frac{x}{2}}$

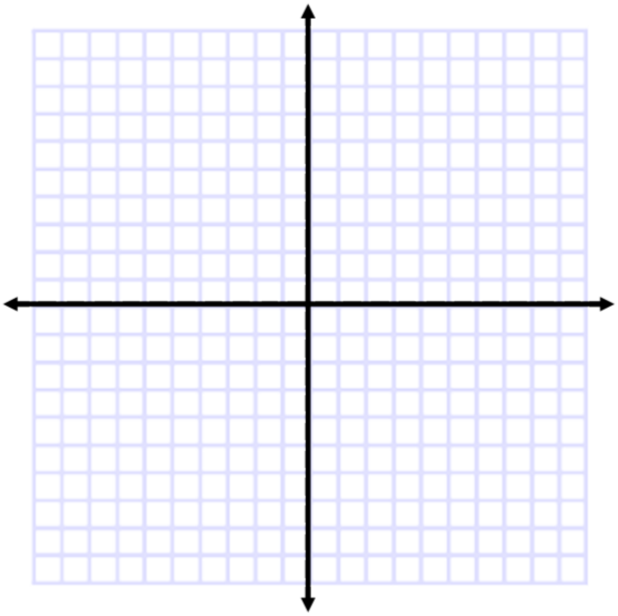
x	y
- 3	
- 2	
- 1	
0	
1	
2	
3	



Graphing Exponential Functions

Part 1:

Graph the function $f(x) = 2^x$ and sketch the graph on the grid provided below. Create a table of values to help you graph.



1.) Is the graph increasing or decreasing? Explain your answer.

2.) Use your table of data points to help you answer the following question.

a.) As the value of x gets very large (5, 10, 15, etc.), what happens to the value of 2^x?

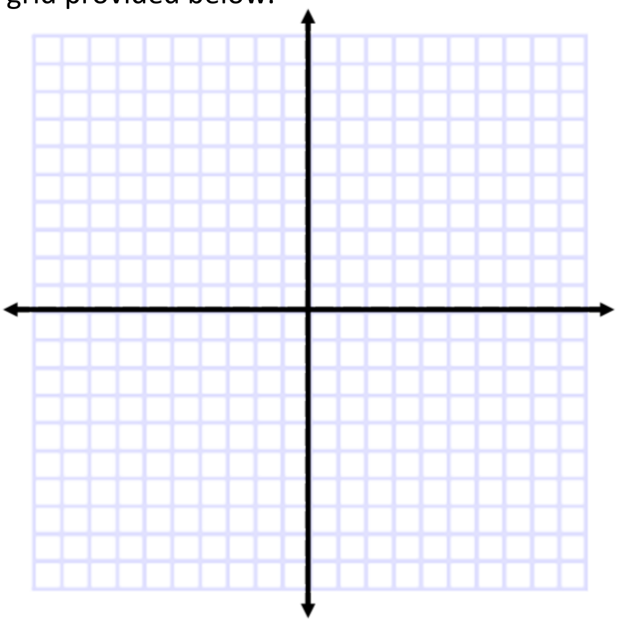
b.) As the value of x gets very small (-15, -10, -5, etc.), what happens to the value of 2^x?

3.) Will the value of 2^x ever equal 0? Explain your answer.

4.) Are there any values of x that would make 2^x undefined? Explain your answer.

Part 2:

Graph the function $f(x) = 3^x$ along with the graph of $f(x) = 2^x$ from Part I, and sketch the graph of $f(x) = 3^x$ on the grid provided below.



1.) Is the graph increasing or decreasing? Explain your answer.

2.) Use your table of data points to help you answer the following question.

a.) As the value of x gets very large (5, 10, 15, etc.), what happens to the value of 3^x?

b.) As the value of x gets very small (-15, -10, -5, etc.), what happens to the value of 3^x?

