Growing, Growing, Growing

Day	Topic	Homework	IXL	Grade
1	Inv 1.1 – Describe the pattern of change	Worksheet 1	F.1	
2	Scientific Notation	Worksheet 2; Read pp. 9-10	F.2	
3	Inv 1.2 – Did the peasant make a wise choice?	Worksheet 3; Read pp. 11-13	F.4	
4	Inv 1.3 –What is the pattern in the new plans?	Worksheet 4		
5	Inv 2.1 - What if the y-intercept is not 1?	Worksheet 5		
6	Inv 2.2 – How do we make sense of the equation?	Worksheet 6	F.8	
7	Inv 2.3 – How do we make sense of the graph?	Study for Quiz	F.9	
8	Quiz	Worksheet 7	F.10	
9	Inv 3.1 – What if the growth factor is a fraction?	Worksheet 8	F.11	
10	Inv 3.2 – What is a growth rate?	Worksheet 9		
11	Inv 3.3 – How are growth rate & growth factor connected?	Worksheet 10	F.13	
12	Inv 4.1 – What is exponential decay?	Worksheet 11	F.7	
13	Inv 4.2 – How is decay different from growth?	Study for Quiz	F.6	
14	Quiz	Worksheet 12		
15	Practice with Scientific Notation	Worksheet 13		
16	Inv 5.2	Worksheet 14; Read pp. 80-81	G.1	
17	Inv 5.3	Worksheet 15	G.2	
18	Practice	Review Packet	G.3	
19	Review	Study for Test; IXL due	G.4	
20	Test	None		

Name: ______________________________

Important Concepts	Examples

Exponential Growth

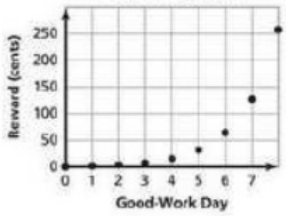
An exponential pattern of change can often be recognized in a verbal description of a situation or in the pattern of change in a table of (x, y) values.

Suppose a reward is offered for days of good work. At the start, 1¢ is put in a party fund. On the first good-work day, 2¢ is added; on the second good-work day, 4¢ is added; and on each succeeding good-work day, the reward is doubled. How much money is added on the eighth good-work day?

Good-Work Day	Reward (cents)
0 (start)	1
1	2
2	4
3	8
4	16
5	32
6	64
7	128
8	

The exponential growth in rewards for good-work days in the example can be represented in a graph. The increasing rate of growth is reflected in the upward curve of the plotted points.

Class Party Fund



Growth Factor

A constant factor can be obtained by dividing each successive y-value by the previous y-value. This ratio is called the *growth factor* of the pattern.

For each good-work day, the reward doubles. You multiply the previous award by 2 to get the new reward. This constant factor can also be obtained by dividing successive y-values: $\frac{2}{1} = 2$, $\frac{4}{2} = 2$, etc.

Exponential Equation

Examining the growth pattern leads to a generalization that can be expressed as an equation.

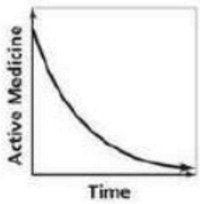
An exponential growth pattern $y = a(b)^x$ may increase slowly at first but grows at an increasing rate because its growth is multiplicative. The growth factor is b.

Day	Calculation	Reward (cents)
0	1	1
1	$1 \times 2 = 2^1$	2
2	$1 \times 2 \times 2 = 2^2$	4
3	$1 \times 2 \times 2 \times 2 = 2^3$	8
⋮	⋮	⋮
6	$1 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^6$	64
⋮	⋮	⋮
n	$1 \times 2 \times 2 \times \ldots \times 2 = 2^n$	2^n

On the nth day, the reward R will be $R = 1 \times 2^n$. Because the independent variable in this pattern appears as an exponent, the growth pattern is called exponential. The growth factor is the *base* 2. The *exponent* n tells the number of times the 2 is a factor.

Exponential Decay

Exponential models describe patterns in which the value decreases. Decay factors result in decreasing relationships because they are less than 1.



$y = 50\left(\frac{1}{2}\right)^n$

Rules of Exponents

Students begin to develop understanding for the rules of exponents by examining patterns in a powers table for the first 10 whole numbers.

By examining the multiplicative structure of the bases:

$8^2 = (2 \times 2 \times 2)^2 = (2^3)^2 = 2^6$; the general pattern is $(b^m)^n = b^{mn}$

$9 \times 27 = 243$ or $3^2 \times 3^3 = 3^5$; in general, $(b^m)(b^n) = b^{m+n}$

$4 \times 25 = 2^2 \times 5^2 = (2 \times 5)^2 = 10^2 = 100$; in general, $(a^m b^m) = (ab)^m$

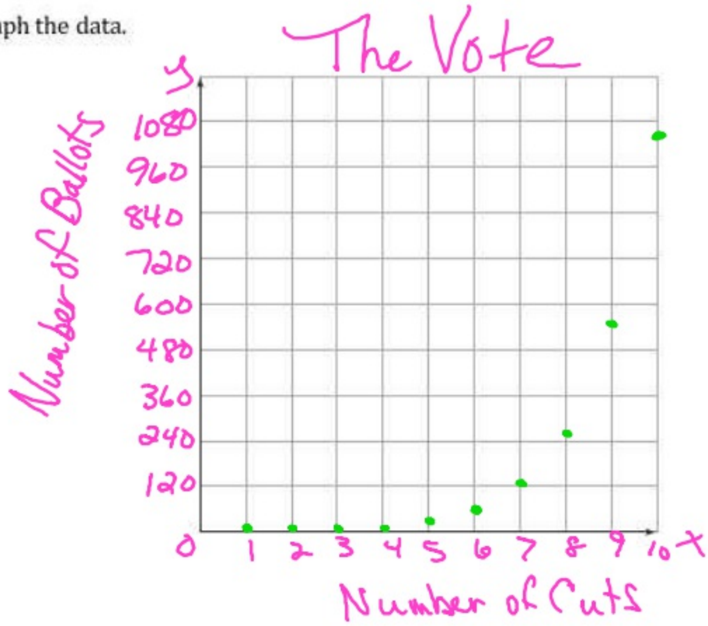
Similar explorations lead to the rule $\frac{a^m}{a^n} = a^{m-n}$.

