

Exponential Growth & Decay

Agenda

Warm-Up
(Card Sort)

HW Wheel Spin

Notes

HW #1-9
ODDS

Reminders

HW 5.6 is LATE

Test on Friday!

Warm-Up Monday

TURN IN THIS WEEKENDS' HW ASSIGNMENT

The situations in the cards represent either an exponential GROWTH or DECAY.

1. Sort the cards into these 2 categories.
2. How can you tell if it is a growth or decay?
Write this answer in the Monday box.

Jaime buys a new car for \$23,520 and expects the car to lose value, or depreciate, by 15% each year.

The table of values below shows average annual salaries of professional basketball players in the United States beginning in 1980.

Year	1980	1985	1990	1995	1996
Average salary in thousands	170	325	750	1,900	2,000

Algebra I - Unit 9: Topic 1 –Exponential Functions

Practice – Writing Functions of Exponential Equations

Name _____ Date _____ Period _____

Write the function rule for each, then use your calculator to answer the questions.

1.

x	-2	-1	0	1	2
y	5	25	125	625	3125

Function Rule: _____

What is the value of y when x is -3?What is the value of x when y is 390,625?

2.

x	-3	-2	-1	0	1
y	32	16	8	4	2

Function Rule: _____

What is the value of y when x is 5?What is the value of x when y is 16,384?

3.

x	-2	-1	0	1	2
y	$\frac{1}{81}$	$\frac{1}{27}$	$\frac{1}{9}$	$\frac{1}{3}$	1

Function Rule: _____

What is the value of y when x is 6?What is the value of x when y is 6561?

4. Use the data in the table to describe how the ladybug population is changing. Write a function that models the data. Use your function to predict the ladybug population after one year.

Ladybug Population	
Time (mo)	Ladybugs
0	10
1	30
2	90
3	270

How data is changing:

Function rule: _____

Number of lady bugs after one year: _____

5. Which function best models the data $\{(-4, -2), (-2, -1), (0, 0), (2, 1), (4, 2)\}$?

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

B $y = \frac{1}{2}x$

C $y = \frac{1}{2}x^2$

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

Algebra I - Unit 9: Topic 1 –Exponential Functions

Use the data from each problem below to calculate an equation of best fit, then use the equation to answer the questions.

6. The table shows the number of computers in a school for four years. Write a function to model the data. Use your function to predict how many computers the school will have in 2006 if the pattern continues.

Number of Computers				
Year	'00	'01	'02	'03
Computers	14	28	56	112

Function Rule: _____

Prediction of computers in 2006: _____

7. What type of function does the data $\{(-6, 17), (-7, 20), (-8, 23), (-9, 26)\}$ represent?

8. The chart below shows the ticket sales for movies on a certain screen at one theater over four days.

Day	# Tickets
1	3000
2	2400
3	1920
4	1536

Function rule: _____

How many tickets were sold on Day 8? _____

9. Use the data in the table to describe how the restaurant's sales are changing. Then write a function that models the data. Use your function to predict the amount of sales after 10 years.

Restaurant				
Year	0	1	2	3
Sales (\$)	20,000	19,000	18,050	17,147.50

How data is changing: _____

Function rule: _____

Amount of sales after ten years: _____



Exponential Growth & Decay

Growth

The table of values below shows annual salaries of professional players in the United States:

Year	1980	1985	1990
Average salary in thousands	170	325	750

The wall of Mr. Jones' house has about 1,200 termites. The table below represents data collected over several days.

Days	0	1	2	3	4
"	200	1,228	1,260	1,258	1,321

Lady Gaga started her Twitter account and had 50 followers. Each day her number of followers tripled in size.

in his bank. Each day he plans to double the number of dollars in the bank.

An initial count of the population of rabbits in an area is 150. After 2 years the rabbit population is 300. After 4 years, the rabbit population is 600.

There are 30 zombies headed to your town. Each one bites four people every day.

Decay

The amount of caffeine in a beverage is 150mg. Every hour the caffeine in your system decreases at a rate of 15%.