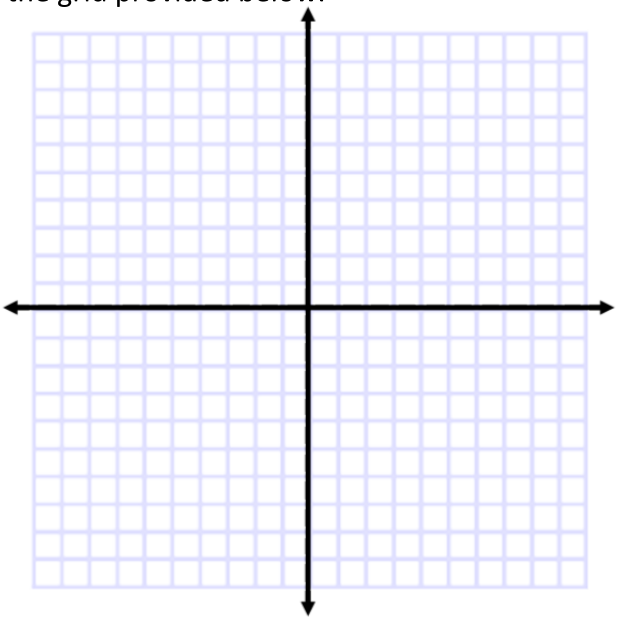
3.) How does the graph of $y = 3^x$ compare to the graph of $y = 2^x$?

4.) a. Given the general form $f(x) = a^x$ (where $a > 1$), what effect does increasing the value of "a" have upon the graph?

b. What effect does decreasing the value of "a" have upon the graph?

Part 3:

Graph the function $f(x) = 0.5^x$ along with the graph of $f(x) = 2^x$ from Part I, and sketch the graph of $f(x) = 0.5^x$ on the grid provided below.



1.) Is the graph increasing or decreasing? Explain your answer.

2.) Use your table of data points to help you answer the following question.

a.) As the value of x gets very large (5, 10, 15, etc.), what happens to the value of 0.5^x?

b.) As the value of x gets very small (-15, -10, -5, etc.), what happens to the value of 0.5^x?

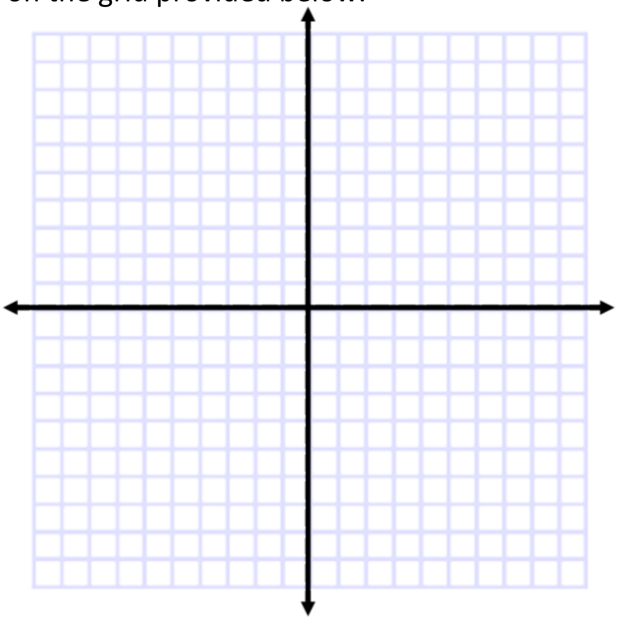
3.) Will the value of 0.5^x ever equal 0? Explain your answer.

4.) Are there any values of x that would make 0.5^x undefined? Explain your answer.

5.) How does the graph of $y = 0.5^x$ compare to the graph of $y = 2^x$?

Part 4:

Graph the function $f(x) = 0.8^x$ along with the graph of $f(x) = 0.5^x$ from Part 3, and sketch the graph of $f(x) = 0.8^x$ on the grid provided below.



1.) Is the graph increasing or decreasing? Explain your answer.

2.) Use your table of data points to help you answer the following question.

a.) As the value of x gets very large (5, 10, 15, etc.), what happens to the value of 0.8^x?

b.) As the value of x gets very small (-15, -10, -5, etc.), what happens to the value of 0.8^x?

3.) Will the value of 0.8^x ever equal 0? Explain your answer.

4.) Are there any values of x that would make 0.8^x undefined? Explain your answer.

5.) How does the graph of $y = 0.8^x$ compare to the graph of $y = 0.5^x$?