Date: 11/1/18 Inv 1.1 Day 1

A) Complete the table.

Number of Cuts	Number of Ballots
1	2
2	4
3	8
4	16
5	32
6	64
7	128
8	256
9	512
10	1024

B) Graph the data.



Is this a linear relationship? How do you know?

This is not linear because it does not have a constant rate of change and the graph is not a straight line.

What is the pattern in the data?

As the number of cuts increases by 1, the number of ballots doubles (x 2).

Write an equation that represents the relationship between the number of ballots and the number of cuts.

Equation:

20 cuts = 1,048,576 ballots

40 cuts = ______ ballots 1.099511628 x 10^{12} Scientific Notation

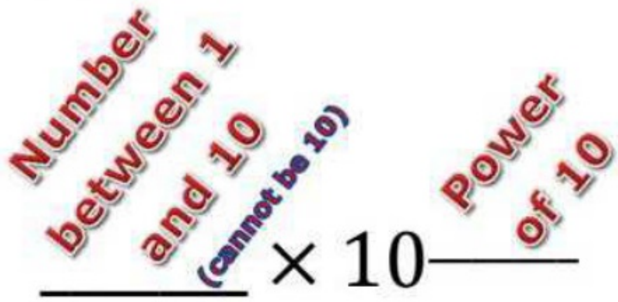
9 cuts to make 500 ballots

at least

Date: ____ Scientific Notation Day 2

Scientific notation is always converting a number in standard form that is very, very large or very, very small.

It is always written in the form:



Remember: if we were to actually multiply this out, we would get the number in standard form.

- Determine where the decimal point is in standard form.
- Move it to the right of the first nonzero number (from the left not the right!)
- The number of places you move it is the exponent on the 10

Let's try some:

Convert to scientific notation.

1) 800,000,000,000,000,000,000,000,000 ____________________

2) 40,000,000,000,000,000,000 ____________________

3) 5,000,000,000,000 ____________________

4) 12,300,000,000,000,000,000,000,000 ____________________

5) 0.00000000000000000002 ____________________

6) 0.00000000000000000000000000007 ____________________

7) 0.000000000009 ____________________

8) 0.00000000000001010 ____________________

To convert back to standard form:

- Move the decimal the distance and direction of the exponent on the 10.
- Rewrite the number, being sure to remove the old decimal.
- Add commas if the number is bigger than 1.

Convert to standard form.

9) 6×10^{15} ______________________________

10) 3×10^{8} ______________________________

11) 8×10^{19} ______________________________

12) 2.61×10^{9} ______________________________

13) 5×10^{-11} ______________________________

14) 4×10^{-24} ______________________________

15) 6×10^{-8} ______________________________

16) 8.010×10^{-7} ______________________________

*****Read pp. 9-10 before class tomorrow.*****

Date: _____ Inv 1.2 Day 3

Exponent power
times you multiply the factor

Base
factor

Exponential form

$$2^5 = \underbrace{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2}_{\text{Expanded form}} = \underbrace{32}_{\text{standard Form}}$$

Standard form

Expanded form

Scientific notation

$\_\_\_ \times 10^{\_}$

from 1 to 10 — +/- whole number (Integer)

A) 1. Complete the table below.

Chessboard 8x8 grid 64 squares

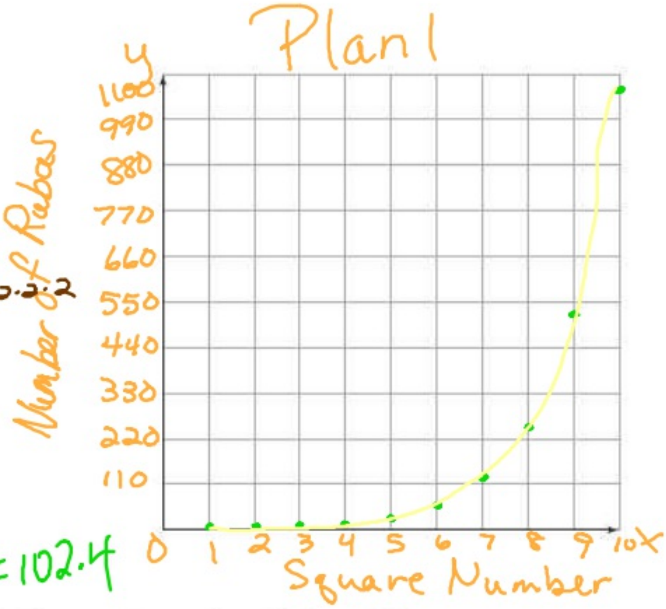
Square Number	Number of Rubas
1	2^1 2
2	2^2 4
3	2^3 8
4	2^4 16
5	2^5 32
6	2^6 64
7	2^7 128
8	2^8 256
9	2^9 512
10	2^{10} 1024

$\cdot 2$ $\cdot 2$ $\cdot 2$ $\cdot 2$ $\cdot 2$ $\cdot 2$ $\cdot 2$ $\cdot 2$ $\cdot 2$

$2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

$\frac{1024}{10} = 102.4$

2. Graph the data.



3. Write an equation that represents the relationship between the number of rubas and the square.

Equation: $y = 2^x$

Let ~~x~~ n = square number
Let ~~y~~ r = number of rubas

$r = 2^n$

64th square

$2^{64} = 1.88 \times 10^{19}$

B) How does the number of rubas change from one square to the next?

$\times 2$

How does this pattern show up in the table? In the graph?

table → the y values are doubled

graph → 

C) 1) Which square will have 2^{30} rubas?

2^{30} → square 30

2) What is the first square on which the king will place at least one million rubas? How many rubas will be on this square?

*****Read pp. 11-13 before next class.*****

exponential function: a relation whose variable is in the exponent

Date: 11/6/18 Inv 1.3 Day 4 $r=4^{n-1}$

A) 1) Complete the table.

