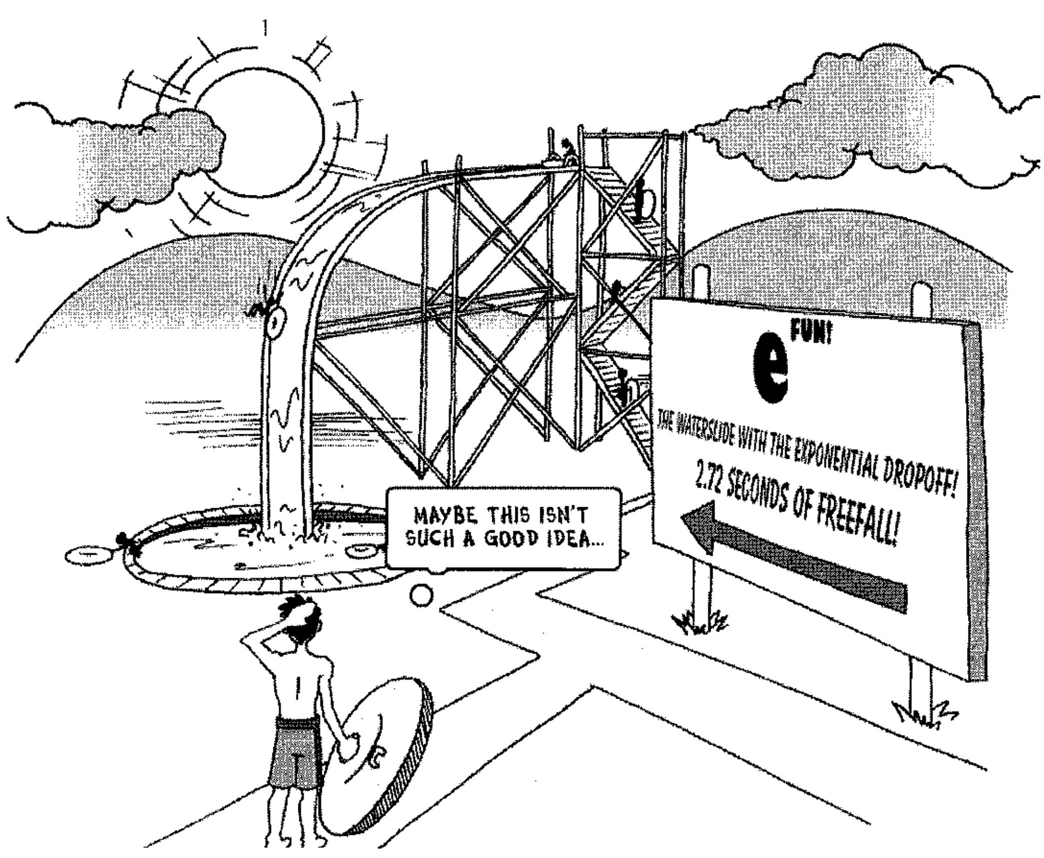
Name:______________________________________ Period:_____

Exponential Functions

NOTE: YOU WILL NEED GRAPH PAPER FOR THIS UNIT. MAKE SURE YOU BRING IT TO CLASS EVERYDAY. YOU CAN PRINT SOME OFF GOOGLE IF YOU NEED TO.

Day	Topic/EQ	Classwork/Homework
Thursday January 14	What in the World is an Exponential Function? Characteristics of exponential functions?	Pages 1-4
Friday January 15	Graphing Exponential Functions	Pages 5a – 8
Monday January 18	NO SCHOOL!!!!	
Tuesday January 19	Solving Exponential Functions	Pages 9-11
Wednesday January 20	Help Session 10:30 – 11:30 am	
Thursday January 21	Solving Exponential Functions	Page 12
Friday January 22	Average Rate of Change Over Functions	Pages 13-18
Monday January 25	QUIZ Exponential Functions	Get caught up on homework
Tuesday January 26	Introduction to Exponential Word Problems (Growth and Decay)	Pages 19-21
Wednesday January 27	Help Session 10:30 -11:30 am	
Thursday January 28	Exponential Word Problems Money Problems $A = P(1+\frac{r}{n})^{nt}$ $A = P(1-r)^t$ $A = P(1+r)^t$ $A = Pe^{rt}$	Pages 22-28

Friday January 29	Exponential Word Problems Money Problems $A = P(1+\frac{r}{n})^{nt}$ $A = P(1-r)^t \quad A = P(1+r)^t$ $A = Pe^{rt}$ Appreciation and Depreciation PPT	Pages 29-31
Monday February 1	Exponential Word Problems Characteristics Warm-Up $A = P(1+\frac{r}{n})^{nt}$ $A = P(1-r)^t \quad A = P(1+r)^t$ $A = Pe^{rt}$ *Money Problems Practice with Pert WS* Ticket out the Door: Money Madness!	Pages 32-33
Tuesday February 2	Exponential Stations (graphing, characteristics, word problems, average rate of change, transformations)	Review sheet pages 34-37
Wednesday February 3	Help Session 10:30 -11:30 am	
Thursday February 4	TEST	



EXPONENTIAL EXPLORATION ACTIVITY:

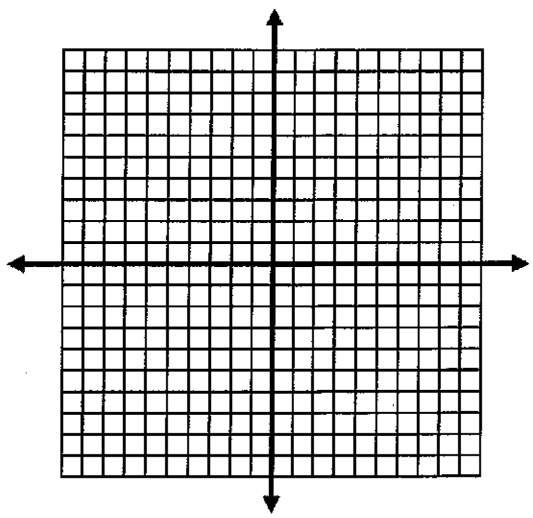
Today we will learn what an exponential function is and how it behaves graphically!!!

What is an exponential function?

How does it look graphically? Good question! Pull out your graphing calculators and let's get started!

1) In your graphing calculator, go to y= and enter in $y=2^x$, then hit "graph". Pull up the table of values and make your t-chart here:

x	y



2) Now go back to your y = and type in the following graphs, explain what happens each time compared to the graph from #1.

a) $y=2^{x-2}$ ____________________________________

b) $y = 2^{x+2}$ ____________________________________

c) $y = 2^x - 1$ ____________________________________

d) $y = 2^x + 1$ ____________________________________

e) $y = (3)2^x$ ____________________________________

f) $y = (1/2)2^x$ ____________________________________

g) $y = -2^x$ ____________________________________

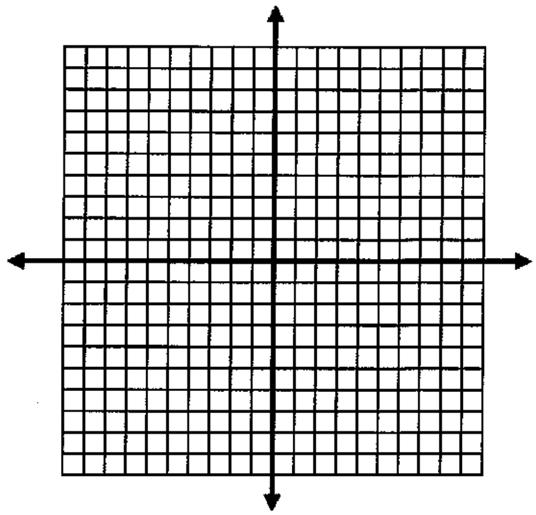
h) $y = 2^{-x}$ ____________________________________

i) $y = (3)2^{x+1} - 1$ ____________________________________

Now let's graph!