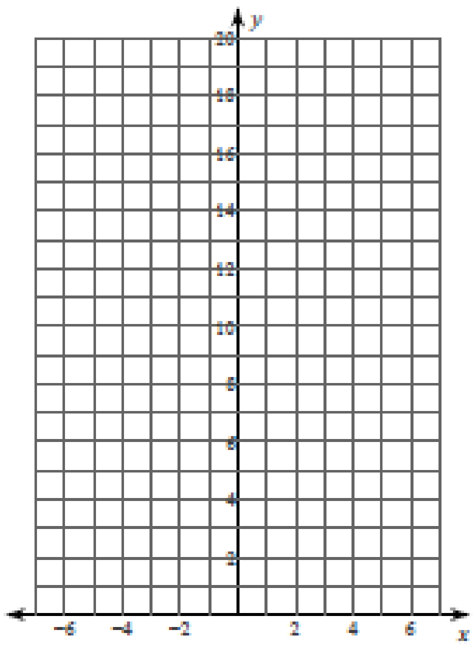
6.) a. Given the general form $f(x) = a^x$ (where $0 < a < 1$), what effect does increasing the value of "a" have upon the graph?

b. What effect does decreasing the value of "a" have upon the graph?

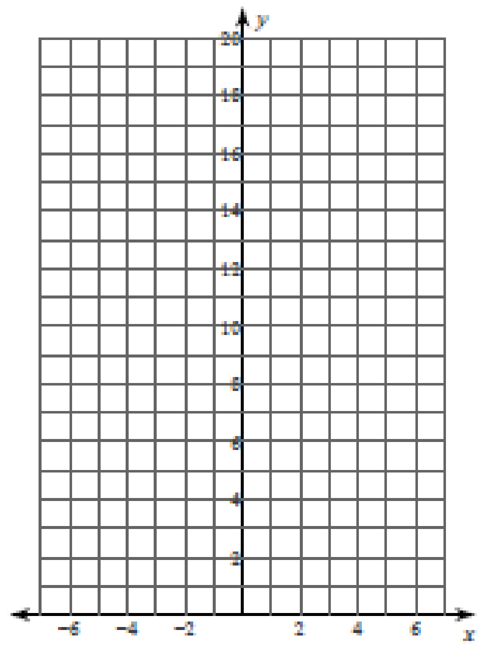
Write a response: Explain the similarities and differences between exponential functions when $a > 1$ versus $0 < a < 1$.