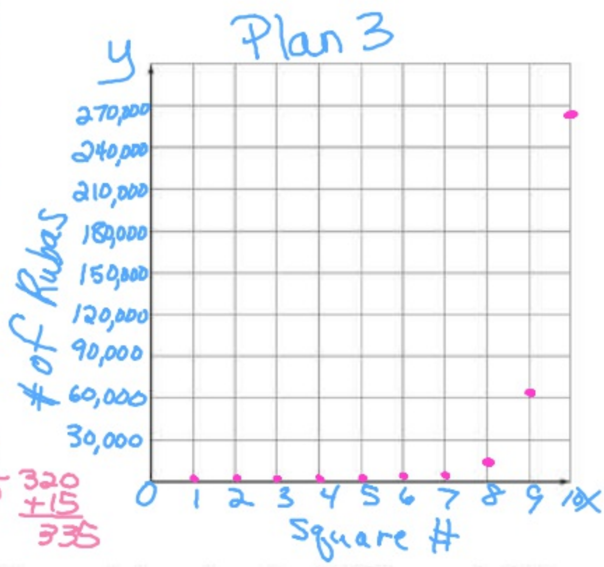
Peasant's — King — Queen — Financial Adviser

What are the independent and dependent variables?

Sq # → independent; # Rubas → dependent

Plan 3 Graph the data.

	Square Number	Number of Rubas				
		Plan 1	Plan 2	Plan 3	Plan 4	
	1	1	1	4^0 1	20	5
	2	2	3	4^1 4	25	10
	3	4	9	4^2 16	30	15
	4	8	27	4^3 64	35	20
2^4	5	16	81	4^4 256	40	25
2^5	6	32	243	1024	45	30
2^6	7	64	729	4096	50	35
2^7	8	128	2187	16,384	55	40
2^8	9	256	6561	65,536	60	45
2^9	10	512	19,683	262,144	65	50
2^{11}	12	2048	177,147	4^{11} 4,194,304	75	
2^{15}	16	32,768	3^{15} 14348907	X	95	
2^{63}	64	9.22×10^{18}	X	X	335	$\begin{array}{r}64\\ \times 5\\ \hline 320\end{array}$
	n	2^{n-1}	3^{n-1}	4^{n-1}	$5n+15$	$\begin{array}{r}320\\ +15\\ \hline 335\end{array}$



What is the growth factor for each plan? How can you find the growth factor from the table? The equation? The graph?

growth factor: what you multiply each y value by to get the next y value

Plan 1 : 2
Plan 2 : 3
Plan 3 : 4

the base of the variable

Plan 4 Write an equation that represents the relationship between the number of rubas and the square.

$r=5n+15$

linear +5 constant rate of change

How many rubas are on the last square for each plan?

Order the plans from least to greatest.

Plan 4, Plan 3, Plan 2, Plan 1

Date: 11/8/18 Inv 2.1 Day 5

Anything$^0 = 1$

Ghost Lake Plant Growth

Months	Area Covered ()	
0	1,000	$1 \cdot 1000 = 2^0 \cdot 1000$
1	2000	$2 \cdot 1000 = 2^1 \cdot 1000$
2	4000	$4 \cdot 1000 = 2^2 \cdot 1000$
3	8000	$8 \cdot 1000 = 2^3 \cdot 1000$
4	16,000	$16 \cdot 1000 = 2^4 \cdot 1000$
5	32,000	$32 \cdot 1000 = 2^5 \cdot 1000$

Let x= months
Let y= Area Covered (sq. ft.)

A) 1. Equation: $y = 2^x \cdot 1000$ $y = 1000 \cdot 2^x$

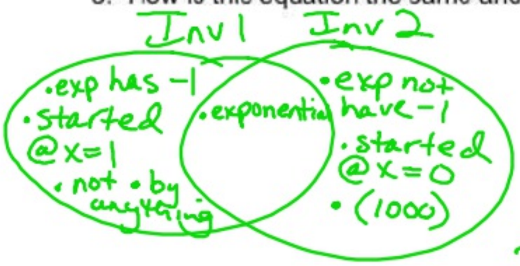
$A = 1000 \cdot 2^m$

2. Explain what all the letters and numbers represent in your equation {apply it to the situation!}.

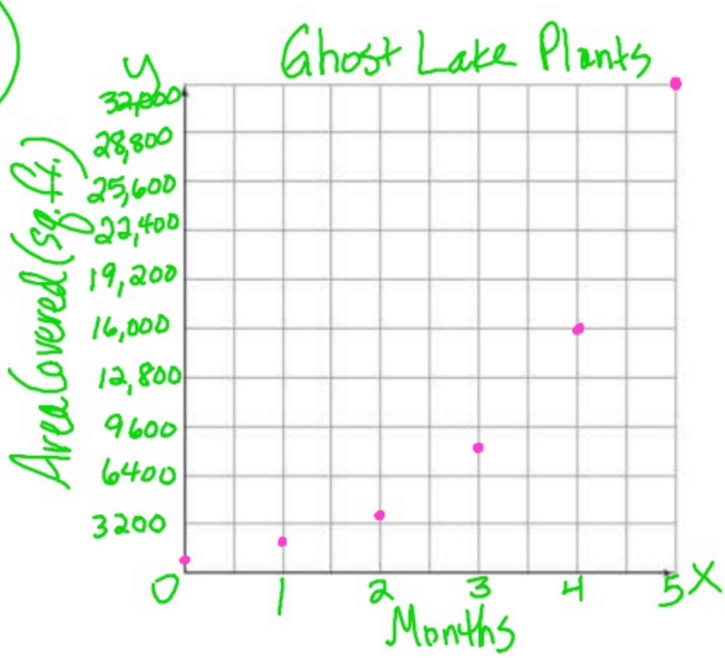
We have 1000 sq. ft. covering the lake at 0 months.

The area is multiplied by 2 each month (doubled).

3. How is this equation the same and different from the equations in investigation 1?



B) 1. Graph



2. How is this graph the same and different from the graphs in investigation 1?

started at 0
y-intercept

3. **function**: a relationship where there is no more than one y value for each x value

Is the plant growth relationship a function? How do you know?

