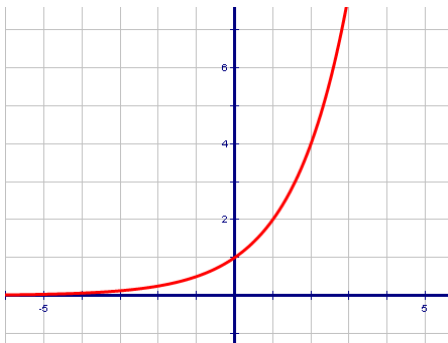


## 1.4A Applications of Exponential Functions

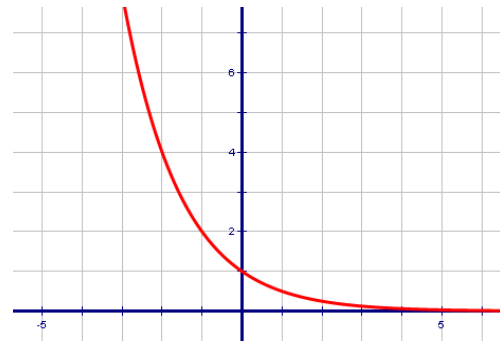
### Exponential Growth:



Graph:  
Increases slowly then quickly

**Asymptote:**  
A line that a curve will continually approach but never touch

### Exponential Decay:



Graph:  
Decreases quickly then slowly

**Asymptote:**  
• x axis  
• eq'n:  $y=0$   
y will never be zero!

NOTE: for our purposes we will not be looking at a graph that has been translated up or down, that is why the x axis will be the asymptote

### Equation:

Example:  
 $A = 250(1.04)^x$

Final Amount

$$A = a_0(b)^x$$

exponent is a variable

Initial value (stretch)

base  
exp growth if  $b > 1$   
exp decay if  $0 < b < 1$

Explore:

- y intercept is 1 if there is no stretch  
i.e.  $a = 1$
- your base is the ratio of your 1<sup>st</sup> differences
- from your graph you can see your base by finding your y value at  $x = 1$

**\* watch for a stretch\***

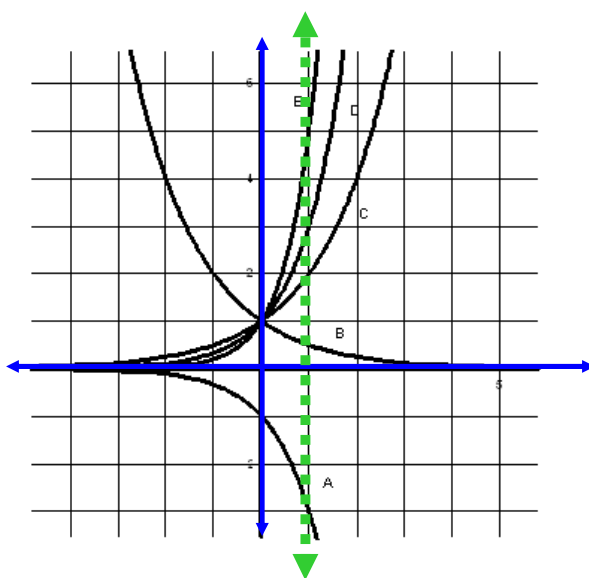
Explore gizmos:  
Look for:  
The location of the x and y intercepts?  
The location of the horizontal asymptote?

Don't write this ...let's try it together...

Match the Graph to the Exponential Equation

(Hint: To find the appropriate base find the value of  $y$  when  $x = 1$ )

1.