$y = 3^{x-1}$

x	y



Characteristics:

Domain:____

Range:____

Asymptote:______________________________________

y-intercept:______________________________________

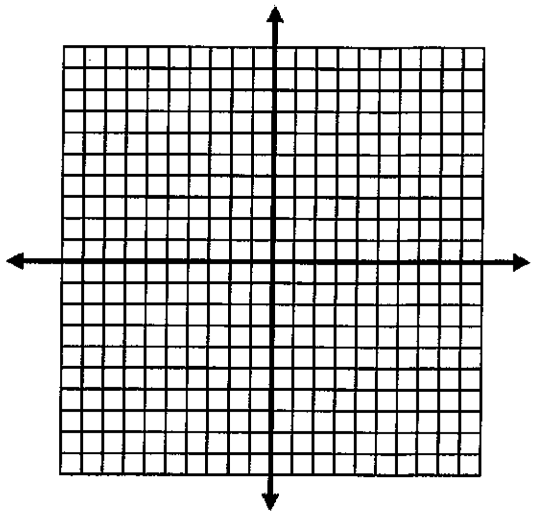
x-intercept:______________________________________

end behavior:____________________________________

interval of increase/decrease:________________________

$y = 2^x + 2$

x	y



Characteristics:

Domain:____________________________________

Range:____________________________________

Asymptote:____________________________________

y-intercept:____________________________________

x-intercept:____________________________________

end behavior:____________________________________

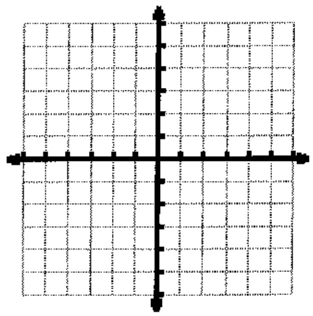
interval of increase/decrease:________________________

CCGPS A – Linear and Exponential Functions **Name** ________________
Graphing Exponential Functions

Exponential Functions: $\mathbf{y = b^x}$, where b is a positive number other than 1

Graph $y = 2^x$ using a t-chart.

X	Y

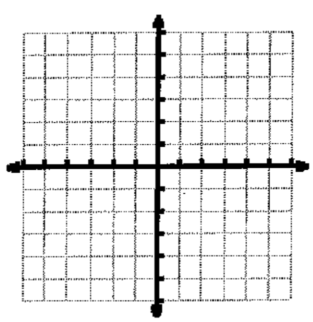


Asymptote - a line that a graph <u>approaches</u> as you move away from the origin; the graph hugs the asymptote

General Exponential Function $y = a(b^{x-h}) + k$

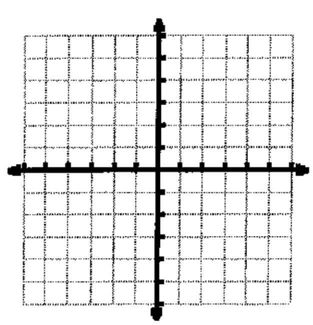
- Sketch the horizontal asymptote with a dashed line ($y = k$)
- Find the y-intercept of the graph by evaluating the function when x=0.
- Use a t-chart to sketch the graph of $y = ab^x$
- Transform the graph
  - Multiply y value of each coordinate in t-chart by a – move pencil to this point.
  - Shift h units horizontally
  - Shift k units vertically

1. $y = 2^x + 3$



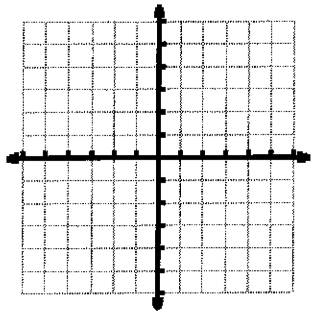
Y-intercept ________________
Asymptote ________________
Domain ________________
Range ________________
Growth or Decay
end behavior: ________________

2. $y = 2^{x+3} - 4$



Y-intercept ________________
Asymptote ________________
Domain ________________
Range ________________
Growth or Decay
end behavior: ________________

3. $y = 3^{x-2}$



Y-intercept ________________

Asymptote ________________

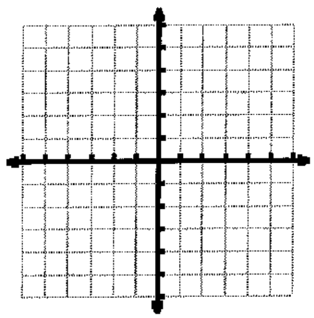
Domain ________________

Range ________________

Growth or Decay

end behavior: ________________

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



Y-intercept ________________

Asymptote ________________

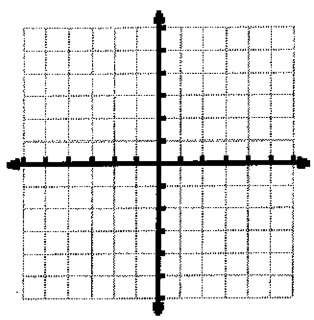
Domain ________________

Range ________________

Growth or Decay

end behavior: ________________

5. $y = \left(\frac{1}{3}\right)^x - 2$



Y-intercept ________________

Asymptote ________________

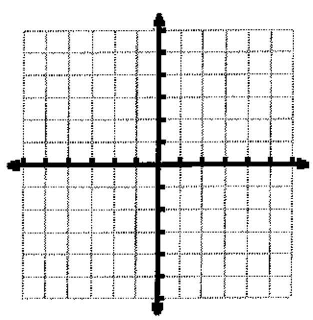
Domain ________________

Range ________________

Growth or Decay

end behavior: ________________

6. $y = -(3)^x$



Y-intercept ________________

Asymptote ________________

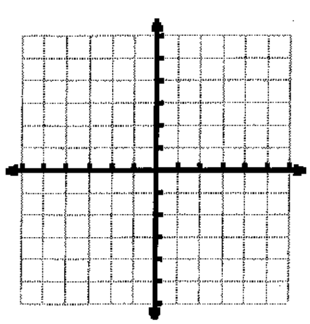
Domain ________________

Range ________________

Growth or Decay

end behavior: ________________

7. $y = 3 \bullet (2)^x - 4$



Y-intercept ________________

Asymptote ________________

Domain ________________

Range ________________

Growth or Decay

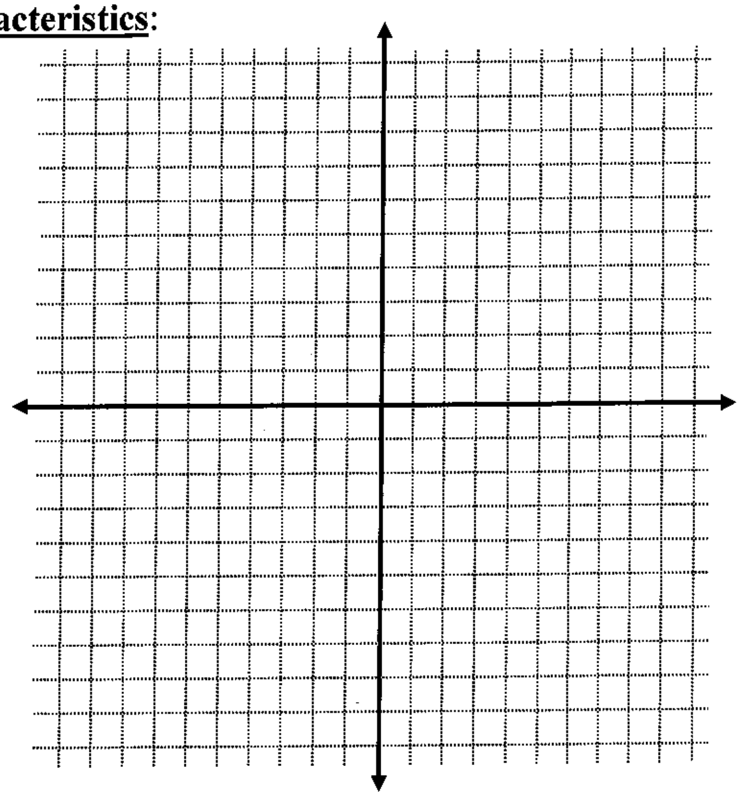
end behavior: ________________

Exponential Functions Worksheet Name_______________class_____

Graph the functions and **list all characteristics**:

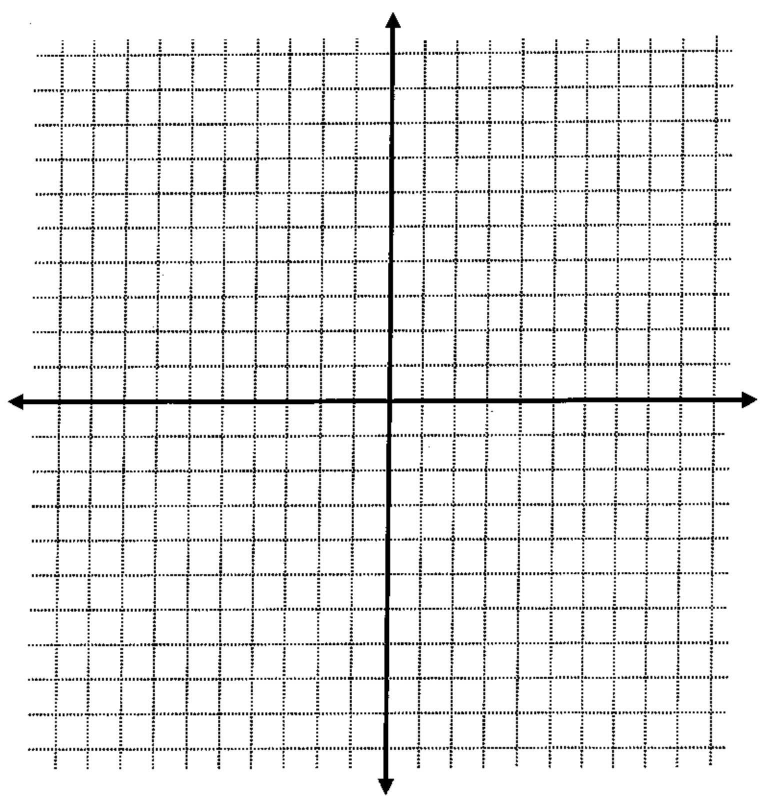
1. $f(x) = 4^x - 1$

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



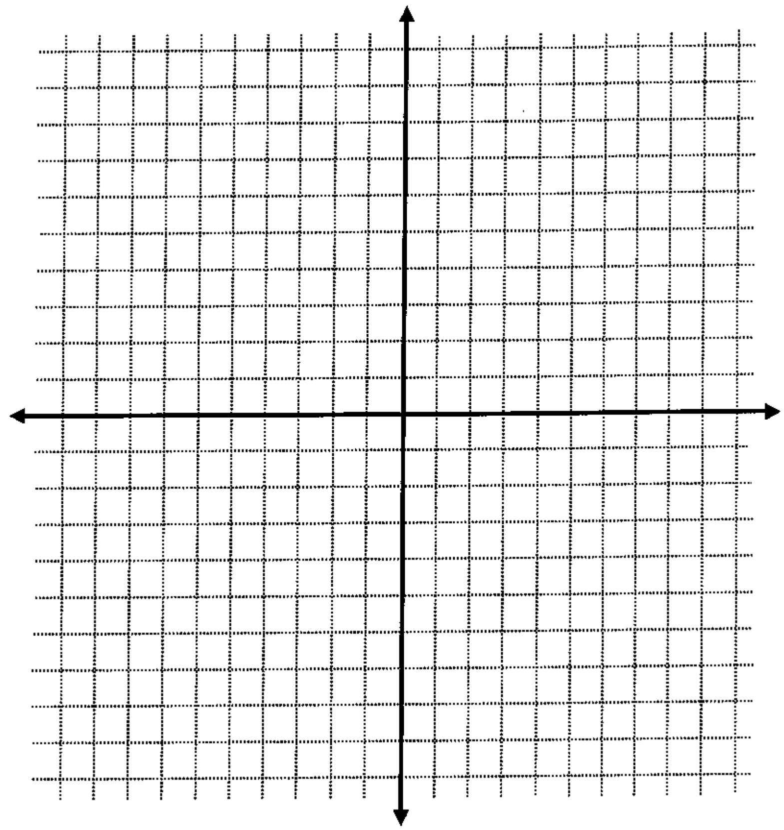
2. $f(x) = 0.5^x$

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



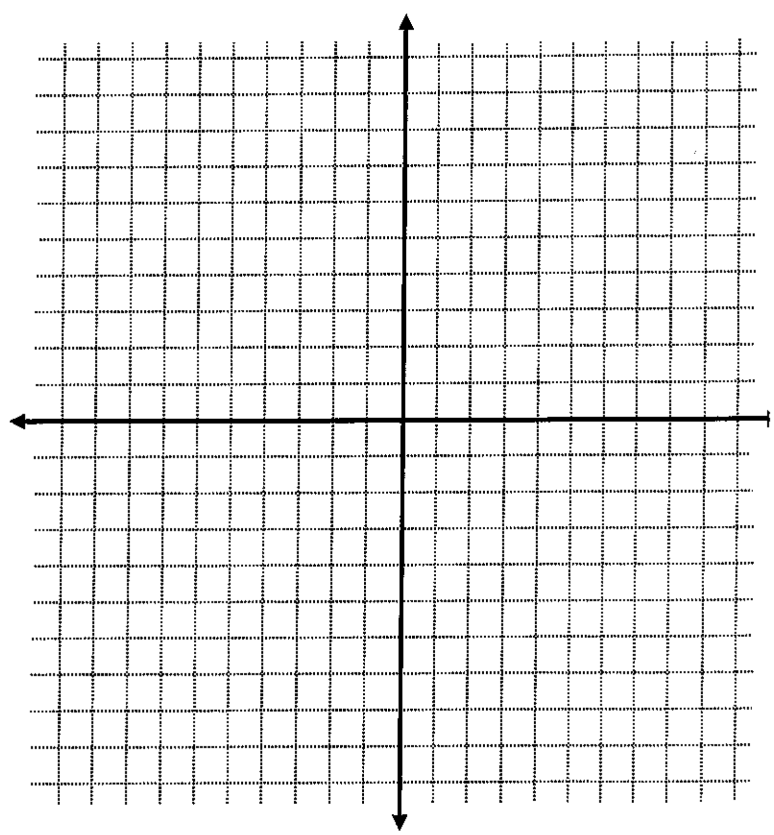
3. $f(x)=2\left(\frac{1}{2}\right)^x$

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



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

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



Transformations of Exp functions   Name: ____________________

Describe how the following graphs have been transformed from their original parent graph.

Original graph: $f(x)=5^x$

1. $f(x)=5^{x-1}$ — 1. ____________________
2. $f(x)=5^x+2$ — 2. ____________________
3. $f(x)=-5^x$ — 3. ____________________
4. $f(x)=3(5)^x$ — 4. ____________________
5. $f(x)=-\frac{1}{2}(5)^{x+2}-3$ — 5. ____________________

Original graph $y=2^x$

6. $y=2^{x-6}+1$ — 6. ____________________
7. $y=-2^{x+3}-3$ — 7. ____________________
8. $y=\frac{1}{3}(2)^x+8$ — 8. ____________________
9. $y=(-4)2^{x-1}$ — 9. ____________________
10. $y=8\cdot 2^{x+2}-5$ — 10. ____________________

Write an equation that has transformed $y=(\frac{1}{2})^x$ in the way that is described.

1. Up 6, to the left 1.
2. Reflected over the x axis, right 2, down 3
3. Stretch of 5, up 2
4. Reflected over the x axis, shrink of 1/3 , left 6, up
5. Stretch of 2, right 3, down 4

11. ____________________

12. ____________________

13. ____________________

14. ____________________

15. ____________________

Topic: **Transformations of graphs**

What is it? Shifting, stretching, shrinking, and reflecting of graphs

Types:

Vertical or Horizontal shift

Examples

Add outside $y = 2^x + 3$

MOVES ______________

Subtract outside $y = 2^x - 3$

MOVES ______________

Add inside $y = 2^{(x+3)}$

MOVES ______________

Subtract inside $y = 2^{(x-3)}$

MOVES ______________

Reflection

Multiply by negative (-) $y = -2^x$

Causes the graph to ______________

____

Vertical Stretch or Shrink

Multiply by Fraction (less than 1) $y = \frac{1}{4}(2)^x$

Causes the graph to ______________

Multiply by integer $y = 4(2)^x$

Causes the graph to ______________

Describing and Writing Transformations of Functions

1. Identify a, b, c, and d and describe what transformation(s) the graphs of the function $f(x)=4^x$ has undergone in each of the following cases.