Yes

every x value will have no more than 1 y value.

C) 1. How much of the lake's surface will be covered by the plant by the end of the year? $x=12$

$$y = 1000 \cdot 2^x$$

$$y = 1000 \cdot 2^{12} = 4{,}096{,}000 \text{ sq. ft.}$$

2. How many months will it take for the plant to completely cover the surface of the lake?

13	14	15
8,192,000	16,384,000	32,768,000

15 mos.

Date: 11/9/18 Inv 2.2 Day 6

Mold

Equation (copy from the book): $m = 50(3^d)$

Let m = area of mold (mm^2)
Let d = days

Creating a table **before you answer the questions** in this investigation may be helpful.

Mold Growth

Days	Area of Mold ()	
0	50	$50(3^0)$
1	150	$50(3^1)$
2	450	
3	1350	
4	4050	← 6400
5	12,150	

A) 1. What is the area of the mold at the start of the experiment? Explain.

$50 \, mm^2$ The area on 0 days.

(0,50) → y intercept 50 is the coefficient

2. What is the growth factor? Explain.

3 multiplying area by 3 to get the next area.

the base in the equation

3. What is the area of the mold after 5 days? Explain.

$12,150 \, mm^2$ $m = 50(3^d)$ Substitute 5 in for the d.

4. On which day will the area of the mold reach 6,400 ?

5days.

B) $y = a(b^x)$

1. What is the value of b in the mold equation? What does this value represent? Does this make sense for this situation? Explain.

$b = 3$ base = growth factor

Yes, it makes sense

2. What is the value of a in the mold equation? What does this value represent?

$a = 50$

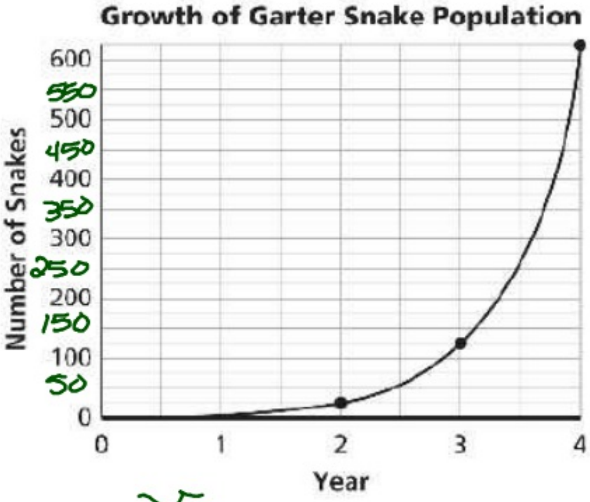
coefficient

y-intercept

area of mold @ 0 days.

Date: 11/13/18 Inv 2.3 Day 7

Garter Snake Population Growth



A) 1. Population Year 2 = 25 snakes

Year 3 = 125 snakes

Year 4 = 625 snakes

$\downarrow \cdot 5$

$\frac{625}{125} = 5$

$\frac{125}{25} = 5$

2. Year 1 = 5 snakes

$\frac{25}{5}$

3. Explain how you can find the y-intercept for the graph.

$x = 0$ @ the y-intercept

$\frac{5}{5} = 1$

There was 1 snake at year 0.

x	y
0	1
1	5
2	25
3	125
4	625

$\uparrow \div 5$

$\frac{5}{5} = 1$

$\boxed{\text{Divide the number of snakes in year 1 by the growth factor (5.)}}$

B) Explain how to find the growth factor.

Divide the number of snakes by the previous year's number of snakes.

C) Write an equation. Explain what all the letters and numbers represent.

$y = a(b^x)$

the y value when $x = 0$ — 1 snake @ year 0

growth factor — 5

$y = 1(5^x)$

Let x = year #

Let y = # of snakes

D) Year about 5 = 1,500 snakes Explain or show work.

625(5)

4	5
625	3125

E) Who is correct? Why?

Chuck is correct.

It is a function because every input only has 1 output (including at $x=4$).

The graph is deceptive.

Day 8 is a Quiz Day.

Date: 11/15/18 Inv 3.1 Day 9

Growth of Rabbit Population

Time (yr) n	Population p
0	100
1	180
2	325
3	583
4	1,050

$\cdot 1.8$

A) 1. What is the growth factor? Be sure you show all work.

1.8 $\frac{180}{100} = 1.8$ $\frac{325}{180} = 1.8$ $\frac{583}{325} = 1.8$

2. Write an equation. Explain what all numbers and variables mean for this situation.

$y = a(b^x)$ $y = 100(1.8^x)$ $p = 100(1.8^n)$

a: 100 rabbits @ 0 years

b: growth factor (1.8)

3. How many rabbits will there be after 10 years? 25 years? 50 years?

$n = 10$ years
$p = 100(1.8^{10})$
$p = 35,704$ rabbits

$n = 25$ years
$p = 100(1.8^{25})$
$p = 2,408,86,592$ rabbits

$n = 50$ years
$p = 100(1.8^{50})$
$p = 5.8 \times 10^{14}$
580,000,000,000,000

4. When is the first year that the population will exceed one million?

15	16
674,664	1,214,395

16 years

B) p = population (rabbits) n = years $p=15(1.2^n)$

1. What is the growth factor?

1.2 (base)

2. What was the initial population?

15 (coefficient)

3. In how many years will the initial population double?

4. What will the population be after 3 years? How long will it take for this amount to double?

5. What will the population be after 10 years? How long will it take for this amount to double?

6. Compare your doubling time answers in numbers 3 through 5. Do you think this will always be true?

Percent Change = $\frac{New-Old}{Old} \cdot 100$

Date: 11/19/19 Inv 3.2 Day 10

$\frac{8}{10} = \frac{80}{100}$

1.80 factor
80% increase

$1.8 = \underbrace{1}_{100\%} + \underbrace{.80}_{80\%}$

Growth rate: percent increase

A) 1.