Graphing Exponential Functions

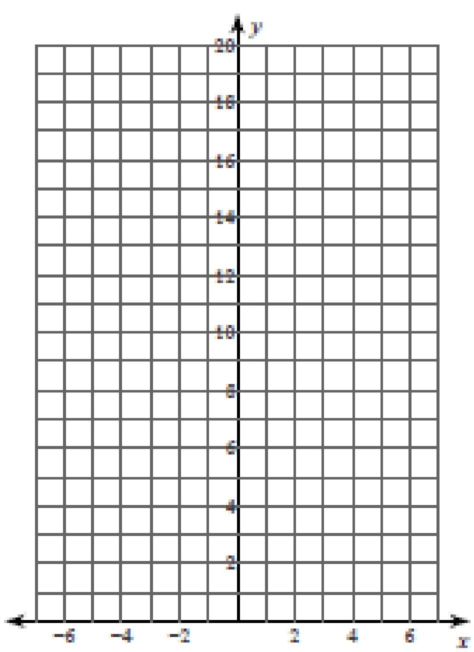
1) $y = 4 \cdot 2^x$



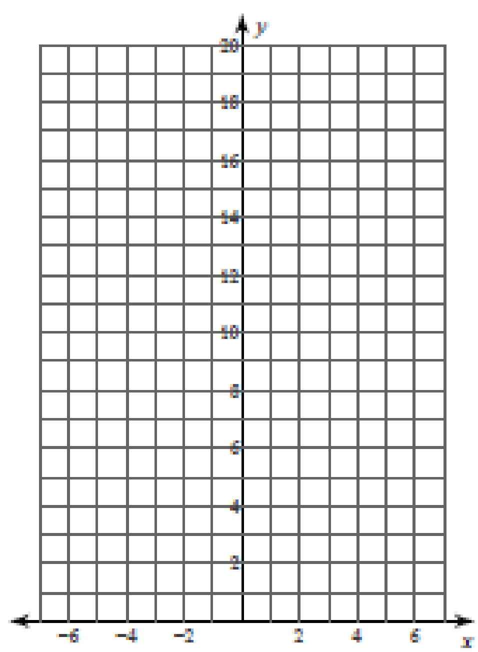
2) $y = 5 \cdot 2^x$



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



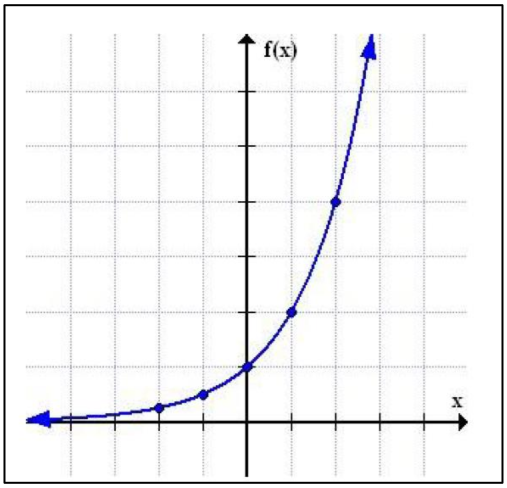
4) $y = 2 \cdot \left(\frac{1}{2}\right)^x$



Domain & Range of Exponential Functions

The domain of a function demonstrates the ______ values. The range of a function demonstrates the ______ values.

1.) Here is the graph of $f(x) = 2^x$.



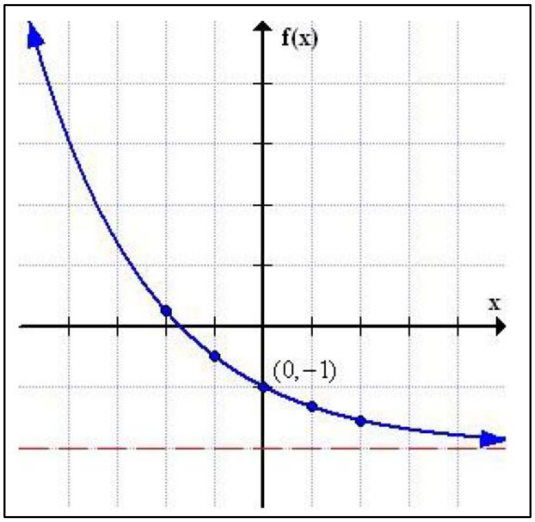
x-intercept: ______________________

y-intercept: ______________________

Domain: _________________________

Range: __________________________

2.) Here is the graph of $f(x) = \left(\frac{2}{3}\right)^x - 2$.



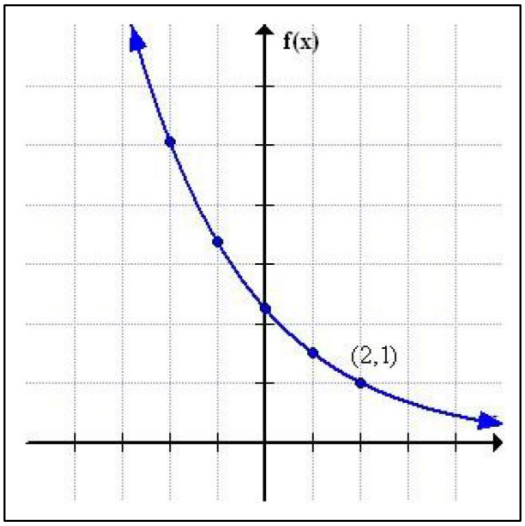
x-intercept: ______________________

y-intercept: ______________________

Domain: _________________________

Range: __________________________

3.) Here is the graph of $f(x) = \left(\frac{2}{3}\right)^{x-2}$.



x-intercept: ______________________

y-intercept: ______________________

Domain: _________________________

Range: __________________________

4.) $y = 100 \cdot (2)^x$

What is the domain of the situation? Explain your answer.

What is the range of the situation? Explain your answer.

5.) $y = 2 \cdot (100)^x$

What is the domain of the situation? Explain your answer.

What is the range of the situation? Explain your answer.

6.) $y = 20 \cdot (2)^x$

What is the domain of the situation? Explain your answer.

What is the range of the situation? Explain your answer.

7.) $y = 2 \cdot (20)^x$

What is the domain of the situation? Explain your answer.

What is the range of the situation? Explain your answer.