$g(x)=4^{x-1}$

$h(x)=5(4^{x+4})$

$m(x)=4^x+5$

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

$r(x)=3\left(4^{-x}\right)-1$

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

2. Sketch the graphs of the transformations using the given parent function, $f(x)=3^x$. Label each one.

$g(x)=3^{x-2}$

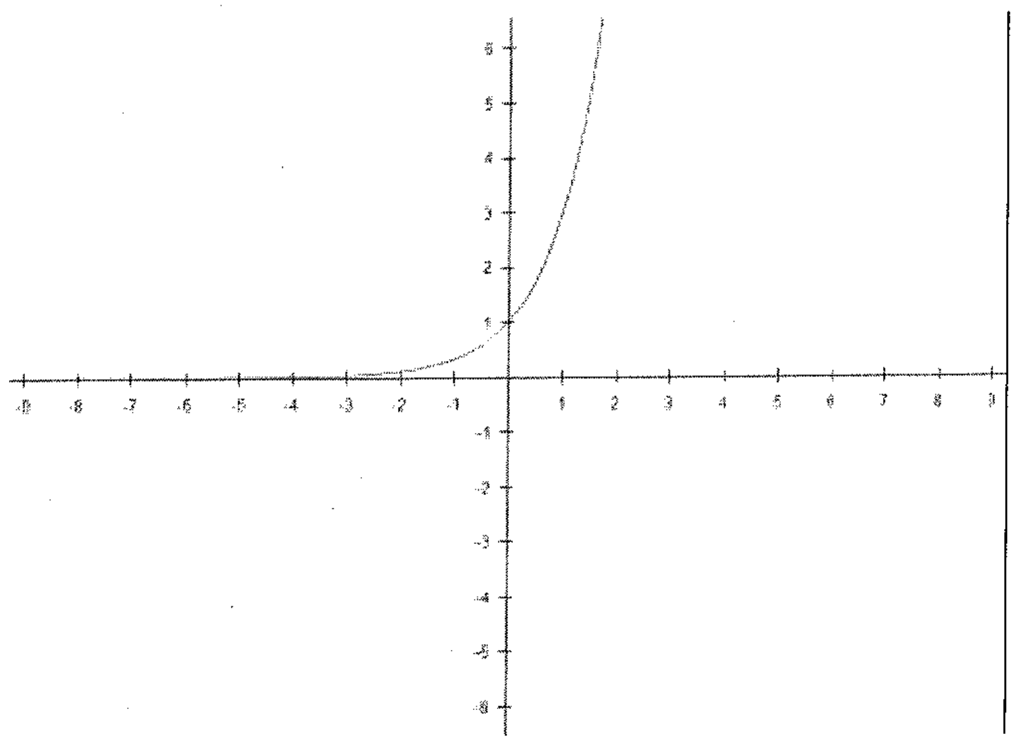
$h(x)=-3^x$

$j(x)=3^x+4$

$k(x)=2(3^x)$

$m(x)=3^{x+3}-2$

$n(x)=3^{-x}$



The properties of exponents can be used to solve exponential equations. The first step is to rewrite the equation so that the bases on both sides of the equation are the same. If the bases on both sides are the same, then the exponents must be equal. For instance,

$$3^{x+1} = 9^x$$

both bases can be made the same... $3^{x+1} = (3^2)^x$

using the exponent properties... $3^{x+1} = 3^{2x}$

if the bases are the same, then the exponents must be equal, so...

$$x + 1 = 2x$$

and $x = 1$

Try these problems:

1. $2^x = 8$
2. $3^{x+5} = 9^2$
3. $5^{2x+3} = \frac{1}{125}$
4. $\left(\frac{1}{2}\right)^{x+4} = 8^{x-1}$
5. $\left(\frac{1}{9}\right)^{x-2} = 81^{5-x}$
6. $8^{7x} = 16^{3x+9}$
7. $7^{3x+5} = 7^{x-3}$
8. $\left(\frac{1}{7}\right)^{x} = 7^{x+4}$
9. $10^{3x+5} = 10^{x-3}$
10. $27^{7x} = 81^{3x+9}$

Think about these:

11. If $2^x = 8$ yields $x = 3$ and $2^x = 16$ yields $x = 4$, what would $2^x = 10$ yield?

12. How would you solve $5^x = 37$?

---

answers: 1) 3 2) –1 3) –3 4) –1/4 5) 8 6) 4 7) –4 8) –2 9) –4 10) 4

AC Alg 1/Geo A

Name________________________________ ID: 1

Solving Exponential Equations

Date________________ Period____

Solve each equation.

1) $36^{2m} = 216$

2) $\left(\frac{1}{16}\right)^{-a-2} = 4$

3) $3^{3-3n} = 3^{-2n}$

4) $\left(\frac{1}{243}\right)^{n} = \frac{1}{9}$

5) $6^{-2a} = 36$

6) $6^{-3n} = 216$

7) $2^{-3x+3} = 32$

8) $3^{-n} = 1$

9) $64^{r} = 4^{3r}$

10) $81^{n+3} = 9^{2n}$

11

AC Alg 1/Geo A

Exponential Equations

Name ______________________________

Solve each equation.

1. $5^x = 5^{-3}$	14. $\frac{1}{27} = 3^{x-5}$
2. $6^x = 216$	15. $\left(\frac{1}{3}\right)^x = 3^{x-6}$
3. $7^y = \frac{1}{49}$	16. $25^{2m} = 125^{m-3}$
4. $10^x = .001$	17. $4^{x-1} = 8^x$
5. $2^{2x} = \frac{1}{8}$	18. $2^{x+1} = 2^{2x+3}$
6. $\left(\frac{1}{5}\right)^{x-3} = 125$	19. $3^{2x-1} = \frac{1}{9}$
7. $3^y = 3^{3y+1}$	20. $6^y = 6^{3y-1}$
8. $5^{3y+4} = 5^y$	21. $\left(\frac{1}{7}\right)^{6x} = 7^{2x-20}$
9. $3^x = 9^{x+1}$	22. $3^{6x-5} = 9^{4x-3}$
10. $2^5 = 2^{2x-1}$	23. $5^{2x+3} = \left(\frac{1}{25}\right)^{x+4}$
11. $8^{x-1} = 16^{3x}$	24. $2^{3x-1} = \left(\frac{1}{8}\right)^x$
12. $2^{x+3} = \frac{1}{16}$	25. $\left(\frac{1}{16}\right)^{x+1} = \left(\frac{1}{8}\right)^{2x-1}$
13. $9^{3y} = 27^{y+2}$	

Name: ____ Period: __________

Average Rate of Change

Notes:

Rates are used to describe how one quantity is changing in relation to another. This is called a "**rate of change**" or an "**average rate of change.**" To illustrate this, consider the following statement: Reagan drove from Salt Lake to Bluffdale (a distance of about 28 miles) in 30 minutes.

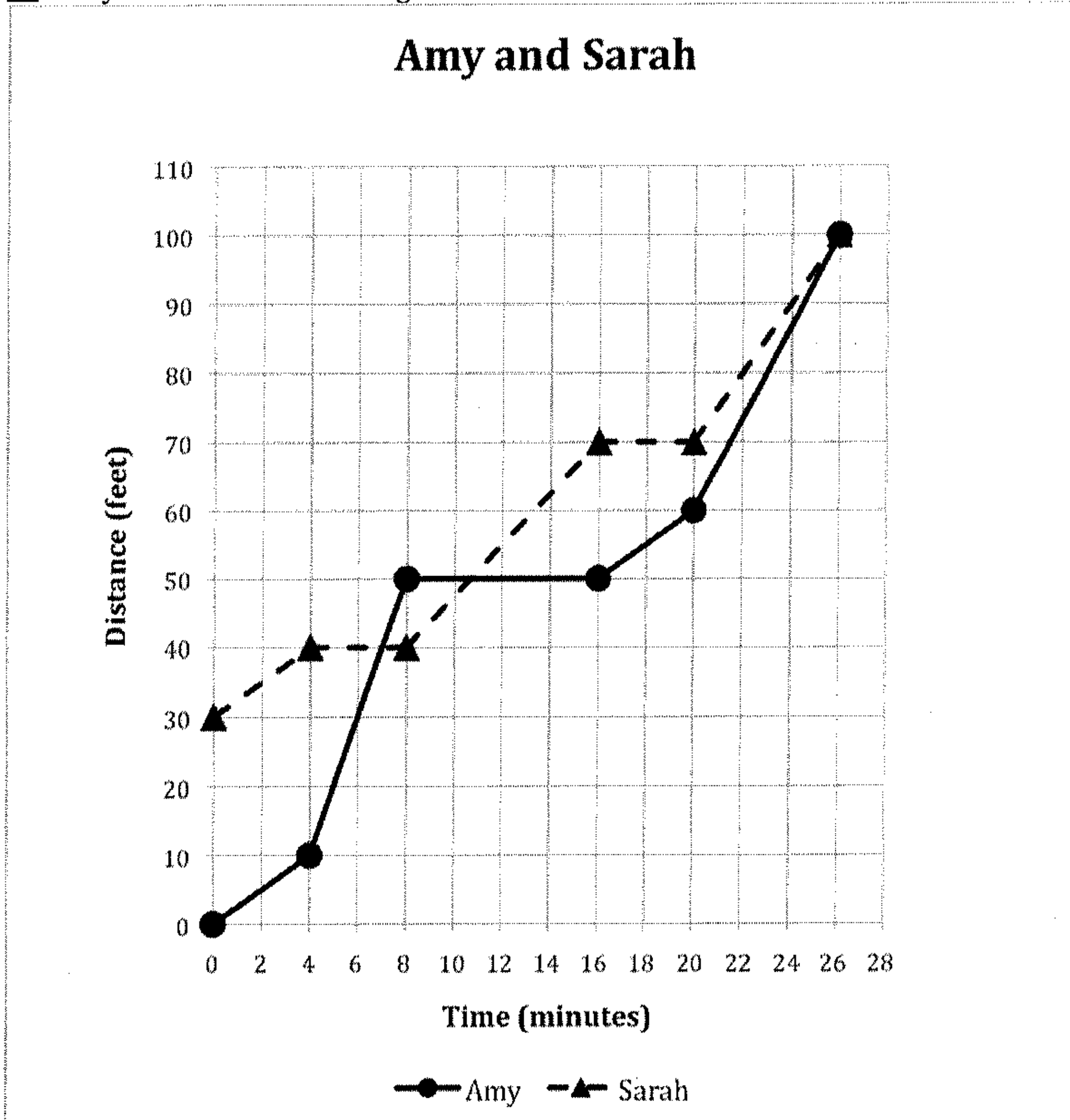
A.) What was his average speed in miles per hour?