Sam's Stamp Value at 6%

Year	Value
0	2500
1	2650
2	2809
3	2977.54
4	3156.19
5	3345.56

$\frac{2650}{2500} = 1.06$

$\frac{2809}{2650} = 1.06$

$\frac{2977.54}{2809} = 1.06$

$\frac{3156.19}{2977.54} = 1.059999194$

$\frac{3345.56}{3156.19} = 1.059999556$

$.06(2500) = 150$

$2500 + 150 = 2650$

$.06(2650) = 159$

$2650 + 159 = 2809$

$.06(2809) = 168.54$

$2809 + 168.54$

$.06(2977.54) = 178.6524$

$2977.54 + 178.65$

$.06(3156.19) = 189.3714$

$\underbrace{189.37}_{6\%} + \underbrace{3156.19}_{100\%}$

1.06
1+.06

6%
↓
.06

2. Is this an exponential relationship? How do you know?

This is exponential because we multiply each y value by a growth factor of 1.06 to get the next y value.

3. Write an equation.

Let x = years
Let y = value ($)

$y = a(b^x)$
$a = 2500$
$b = 1.06$

$y = 2500(1.06^x)$

4. How many years will it take to double the value?

$2500 + 2500$

$2500(2) = 5000$

~~10 yrs~~
$y = 2500(\cancel{1.06^{10}}) = 4477.12$

12 yrs
$y = 2500(1.06^{12}) = 5030.49$

~~11 yrs~~
$y = 2500(\cancel{1.06^{11}}) = 4745.75$

12 years

$100\% + 6\%$
$1 + .06 = 1.06$

B) 1.

$100\% + 4\% = 104\%$ growth rate
1.04 growth factor

Sam's Stamp Value at 4%

Year	Value
0	2500
1	2600
2	2704
3	2812.16
4	2924.65
5	3041.63

2. What is the growth factor?
1.04

3. Write an equation.
$y = 2500(1.04^x)$

4. How many years will it take to double the value?
$2(2500) = 5000$
18 years

~~If x=8 y=2500(1.04^8)=3421.42~~
~~If x=15 y=2500(1.04)^15=4502.36~~
If x=18 $y = 2500(1.04)^{18} = 5064.54$
~~If x=17 y=2500(1.04^17)=4869.75~~

5. How does the change in percent affect the graphs?

C) 1. Find the growth factor associated with each growth rate.
a. 0% $100 + 0 = 100\%$ → 1
b. 15% $100\% + 15\% = 115\%$ → 1.15
c. 30% $100 + 30 = 130\%$ → 1.30
d. 75% $100 + 75 = 175\%$ → 1.75
e. 100% $100 + 100 = 200\%$ → 2
f. 150% $100 + 150 = 250\%$ → 2.50

2. How can you find the growth factor if you know the growth rate?
Growth Rate + 100% ← Change to Decimal

D) 1. Find the growth rate associated with the growth factor.
a. 1.5 $150\% - 100 = 50\%$
b. 1.25 $125\% - 100 = 25\%$
c. 1.1 $110\% - 100 = 10\%$
d. 1 $100\% - 100 = 0\%$

2. How can you find the growth factor if you know the growth rate?
Change the factor to a %, subtract 100

$I = prt$ $I = p(a r)(t\, y)$

Date: 11/26/18 Inv 3.3 Day 11

Simple Interest = principal · annual rate · time years

Compound growth: calculate growth based on each new value.

"Earning Interest on your interest."

A) 1. Write an equation for each fund.

$y = a(b^x)$

Cassie: $y = 1250(1.04^x)$

Kaylee: $y = 2500(1.04^x)$

Let x = years

Let y = Value of Fund ($)

2.

Value of College Funds

1.04

Year	Cassie's Fund	Kaylee's Fund
0	$1,250	$2,500
1	1300	2600
2	1352	2704
3	1406.08	2812.16
4	1462.32	2924.65
5	1520.82	3041.63
6	1581.65	3163.30
7	1644.91	3289.83
8	1710.71	3421.42
9	1779.14	3558.28
10	1850.31	3700.61

50

52

100

104

$1850.31 - 1250.00 = 600.31$

$3700.61 - 2500.00 = 1200.61$

4. a. How does the initial value of the fund affect the yearly value increases?

$\frac{1200.61}{600.31} = 2$ $\frac{2500}{1250} = 2$

If you double the initial value, you will double the yearly increases.

b. How does the initial value of the fund affect the growth factor?

The initial value does not affect the growth factor.

c. How does the initial value of the fund affect the final value?

$\frac{3700.61}{1850.31} = 2$

Doubling I.V. will double the final value.

$2 \cdot y = 2 \cdot I(1.04^x)$

Matt's : $2000 \cdot 1.05 \cdot 1.05 \cdot 1.05 \cdot 1.05$

B) 1. Identify:

Initial value = 2000

Growth rate = 5%

Growth factor = 1.05 $\longrightarrow$ 105%

Number of years = 4

2. How much will the fund be worth in one more year? (5yrs)

$2552.56

C) Which is the better option? Explain

Date: 11/27/18 Day 12

Inv 4.1

Areas of Ballots

n A

Number of Cuts	Area (in.²)
0	64
1	32
2	16
3	8
4	4
5	2
6	1
7	.5
8	.25
9	.125
10	.0625