$y = 3^x$      D

$y = 2^x$      C

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

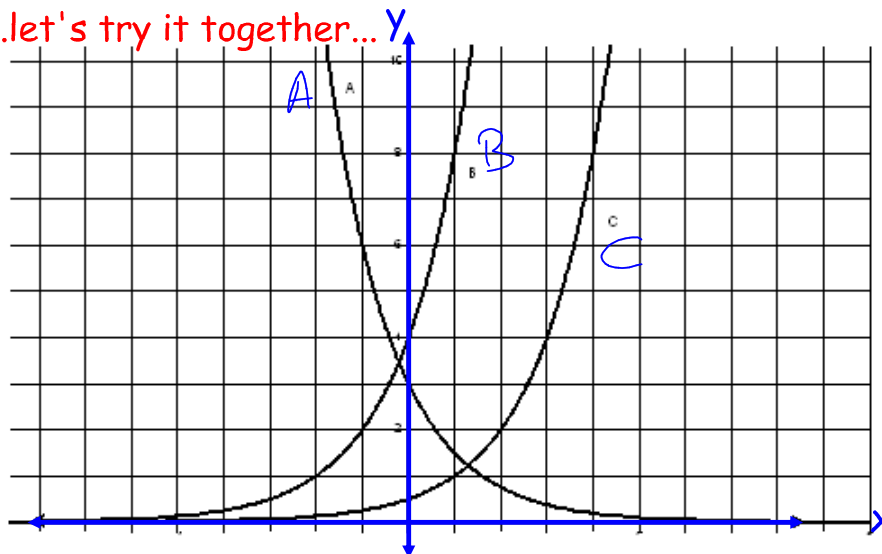
$y = \left(\frac{1}{3}\right)^x$      DNE

$y = 5^x$      E

$y = -3^x$      A

Don't write this ....let's try it together... Y

2.



$y = 4(2)^x$          B    

$y = \frac{1}{2}(2)^x$          C    

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

$y = (-6)^x$          DNE      
 ↑  
 Neg base ???

Don't write this ....let's try it together...

3. Discuss each of the following graphs:

$y = (-2)^x$

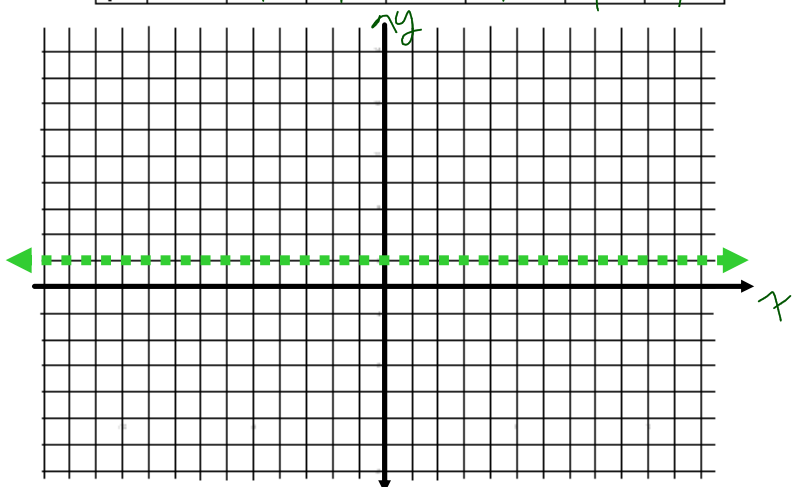
x	-3	-2	-1	0	1	2	3
y	$-\frac{1}{8}$	$\frac{1}{4}$	$-\frac{1}{2}$	1	-2	4	-8

Don't have neg base

Straight line

$y = 1^x$

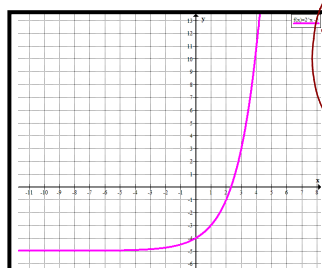
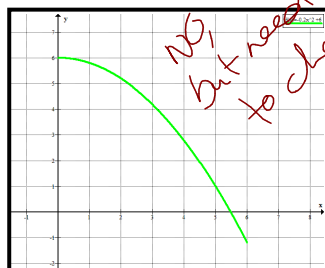
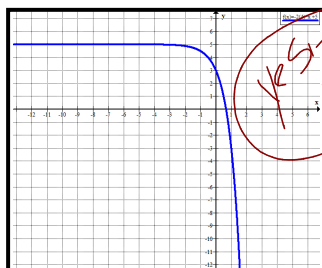
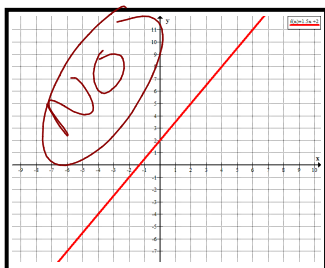
x	-3	-2	-1	0	1	2	3
y	1	1	1	1	1	1	1



What do you notice:

- Exponential functions need a positive base
- when the base is 1 the graph is a horizontal line ( $y=1$ )

Ex. 1 Which could represent exponential growth or decay?