8.) $y = 2.5^x$

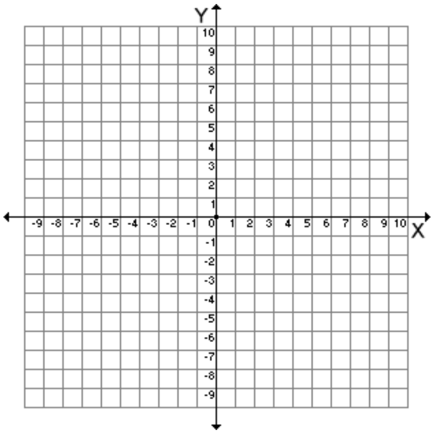
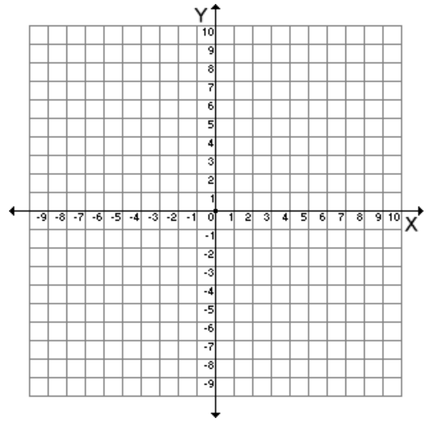
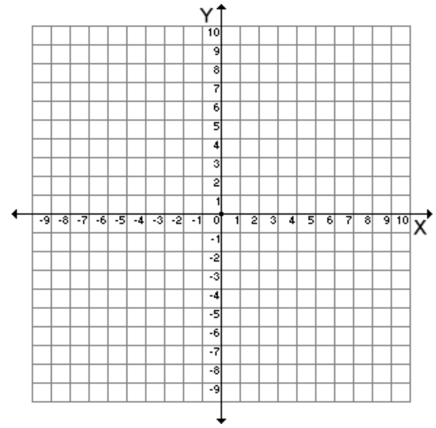
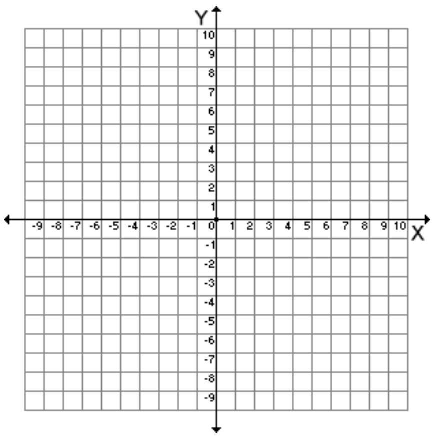
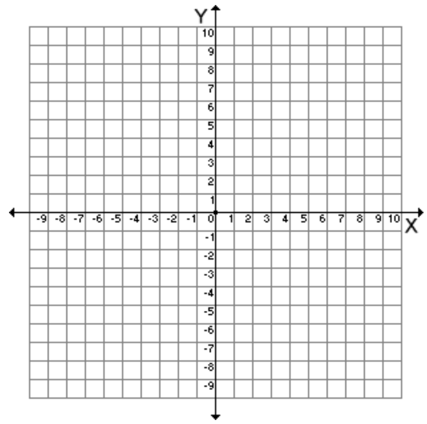
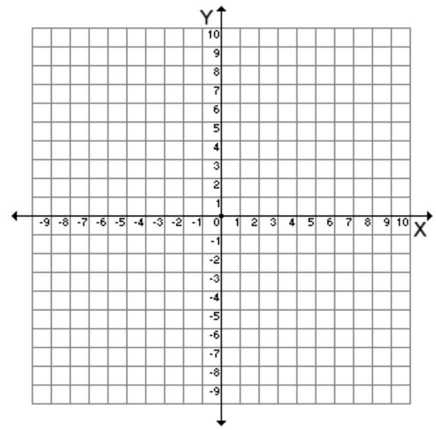
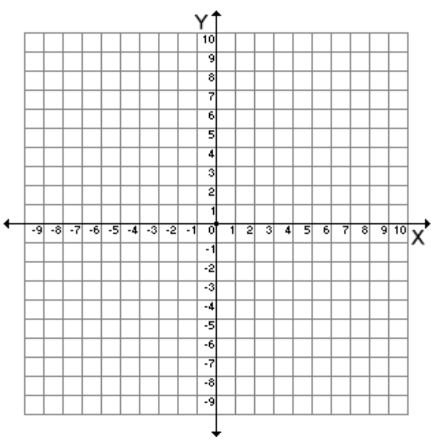
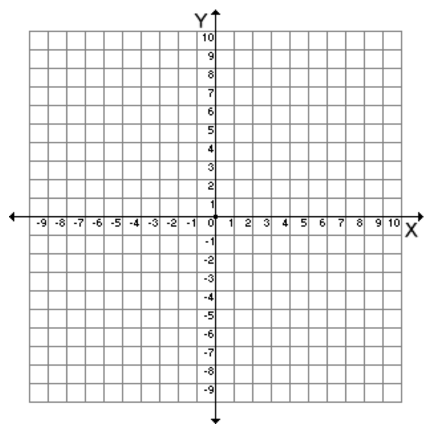
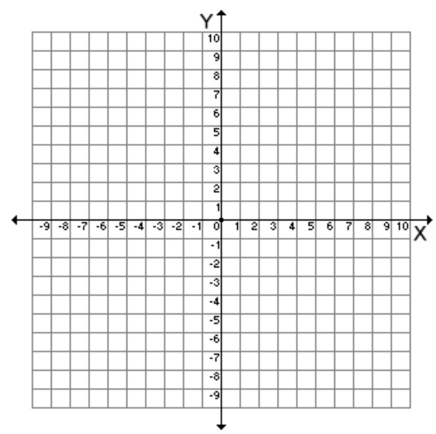
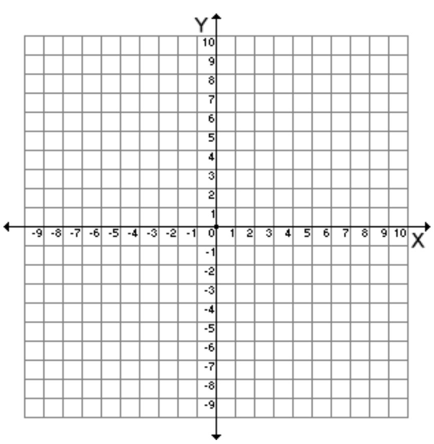
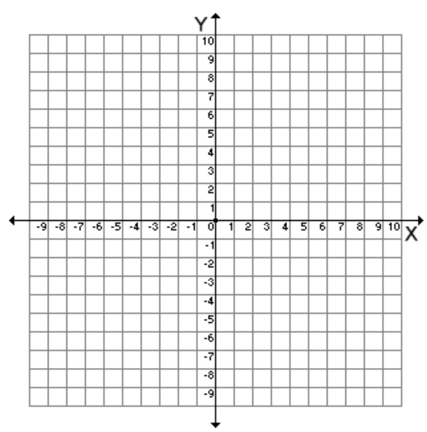
What is the domain of the situation? Explain your answer.