$\frac{1}{2}$ $\frac{1}{4}$ $\frac{1}{8}$ $\frac{1}{16}$

$\downarrow \cdot .5$

$\div 2$

$\cdot .5$ OR $\cdot \frac{1}{2}$

$y = a(b^x)$

$y = 64(.5^x)$

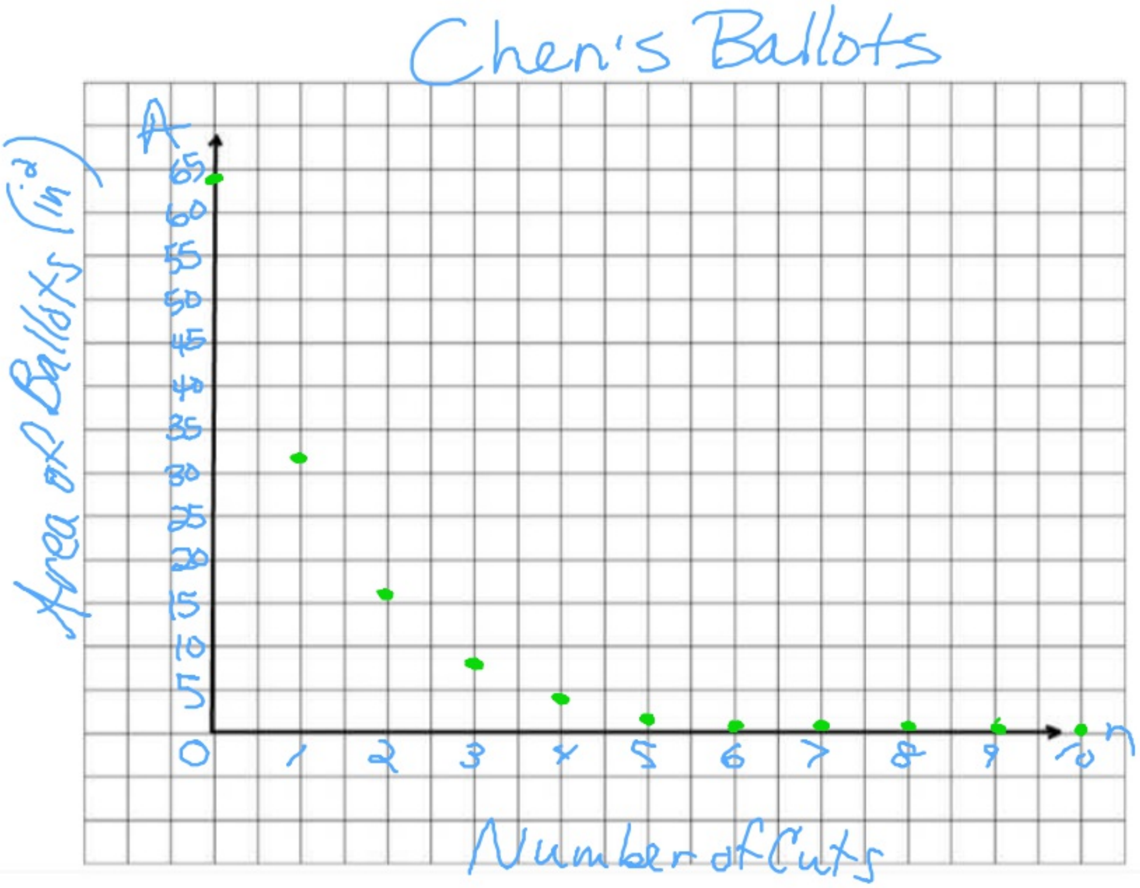
B How does the area of a ballot change with each cut?

The area was cut in half each time. $(\div 2)$

C Write an equation for the area A of a ballot after any cut n.

$A = 64(.5^n)$

D Make a graph of the data.



E

1. How is the pattern of change in the area different from the exponential growth patterns you studied? How is it similar?

decreasing exponential → multiplying by a set number

2. How is the pattern of change in the area different from linear patterns you studied? How is it similar?

all are functions

not a straight line

Date: 11/28/18 Day 13 Inv 4.2

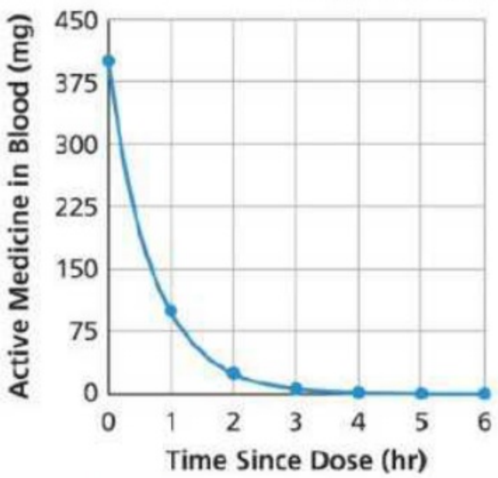
Exponential decay: just like exponential growth except the numbers get smaller.

Decay factor: just like growth factor except it must be between 0 and 1

must be bigger than 1

$\frac{100}{400} = .25$

Breakdown of Medicine



Time Since Dose (hr)	Active Medicine in Blood (mg)
0	400
1	100
2	25
3	6.25
4	1.5625
5	0.3907
6	0.0977

$\div 4$ $\cdot .25$

$\div 4$

$\cdot \frac{1}{4} = .25$

A Study the pattern of change in the graph and the table.

1. How does the amount of active medicine in the dog's blood change from one hour to the next?

The amount of medicine is being divided by 4.
(multiplied by $.25 = \frac{1}{4}$)

2. Write an equation to model the relationship between the number of hours h since the dose is given and the milligrams of active medicine m.

$m = 400(.25)^h$

4. Does the relationship displayed in the table and graph represent an exponential function? Explain.

Yes, it is exponential because we multiplied each y value by the same factor (.25) to get the next one.