$y = 5x^2 + 7x - 3$

NO  
(quad)

$A = 400(0.76)^{t/4}$

yes  
decay

$P = 200(1.07)^t$

yes  
growth

$P = 7w + 5$

NO  
(linear)

x	y
0	5
1	13
2	37
3	109
4	325

8 } Ratio?  
24 }  $\frac{24}{8} = 3$   
72 }  $\frac{72}{24} = 3$   
216 }

Yes! Ratio is the same.

∴ Exponential

Ex. 2 Take a regular 8.5" x 11" piece of paper and fold it in half...then in half again...and so on. Record the # of rectangles created on the paper by each successive fold.

# folds	# rectangles
0	1
1	2
2	4
3	8
4	16
5	32
6	64
7	128

### Myth Busters-7 Folds

a) Is this relationship exponential? Explain how you know.

Yes, common ratio (doubling)

b) Does the relation model growth forever? Explain how the context of the questions limits the values of the domain and range.

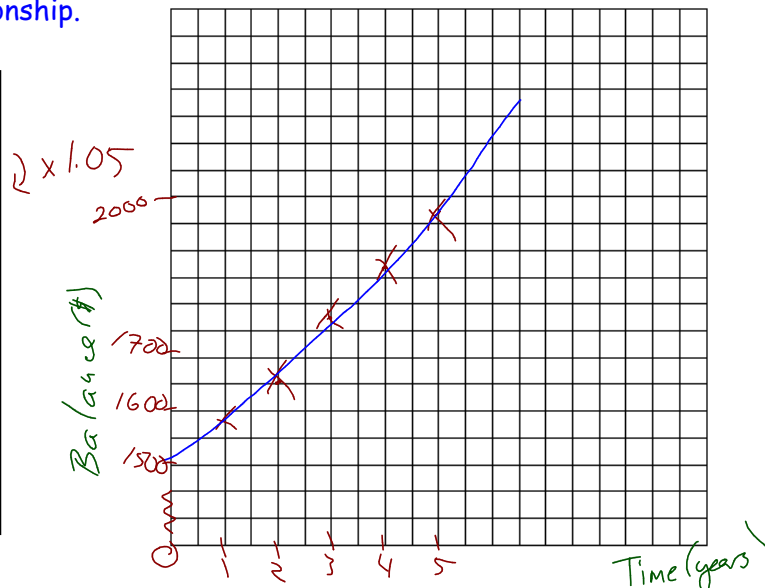
NO,

finite # of times an actual paper could be folded.

Ex. 3 Sarah invests \$1500 into an account that pays 5% compound interest per year. This means that Sarah earns 5% of the balance in interest every year.

- a) Complete the table to show the balance in the account at the end of each year.
- b) Graph the relationship.

Year	Balance (\$)
0	1500
1	1575
2	1653.75
3	1736.43
4	1823.25
5	1914.42
6	2010.14
7	2110.65
8	2216.18



- c) How long does it take for Sarah to have \$2000 in her account?

6 years

- d) Does this relationship model exponential growth or exponential decay? Give reasons.

Growth, because its growing 5%/year

- e) Explain how the context of the question limits the values of the domain and range.

Domain  $\rightarrow$  Set of 'x' values  $0 \leq x \leq \text{lifespan}$

Range  $\rightarrow$  Set of 'y' values  $y \geq 1500$

- f) What would happen to the shape of the graph if she deposited more money in the account at the end of every year?

Steeper

Ex. 4 Model each situation with an exponential equation.  
Define "x" for each.

- a) An initial population of 200 tent caterpillars grows by 15% each day

Let  $t$  be # of days  
Let  $P$  be the population

$$P = 200(1.15)^t$$

- b) A car worth \$25 000, depreciates in value by 13% each year.

Let  $t$  be # yrs  
Let  $V$  be value in \$\$\$

$$V = 25000(0.87)^t \quad \begin{array}{l} 100\% - 13\% \\ = 87\% \end{array}$$

- c) 400 mg of radioactive material deteriorates by 5% every 4 hours.

- d) A rabbit population of 50 doubles every 6 weeks.