What is the range of the situation? Explain your answer.

Domain & Range for Exponential Functions

Directions: Plot at least 5 Points for each graph & Complete the Chart:

Equation	Equation of Asymptote	Domain	Range	Increasing or Decreasing
1. $y = 3^x$				
2. $y = 3^x - 2$				
3. $y = 3^{(x-2)}$				
4. $y = 3^{(x+1)} + 2$				
5. $y = 3^{-x}$				
6. $y = \left(\frac{1}{3}\right)^x$				
7. $y = \left(\frac{1}{3}\right)^x - 2$				
8. $y = \left(\frac{1}{3}\right)^{(x-2)}$				
9. $y = \left(\frac{1}{3}\right)^{(x+1)} + 1$				
10. $y = \left(\frac{1}{3}\right)^{-x}$				
11. $y = 2\left(\frac{1}{3}\right)^x$				

Linear vs. Exponential TGECS

Linear vs. Exponential Tables

Determine if each table is linear or exponential. **Defend** your answer. **Determine** the slope OR the growth factor.

1.)

X	f(x)
0	**1**
1	**3**
2	**9**
3	**27**

2.)

X	f(x)
0	**1**
1	**3**
2	**5**
3	**7**

3.)

X	f(x)
0	**64**
1	**32**
2	**16**
3	**8**

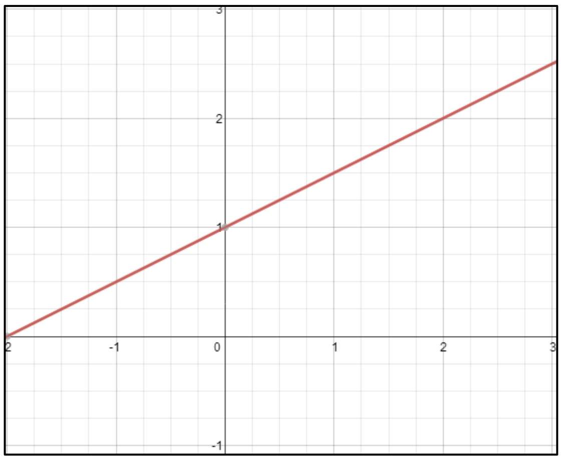
4.)