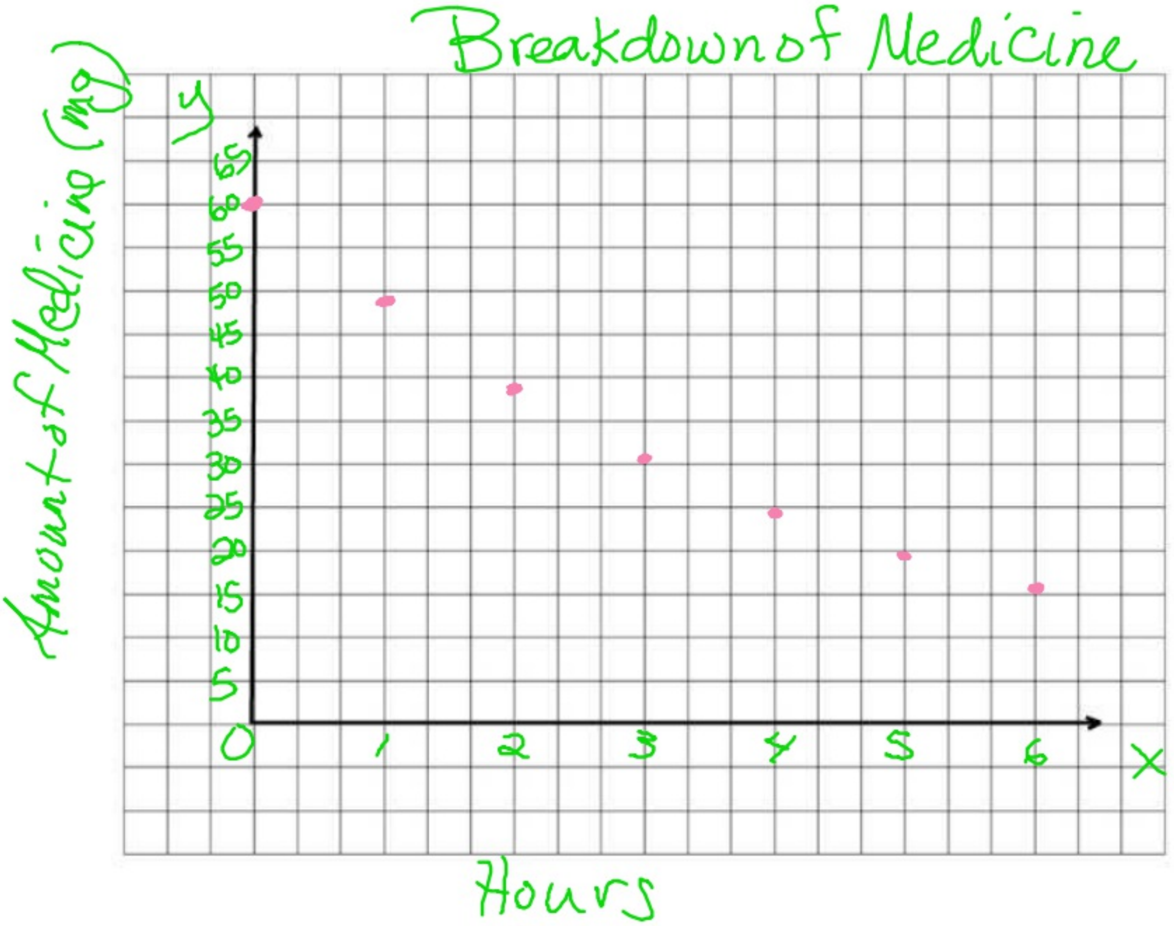
Breakdown of Medicine

$.20(60)=12$
$60-12=48$
$100\%-20\%=80\%$
$.8$

B 1. A different flea medicine breaks down at a rate of 20% per hour. This means that as each hour passes, 20% of the active medicine is used. This is the **rate of decay** of the medicine. The initial dose is 60 milligrams. Extend and complete this table to show the amount of active medicine in an animal's blood at the end of each hour for 6 hours.

Time Since Dose (hr)	Active Medicine in Blood (mg)
0	60
1	48
2	38.4
3	30.72
4	24.576
5	19.6608
6	15.72864

2. Make a graph using the table you completed in part (1).



Day 14 is a Quiz Day.

Date: 12/3/18 Practice with scientific notation Day 15 NO BOOK TODAY!!

Convert from scientific notation to standard form.

1) 4.83×10^{-3} .00483 .00483

2) 9×10^{3} 9,000 9000

3) 8.2×10^{0} 8.2

4) 8.291×10^{-3} 8.291 .008291

5) 1.939×10^{3} 1,939 1939

Convert from standard form to scientific notation.

1) 8.58 8.58×10^{0}

2) 0.0000076 7.6×10^{-6}

3) 0.0000038 3.8×10^{-6}

4) 0.0002829 2.829×10^{-4}

5) 2.55 2.55×10^{0}

2.829 $\boxed{2^{nd}}$ $\boxed{x^{-1}}$ EE (-)4 $\boxed{E}$

2nd

FF.

Convert each problem to standard form.

1) 3.06707e+10 3.06707×10^{10} 30,670,700,000

2) 1.09338e+11 109,338,000,000

3) 3e+10 30,000,000,000

4) 7.6621e+6 7,662,100

5) 9.10296e+8 910,296,000

6) 3e+9 3,000,000,000

7) 1.37188e+12 1,371,880,000,000

8) 5.91088e+9 5,910,880,000

Date: 12/3 Inv 5.2 Day 16

A. 1. $7^4 \cdot 7^3 = 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 = 7^7$

$x^2 \cdot x^5 = x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x = x^7$

2. Observations:

3. $a^m . a^n =$ $a^m \cdot a^n = a^{m+n}$ Add the exponents.

B. 1. Fact Families $2 \cdot 5 = 10$ $\frac{10}{5} = 2$ $\frac{10}{2} = 5$ $\frac{7^7}{7^4} = 7^3$

$\frac{x^7}{x^2} = x^5$

2. Observations

3. $\frac{a^m}{a^n} =$ $\frac{a^m}{a^n} = a^{m-n}$ Subtract the numbers

C. 1. $\frac{15}{20} = \frac{5 \cdot 3}{5 \cdot 4} = \frac{3}{4}$

$\frac{x^4}{x^3} = \frac{x \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x}}{\cancel{x} \cdot \cancel{x} \cdot \cancel{x}} = x^1$ OR x

2. Observations

3. $a^m . b^m =$

$a^m b^m = (ab)^m$

$2^3 5^3 = (2 \cdot 5)^3$

$2 \cdot 2 \cdot 2 \cdot 5 \cdot 5 \cdot 5$

$(2 \cdot 5)(2 \cdot 5)(2 \cdot 5)$

$(4x)^{14} = 4^{14} \cdot x^{14}$

$5^1 x^3 \cdot 5^2 x^6 = 5^3 x^9$

$5 \cdot x^3 \cdot 5^2 \cdot x^6$

$5 \cdot 5^2 \cdot \underbrace{x^3 \cdot x^6}$

$5^3 x^9$

12/4/18

$a^5 = \underbrace{a \cdot a \cdot a \cdot a \cdot a}$ $\qquad$ $a^2 = \underbrace{a \cdot a}$