$$\frac{28 \text{ miles}}{30 \text{ min}} \bullet \frac{2}{2} = \frac{56 \text{ miles}}{1 \text{ min}}$$

B.) Does this mean that he drove that speed the entire trip? If not, what does it mean?

C.) Did he ever drive the average speed of 56 mph?

Ex: Amy and Sarah are meeting each other at the store.



Name: ______________________________ Period: ________

Use the graph to answer the following questions.

1.) How far from the store is Amy at the beginning?

2.) How far from the store is Sarah at the beginning?

3.) How long does it take to get to the store?

4.) What happens between 6 and 7 minutes?

5.) Where is Amy moving faster?

6.) Where is Sarah moving faster?

7.) What is the speed of Amy between 4 and 8 minutes?

8.) What is the speed of Sarah 8 and 16 minutes?

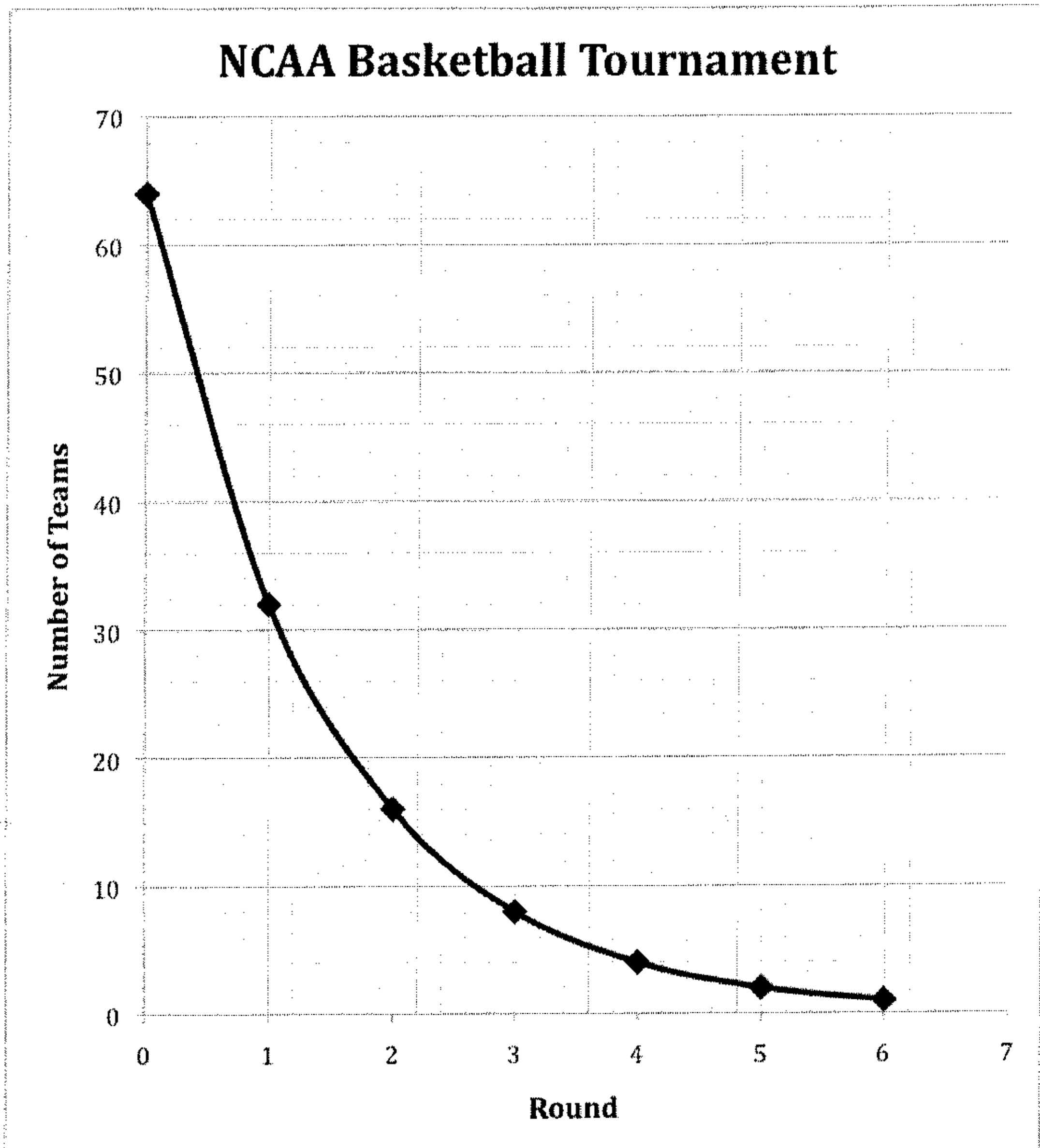
9.) What is Amy doing during 8 and 16 minutes?

10.) What is Amy's average speed for the whole trip?

11.) What is Sarah's average speed for the whole trip?

Ex: The NCAA basketball tournament.

Name: ____ Period: __________



Use the graph to answer the following questions.

1.) How many teams are there when the tournament starts?

2.) How many rounds occur before there is a winner?

3.) What is the rate of change between the 1st and 2nd round?

4.) What is the rate of change between the 2nd and 3rd round?

5.) What is the rate of change between the 3rd and 4th round?

15

Name: ____Period: ________

6.) What is the average rate of change between the 1st and 4th round?

7.) What is the average rate of change from the beginning of the tournament to the end?

8.) The NCAA tournament chairman is considering adding another round to the tournament so more teams can participate. How many teams would start the tournament?

Notes - 3.4B Rate of Change

Ex: What is the average rate of change of the function $g(x) = 6 - 2x$

A.) Over the interval [2, 6]?

B.) Over the interval [5, 7]?

C.) Do you think it is true that $g(x)$ will have a constant average rate of change over *any* interval? Why or why not?

Ex: What is the average rate of change of the function $f(x) = 2^x$

A.) Over the interval [1, 4]?

B.) Over the interval [3, 5]?

C.) Do you think it is true that $f(x)$ will have a constant average rate of change over any interval? Why or why not?

Ex: Given a table, find the rate of change for each interval.

x	y
-3	4
-2	1
-1	0
0	1
1	4
2	9
3	16

A.) [0, 3]

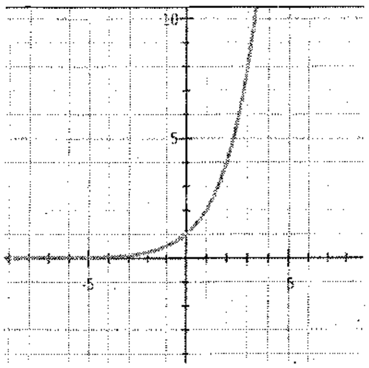
B.) [-2, 1]

C.) [-3, -1]

WS#1 Part 2: Analyzing Characteristics (Rate of Change and End Behavior)

1.