X	f(x)
0	**1**
1	**4**
2	**7**
3	**10**

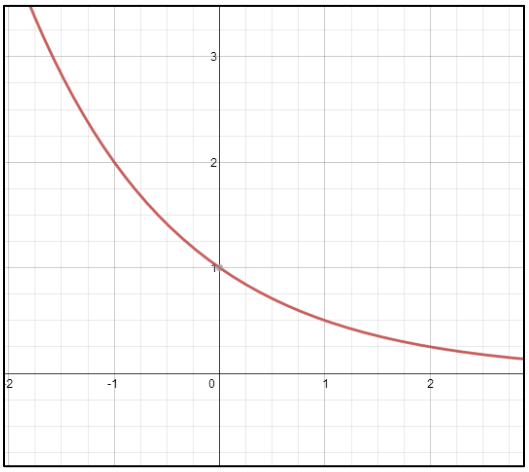
Linear vs. Exponential Graphs

Determine if each graph is linear or exponential. **Defend** your answer.

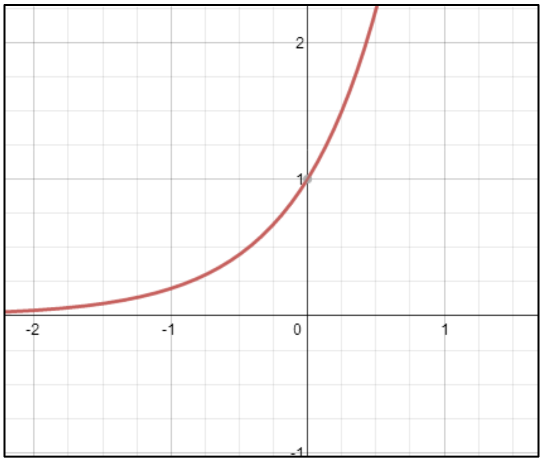
5.)



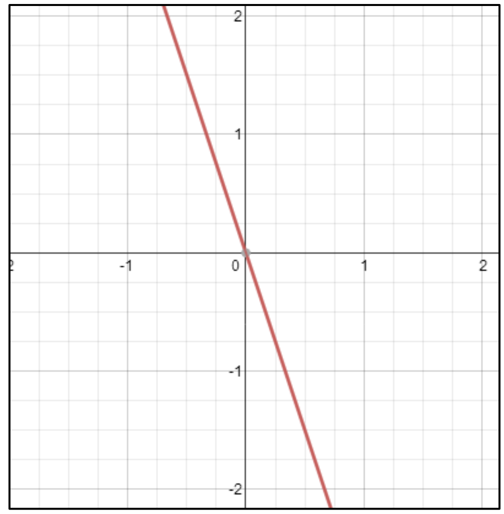
6.)



7.)



8.)



Linear vs. Exponential Equations

Determine if each equation is linear or exponential. **Defend** your answer. **Determine** the slope OR the growth factor.

9.) $f(x) = 3^{x-1} + 2$

10.) $f(x) = 3x + 2$

11.) $y = \frac{1}{2}x$

12.) $y = \left(\frac{1}{2}\right)^x$

Linear vs. Exponential Coordinates

Determine if each set of coordinates is linear or exponential. **Defend** your answer.

13.) $(0,0)$, $(-1,1), (1,-1), (2,-2)$

14.) $(-1,4), \left(-\frac{1}{2},2\right), (0,1), \left(1,\frac{1}{4}\right)$

15.) $(0,1), \left(1,1\frac{1}{4}\right), \left(2,1\frac{1}{2}\right), \left(-1,\frac{3}{4}\right)$

16.) $(0,1), \left(-1,\frac{1}{4}\right), (1,4), \left(1\frac{1}{2},8\right)$

Linear vs. Exponential Situations

Determine if each situation is linear or exponential. **Defend** your answer.

17.) The amount of money you earn each hour is $9.00.

18.) The amount of money you will make if you salary doubles each month.

19.) A phone company charges a monthly rate of $25 and $0.10 per minute.

20.) The original value of a painting is $9,000 and the value increases by 7% each year.