$a^5 \cdot a^2 = a \cdot a \cdot a \cdot a \cdot a \cdot a \cdot a = a^7$

$m^4 \cdot m^7 = m \cdot m \cdot m \cdot m \cdot m \cdot m \cdot m \cdot m \cdot m \cdot m \cdot m = m^{11}$

1. $y^{11} \cdot y^{20} = y^{31}$
2. $f^5 \cdot f^{13} = f^{18}$
3. $6^4 \cdot 6^7 = 6^{11}$

$\frac{a^5}{a^2} = \frac{a \cdot a \cdot a \cdot \cancel{a} \cdot \cancel{a}}{\cancel{a} \cdot \cancel{a}} = a^3$

$\frac{8^4}{8^2} = \frac{8 \cdot 8 \cdot \cancel{8} \cdot \cancel{8}}{\cancel{8} \cdot \cancel{8}} = 8^2$

4. $\frac{m^{14}}{m^6} = m^8$
5. $\frac{9^{12}}{9^2} = 9^{10}$
6. $\frac{z^{25}}{z^{24}} = z^1 = z$
7. $\frac{a^{16}}{a^{16}} = a^0 = 1$

$5^1 = 5$ $\qquad$ $5^0 = 1$

$7^1 = 7$ $\qquad$ $7^0 = 1$

$11^1 = 11$ $\qquad$ $11^0 = 1$

$152^1 = 152$ $\qquad$ $152^0 = 1$

Simplify $\frac{e^{14}e^{6}}{e^{52}} = \frac{e^{20}}{e^{52}} = e^{-32} = \frac{1}{e^{32}}$

Simplify using <u>only</u> positive exponents.

$e^{-32} = \frac{1}{e^{32}}$

$5^{-2} = \underbrace{\frac{1}{5} \times \frac{1}{5} = \frac{1}{25}} = \frac{1}{5^2}$

$m^{-3}n^{4} = \frac{n^4}{m^3}$

$7^{-4} = \frac{1}{7^4}$

$18^{-2} = \frac{1}{18^2}$

$913^{-5} = \frac{1}{913^5}$

$7^{4} = \frac{1}{7^{-4}}$

$a^4 b^6$

$a^{-4} b^6$

$\frac{b^6}{a^4}$

$a^{-4} b^{-6}$

$\frac{1}{a^4 b^6}$

$$(a^7)^3 = a^7 \cdot a^7 \cdot a^7 = a^{21}$$

$$(6^4)^7 = 6^{28}$$

11 $(11 \cdot 5)^8 = 11^8 \cdot 5^8$

12 $(xy)^7 = x^7 y^7$

6^7

12|5|18 More Laws of Exponents

① $x^7 \cdot x^{14} = x^{21}$

② $x^3 \cdot x^{-10} = x^{-7}$

③ $x^4 \cdot x^0 \cdot x^6 \cdot x^1 = x^{11}$

④ $(6x)^4 = 6^4 x^4$

⑤ $(xyz)^{10} = x^{10} y^{10} z^{10}$

⑥ $(x^2 y^1)^4 = x^8 y^4$ $x^2y \cdot x^2y \cdot x^2y \cdot x^2y$

⑦ $\frac{x^{10}}{x^5} = x^5$

⑧ $x^{17} \div x^{12} = x^5$

⑨ $\frac{7^4}{7^1} = 7^3$

⑩ $\left(\frac{a}{b}\right)^5 = \frac{a^5}{b^5}$

⑪ $\left(\frac{3^1x^4}{y^7}\right)^9 = \frac{3^9x^{36}}{y^{63}}$

⑫ $(10x^4y^3)^7 = 10^7 x^{28} y^{21}$

⑬ $\left(\frac{5x^7 \cdot 5x^6}{5x^4}\right)^3 = \left(\frac{5^2x^{13}}{5x^4}\right)^3 = (5^1x^9)^3 = 5^3x^{27}$

⑭ $\left(\frac{5x^7 \cdot 5x^6}{5x^4}\right)^3 = \frac{5^3x^{21} \cdot 5^3x^{18}}{5^3x^{12}} = \frac{5^6x^{39}}{5^3x^{12}} = 5^3x^{27}$

⑮

D. 1.

2. Observations

3. $\left(a^m\right)^n =$

E. 1. Show why $a^0 = 1$.

2. Show why $a^{-1} = \frac{1}{a}$

3. $a^{-m} =$

READ PP. 80-81 IN THE BOOK

Date: ____ Inv 5.3 Day 17

A) What does $16^{\frac{3}{2}}$ mean?

2. Find the value of each of the following. Show your method.

a. $8^{\frac{5}{3}}$ **b.** $125^{\frac{4}{3}}$

B **1.** Use what you learned about roots to compute each of the following.

a. $4^{\frac{3}{2}} \cdot 4^{\frac{1}{2}}$ **b.** $4^{\frac{1}{3}} \cdot 2^{\frac{1}{3}}$ **c.** $\left(2^{\frac{5}{3}}\right)^3$ **d.** $\dfrac{25^{\frac{3}{2}}}{25^{\frac{1}{2}}}$

2. Use the rules for integral exponents to compute the answer in a different way for each of the expressions in part (1). Do you get the same numbers? Explain why or why not.

C Suppose that in Problem 1.2, R is the number of rubas on the nth square of a chessboard. Mari and Latrell came up with the following two equations for R.

Mari	Latrell
$R = \frac{1}{2}(2^n)$	$R = 2^{n-1}$

Which equation is correct? Explain.

D Suppose that in Problem 1.4, the number of cuts is n and the area of each piece is A. Jakayla, Mari, and Latrell came up with three ways to express the exponential relationship.

Mari	Latrell	Jakayla
$A = \frac{64}{2^n}$	$A = 64(0.5^n)$	$A = 64(2^{-n})$

Are these all correct? Explain.

E Use the rules of exponents to write an equivalent expression for each of the following.

1. $x^{\frac{1}{2}} \cdot x^{\frac{3}{2}}$
2. $x^{\frac{2}{3}} \div x^{\frac{7}{6}}$
3. $\left(2x^{\frac{1}{2}}\right)^2$
4. $\left(16x^{\frac{4}{3}}\right)^{\frac{1}{2}}$