$f(x) = 2^x$

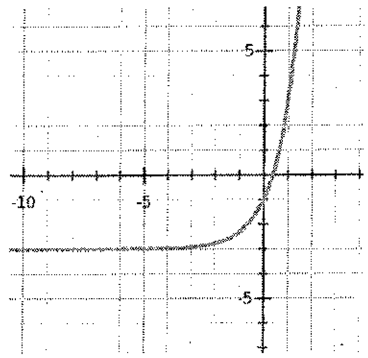


Rate of change for $-2 \le x \le 2$:

End Behavior: $\begin{cases} \text{as } x \to -\infty, f(x) \to \_\_\_\_\_\_ \\ \text{as } x \to \infty, f(x) \to \_\_\_\_\_\_ \end{cases}$

2.

$f(x) = 2(3)^x - 3$

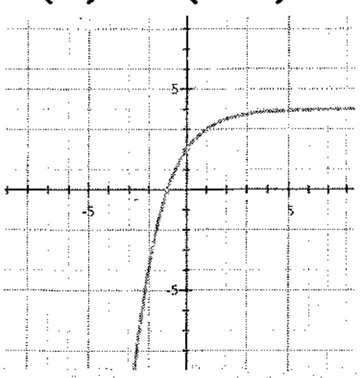


Rate of change for $-2 \le x \le 2$:

End Behavior: $\begin{cases} \text{as } x \to -\infty, f(x) \to \_\_\_\_\_\_ \\ \text{as } x \to \infty, f(x) \to \_\_\_\_\_\_ \end{cases}$

3.

$f(x) = -2(1/2)^x - 4$

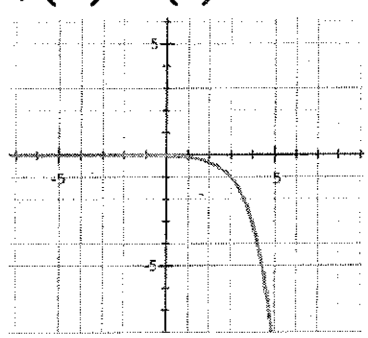


Rate of change for $-2 \le x \le 2$:

End Behavior: $\begin{cases} \text{as } x \to -\infty, f(x) \to \_\_\_\_\_\_ \\ \text{as } x \to \infty, f(x) \to \_\_\_\_\_\_ \end{cases}$

4.

$f(x) = -(3)^{x-3}$



Rate of change for $-2 \le x \le 2$:

End Behavior: $\begin{cases} \text{as } x \to -\infty, f(x) \to \_\_\_\_\_\_ \\ \text{as } x \to \infty, f(x) \to \_\_\_\_\_\_ \end{cases}$

Exploring exponential functions (Decay)

You and a friend are out exploring in the woods and come across a meteorite! Since you are both geniuses, you quickly determine that the meteorite is a radioactive substance that is decaying every hour. You also determine that it weighs 30 ounces.

The substance has a ½ life of 1 hour (this means the substance decays at a rate of ½ every hour.) When will the substance decay and have less than 1 ounce of the original material? Use the table below to figure it out!

Hours	Ounces
0	
1	
2	
3	
4	
5	

How many hours will it take the substance to have less than 1 ounce of the original material?

____

Graph the above data

Try to write an equation that represents the above situation:

Exploring exponential functions (Growth)

You and your friend buy a bunny farm. Congratulations! You want to have as many bunnies as possible to sell for Easter. Well, you're broke and can only afford 2 bunnies. The good news is that after a month of having them home, those bunnies create 2 more bunnies. (Ask your parents if that last sentence confuses you.) Well, the new bunnies create 2 more bunnies and so on. At this rate, how many bunnies will you have after 12 months? Use the table below.

After Month:	Total # of bunnies
1	4
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

How many total bunnies will you have at the end of the 12 month period? ____________

Graph the above data

Try to write an equation that represents the above situation: y =

An exponential function has the form

$$y = ab^x$$

b is a positive number other than 1

If b is greater than 1

$y = ab^x$ ← **b is the "growth factor"**

exponential growth function.

If b is between 0 and 1

$y = ab^x$ ← **b is the "decay factor"**

exponential decay function.

In the bunny problem

a = 2 (because we initially had 2 bunnies)

b = 2 (because they were having 2 babies)

So our equation was $y = 2(2)^x$

a = initial amount
b = growth/decay factor
x = time
y = ending amount

In the meteorite problem:

a = 30 (we initially had 30 ounces)

b = ½ (it was decaying by ½)

So our equation was: $y = 30(\frac{1}{2})^x$

1. Each year the local country club sponsors a tennis tournament. Play starts with 128 participants. During each round, half of the players are eliminated. Write an equation that models this situation. ______________

How many players are left after 5 rounds? ___________ (you can count OR plug in 5 for your x)

2. Bacteria can multiply at an alarming rate when each bacteria splits into two new cells, thus doubling. Write an equation that models one bacteria cell that splits into two new cells every hour. ______________

How many bacteria would you have after 24 hours? ______________

In the following equations, identify the initial amount and growth or decay factor. CIRCLE whether it is growth or decay.

3. $y = 100(3)^x$

Initial amount =

Growth/decay factor =

4. $y = 15(.5)^x$

Initial amount =

Growth/decay factor =

5. $y = 4^x$

Initial amount =

Growth/decay factor =

6. $y = \frac{1}{2}(\frac{3}{2})^x$

Initial amount =

Growth/decay factor =

Exponential Functions Growth and Decay Application Problems

Growth Example
$y=(1.26)^x$

rate:

percent:

Decay Example
$y=(.80)^x$

rate:

percent:

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Possible Equations and their uses:

$A=P(1+r)^t$ - used for appreciating values

$A=P(1-r)^t$ - used for the depreciating values

$A=P(1+r/n)^{nt}$ - **used for values that are being compounded**

monthly = 12
weekly = 52
daily = 365
quarterly = 4
semiannually = 2

$A=Pe^{rt}$ -used when a function is compounded continuously

P=principal (starting amount)
A=amount
r =rate (change to a decimal)
t = time

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Example: Ms. Benzin has a house that is worth $200,000. It appreciates in value 5% each year. How much will it be worth in 5 years?

Which formula will we use?

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Example: Brian's car depreciates at a rate of 11% per year. If his car currently is worth $16,500, how much will it be worth in 7 years?

Which formula will we use?

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Exponential Growth and Decay Worksheet

In the function: $y = a(b)^x$, a is the y-intercept and b is the base that determines the direction of the graph and the steepness. In real-life situations we use x as time and try to find out how things change exponentially over time. Some examples of this are money growing in a bank account by a certain percentage every year or the population of a city growing by a certain percentage every year.

Because *a* is the y-intercept it plays a very important role in word problems involving exponential growth. *a* is known as the **initial value** because it is the value of the function when $x = 0$ or at the beginning of time.

b determines how fast the function increases or decreasing. For this reason, b is known as the **growth factor.** The growth factor is determined by starting with 100% and then adding or subtracting the percentage that the function if being increased by or subtracting the percentage that the function is being decreased by. Finally you take your growth factor as a percentage and change it into a decimal before plugging it into $y = a(b)^x$.

Find the initial value and growth factor for each of the situation below then plug them in to $y = a(b)^x$ *to get the function that models the problem.* ***Answers are at the end.***

1. You deposit $200 into a bank account. Every year that account increases by 12 %. [EXAMPLE]

   Initial value: 200

   Growth factor: 1.12

   Equation: $y=200(1.12)^x$

2. The population of an apartment building is 4,000 people. Every month the population goes down by 12%.

   Initial value:

   Growth factor:

   Equation:

3. You start a bank account with $500 and the interest on the account is 8% every year.

   Initial value:

   Growth factor:

   Equation:

4. The New York Mets sign a new player for $8,000,000 and his salary goes up by 3% every year.

   Initial value:

   Growth factor:

   Equation:

5. A certain stock was worth $42 at the beginning of the day. Every hour the stock goes down by 15%.

   Initial value:

   Growth factor:

   Equation:

After coming up with an equation that models the situation we can find values in the future by plugging in values for x. For example, in problem one you can find the amount of money in your bank account after 4 years by plugging in 4 for x.

$$y = 200(1.12)^{(4)} = \$314.70$$

Try finding the answers to the following questions by plugging in to ***the equations you found in problems 1-6.***

1b) How much money do you have in your bank account after 5 years?

2b) How many people live in the building after 3 months?

3b) How much do you have in your bank account after 4 years?

4b) How much does the player make after 3 years?

5b) How much is the stock worth after 7 hours?

Answers:
2) $y=4000(.88)^x$
3) $y=500(1.08)^x$
4) $y=8000000(1.03)^x$
5) $y=42(.85)^x$

1b. $352.47
2b. 630 people
3b. $680.24
4b. $8,741,816
5b. $13.46

Name: ______________________________ Date: ____________

Exponential Growth and Decay Worksheet

1. $y = 1200 \cdot (1 + 0.3)^t$

A. Does this function represent exponential growth or exponential decay?

B. What is your initial value?

C. What is the rate of growth or rate of decay?

2. $y = 55 \cdot (1 - 0.02)^t$

A. Does this function represent exponential growth or exponential decay?

B. What is your initial value?

C. What is the rate of growth or rate of decay?

3. $y = 100 \cdot (1.25)^t$

A. Does this function represent exponential growth or exponential decay?

B. What is your initial value?

C. What is the rate of growth or rate of decay?

4. $y = 5575 \cdot (0.65)^t$

A. Does this function represent exponential growth or exponential decay?

B. What is your initial value?

C. What is the rate of growth or rate of decay?

5. $y = 2000 \cdot (1.05)^t$

A. Does this function represent exponential growth or exponential decay?

B. What is your initial value?

C. What is the rate of growth or rate of decay?

6. $y = 14000 \cdot (0.92)^t$

A. Does this function represent exponential growth or exponential decay?

B. What is your initial value?

C. What is the rate of growth or rate of decay?

7. $y = 2250 \cdot (1 - 0.9)^t$

A. Does this function represent exponential growth or exponential decay?

B. What is your initial value?

C. What is the rate of growth or rate of decay?

8. $y = 10 \cdot (1 + 0.04)^t$

A. Does this function represent exponential growth or exponential decay?

B. What is your initial value?

C. What is the rate of growth or rate of decay?

Name: ______________________________ Date: ____________

9. The first year of a charity walk event had an attendance of 500. The attendance y increases by 5% each year.

A. Write an exponential growth function to represent this situation.

B. How many people will attend in the 10th year? Round your answer to the nearest person.

10. The population of a small town was 3600 in 2005. The population increases by 4% annually.

A. Write an exponential growth function to represent this situation.

B. What will the population be in 2025? Round your answer to the nearest person

11. Your starting salary at a new company is $34,000 and it increase by 2.5% each year.

A. Write an exponential growth function to represent this situation.

B. What will you salary be in 5 years? Round your answer to the nearest dollar.

12. In 2010 an item cost $9.00. The price increase by 1.5% each year.

A. Write an exponential growth function to represent this situation.

B. How much will it cost in 2030? Round your answer to the nearest cent.

13. The yearly profits of a company is $25,000. The profits have been decreasing by 6% per year.

A. Write an exponential decay function to represent this situation.

B. What will be the profits in 8 years? Round your answer to the nearest dollar.

14. You bought $2000 worth of stocks in 2012. The value of the stocks has been decreasing by 10% each year.

A. Write an exponential decay function to represent this situation.

B. What will your stock be worth in 2017? Round your answer to the nearest cent.

15. Your car cost $42,500 when you purchased it in 2015. The value of the car decreases by 15% annually.

A. Write an exponential decay function to represent this situation.

B. How much will your car be worth in 2022? Round your answer to the nearest dollar.

16. A piece of land was purchased for $65,000. The value of the land has slowly been decreasing by 1% annually.

A. Write an exponential decay function to represent this situation.

B. How much will the land be worth in 20 years? Round your answer to the nearest dollar.

ANSWER KEY

1.

A. Exponential Growth

B. 1200

C. 0.3 or 30%

2.

A. Exponential Decay

B. 55

C. 0.02 or 2%

3.

A. Exponential Growth

B. 100

C. 0.25 or 25%

4.

A. Exponential Decay

B. 5575

C. 0.35 or 35%

5.

A. Exponential Growth

B. 2000

C. 0.05 or 5%

6.

A. Exponential Decay

B. 14000

C. 0.08 or 8%

7.

A. Exponential Decay

B. 2250

C. 0.9 or 90%

8.

A. Exponential Growth

B. 10

C. 0.04 or 4%

9.

A. $y = 500 \cdot (1.05)^t$

B. 814 people

10.

A. $y = 3600 \cdot (1.04)^t$

B. 7888 people

11.

A. $y = 34000 \cdot (1.025)^t$

B. $38,468

12.

A. $y = 9 \cdot (1.015)^t$

B. $12.12

13.

A. $y = 25000 \cdot (0.94)^t$

B. $15239

14.

A. $y = 2000 \cdot (0.9)^t$

B. $1180.98

15.

A. $y = 42500 \cdot (0.85)^t$

B. $13625

16.

A. $y = 65000 \cdot (0.99)^t$

B. $53,164

Example: Jenni opened a savings account when she was 5 years old. She deposited $200 and forgot about the account. The account pays 3.25% interest, compounded quarterly. Jenni is now 18 years old and just remembered she has the account. How much money is in the account now?

What formula will you use?

Oct 20-1:17 PM

Example: Sarah has $2000 and wants to invest in an account which is continuously compounded. The rate is 5% and she plans to keep the money in her account for 10 years. How much money will she have at the end of the 10 years?

Which formula will you use?

Oct 20-1:18 PM

A# ________

Compound Interest and *e* Worksheet

The history of mathematics is marked by the discovery of special numbers such as π or i. Another special number is denoted by the letter e. It is called the *Euler number* after its discoverer and it is also called the **natural base** e. Like π, it is an irrational number.

$$\lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n = e = 2.71828...$$

It is important to remember that e is <u>JUST A NUMBER!</u>

One use of e is for "<u>continuously</u> compounded interest."

$A(t) = Pe^{rt}$	where P = principal investment r = interest rate (as a decimal) t = time

There is another formula we can use to calculate interest when it is not compounded continuously:

For compounding interest a specific # of times annually:

$A(t) = P\left(1+\frac{r}{n}\right)^{nt}$	where P = principal investment r = interest rate (as a decimal) t = time n = # of times you compound annually

1) If you invest $2500 in an account, what is the balance in the account and the amount of interest after 4 years if you earn:

   a) 1.7% interest compounded annually?

   b) 1.5% compounded monthly?

   c) 1.2% compounded daily?

   d) 0.7% compounded continuously?

2) Martha makes an investment of $500 in an account that pays 6% interest compounded monthly.
   a) Write an equation you could use to determine the interest she earns in *t* years.

   b) How much money will Martha have in her account one year from now if she never withdraws any money and reinvests the interest?

   c) What is the effective annual rate for this account (think about what percent of her money has she earned at the end of one year)?

3) A credit card company charges 12.9% annual interest.
   a) If they compound interest monthly, how much will you owe for every dollar you do not pay off for a year?

   b) If they compound interest daily, how much will you owe for every dollar you do not pay off for a year?

   c) What is the effective annual rate in the situation above?

4) An initial investment of $700 is worth $725 a year later. What is the effective annual yield for this account?

5) A loan shark lends a gambler $1,000.00 to cover a debt. He charges 35% annual interest compounded continuously. How much does the gambler owe the loan shark at the end of one year? Two years?

6) The value of a $25,000 car **<u>depreciates</u>** at a rate of 12% per year. What will the car be worth in 5 years?

CCGPS Coordinate Algebra

Name:______________________
Date:______________ Block:______

Exponential Application Problems

Determine whether the function represents exponential growth or decay.

1) $y = 350(0.75)^x$

2) $y = 80(1.03)^x$

3) $y = (1.87)^x$

4) $y = 500(0.9)^{-x}$

Determine the growth/decay factor.

5) $y = 10(1.35)^x$

6) $y = 742(0.60)^x$

Determine the growth/decay percent.

7) $y = (1.04)^x$

8) $y = 7500(0.42)^x$

9) A new SUV depreciates at a rate of 23% per year. If the original selling price was $30,000, how much will the vehicle be worth after 4 years?

10) Two bacteria are discovered at the bottom of a shoe. If the bacteria multiply at a rate of 34% per hour, how many bacteria will be present after 48 hours?

11) $3000 is deposited in an account that pays 4% annual interest compounded monthly. How much will be in the account after 20 years?

12) 10,000 molecules of radioactive material are present in the atmosphere and will dissipate at a rate of 24% per day. How many molecules will be present after one week?

13) The value of a $100,000 house in a prime location appreciates (increases in value) at a rate of 4% per year. How much will this house be worth in 7 years?

14) You have deposited $500 in an account that pays 6.75% interest, compounded continuously. What is the balance in the account after 15 years?

15) A retiree needs $100,000 by the time she retires in 2035. How much should he deposit now in an account that pays 6% annual interest compounded quarterly (the current year is 2014)

Math II Exponential Functions Review

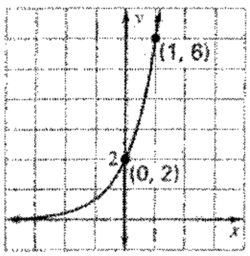
Name:____________________

Date:______________ Period:_____

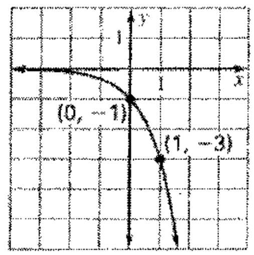
Match the function with its graph.

1. $f(x) = 3^x$
2. $f(x) = -3^x$
3. $f(x) = 2(3^x)$
4. $f(x) = \frac{1}{2}(3^x)$
5. $f(x) = -\frac{1}{2}(3^x)$
6. $f(x) = -2(3^x)$

A.



B.



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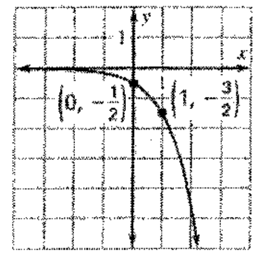

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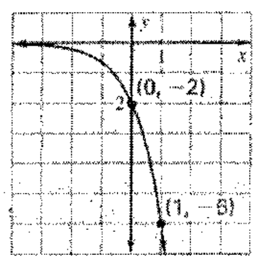

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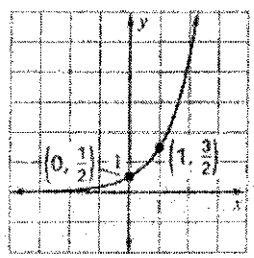

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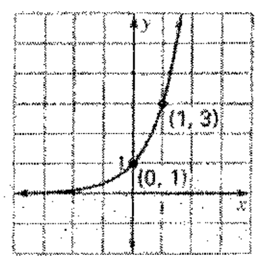
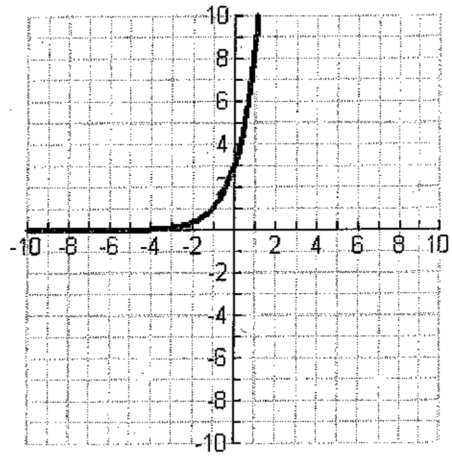


Determine whether the function is exponential growth or decay. State the asymptote of the graph as well.

7. $y = 2(3)^{x+1} - 3$
8. $y = \frac{1}{2}(3)^x + 5$
9. $y = -3(\frac{1}{2})^x - \frac{3}{4}$

10. $y = 2(\frac{9}{5})^x$
11. $y = -(\frac{1}{3})^{-x} + 9$
12. $y = -\frac{1}{4}(2)^{-x}$

List the characteristics of the following exponential functions $y = 3(3)^x$



13.
Range: ________________

Asymptotes: ________________

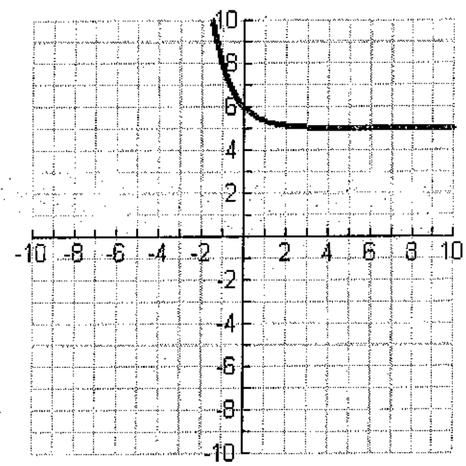
Intercept ________________

Zeros: ________________

End Behavior ______________________________

Rate of change for $-2 \le x \le 2$ ______________

14. $y = (\frac{1}{3})^x + 5$



Domain: ________________

Range: ________________

Asymptotes: ________________

Intercept ________________

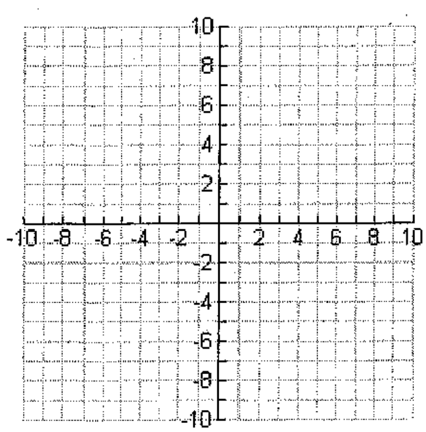
Zeros: ________________

End Behavior ______________________________

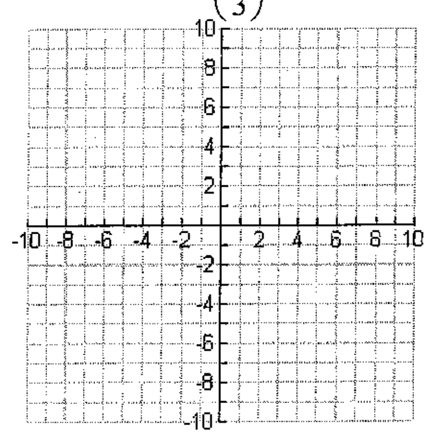
Rate of change for $-2 \le x \le 2$ ______________

Graph the following exponential functions

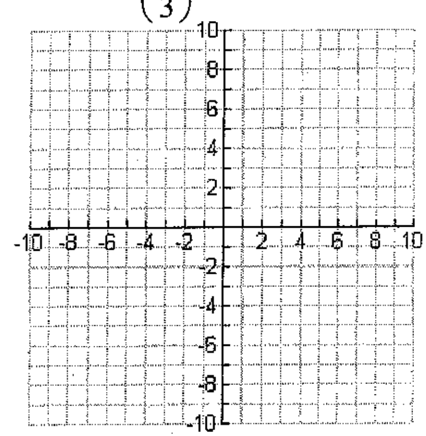
15. $f(x) = 4(2)^{x+1} - 3$



16. $f(x) = \left(\frac{1}{3}\right)^{x-1} + 1$



17. $f(x) = \left(\frac{4}{3}\right)^{x} + 1$



18. Write all transformations that have taken place in the equation $f(x) = -2(3)^{x-4} + 2$

19. Write the two money equations from memory. When do you use each equation?

20. You invest $2,350 in an account for 6 years. How much will you have in the account if the account is...**MAKE SURE YOU WRITE YOUR EQUATION TO GET CREDIT!**

a. 6% compounded weekly	b. 2% compounded annually	c. 3.75% compounded monthly
d. 6.2% compounded semi-annually	e. 10% compounded bi-weekly	f. 7% compounded continuously

21a. In 2020 you want to have $6,000 saved in your bank account. How much should you invest in 2011 into an account with 5% interest compounded quarterly?	21b. In 2010 you have $8,000 saved in your bank account. How much did you invest in 1995 if your account has 8% interest compounded annually?

22a. Your cell phone is worth \$250 when you buy it in 2011. What will the phone be worth in 4 years if it depreciates by 9% each year?	22b. Your Barbie collection appreciates in value by 3% each year. If it is worth \$110 now, what will it be worth in 10 years?
22c. Your grandfather gives you an old set of baseball cards that appreciate in value by 4.5% each year. An appraiser said the set was worth \$955 this year! What was the set worth when it was given to you 6 years ago?	22d. Your ITOUCH just sold on ebay for the price it is currently worth- \$50. If you bought it in 2006 and it has depreciated in value by 7.5% each year, what was it worth when you bought it?

23. The equation $y = 252(1.035)^t$ models the amount of cockroaches in your basement from 2010 to 2020.

a. How many cockroaches were in your basement in 2010?

b. How many cockroaches will be in your basement in 2018?

c. How many cockroaches will be in your basement in 2020?

d. What percentage do the cockroaches increase by in your basement?