An electric car's battery loses $\frac{1}{5}$ battery life every hour of use.

Jaime buys a new car for \$23,520 and expects the car to lose value, or depreciate, by 15% each year.

A basketball tournament starts with 128 teams. After each round half of the teams are eliminated.

A scientist is conducting an experiment with an antibiotic on a colony of bacteria. The antibiotic he introduces kills 2% of the bacteria colony each hour.

A chemist has a 10 g sample of a radioactive isotope with a half-life of 86 minutes.

The amount of a pesticide in a fish population

Year	0	1	2
Pesticide Concentration	19.19	13	11.31

The sequence below shows the purchase price of a new motorcycle and its value each year for several years after purchase. \$29,873; \$24,186; \$20,579; \$17,406

Exponential Growth & Decay

1. Identify the characteristics of an exponential function.

$$f(x) = a \cdot b^x$$

Diagram illustrating the components of the exponential function $f(x) = a \cdot b^x$:

- a : scale factor (initial amount) $x=0$
- b : base (multiplier)
- x : exponent

$$b > 1 \Rightarrow \text{growth}$$
$$0 < b < 1 \Rightarrow \text{decay}$$

If $b > 1$, your equation is exponential _____

If $b < 1$, your equation is exponential _____

Exponential Growth & Decay

2. The data in the table below represents the relationship between the amount of bacteria over time.

Time (h)	0	1	2	3
Bacteria	10	20	40	80

- A. Plot the data points and then connect.
B. What type of function does this data appear to represent?

exponential
How do you know?
• curve \rightarrow not $\approx u$
• multiplying

- C. Write an equation to represent this data.

$y = 10 \cdot 2^x$ $a \rightarrow$ initial
 $b \rightarrow$ mult.

- D. Predict how much bacteria there would be after half a day.

40,960

$x = 12$

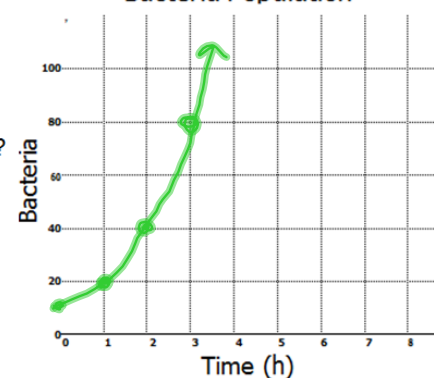
- E. After how many hours was the amount of bacteria 10,240?

10 hours

$y = 10240$

- F. What type of exponential function does this data represent? (Growth/Decay). Justify your answer.

Bacteria Population



Exponential Growth -

increasing \nearrow

Exponential Decay -

decreasing \searrow

Exponential Growth & Decay

Steps to calculate exponential regression:

Process	Purpose
Step 1. STAT, EDIT, L ₁ , L ₂	Enter in the data X's \rightarrow L ₁ Y's \rightarrow L ₂
Step 2. STAT, CALC, 0 (ExpReg), ENTER	calculates equation
Step 3. Plug equation into y=	find specific values on table

Exponential Growth & Decay

Use an exponential regression to write an equation for each function. Determine if the equation models a growth or decay. Answer the following questions. Round to the nearest hundredth.

3.

x	-7	-3	-2	-1
y	81920	320	80	20

Function Rule:

b = 0.25

Exponential Growth/Decay (Choose one)

Equation: $y = 5(0.25)^x$
 $a < 1$

5.

x	1	2	3	4
y	1.05	1.58	2.36	3.54

Function Rule:

b = 1.05

Exponential Growth/Decay (Choose one)

Evaluate f(7).

NORMAL FLOAT AUTO REAL RADIAN MP

ExpReg

y=a*b^x

a=.7014814831

b=1.498889718

$f(x) = y$ $x = 7$
 11.92

4.

x	-1	1	2	3
y	2.5	3.6	4.32	5.184

Function Rule:

b =

Exponential Growth/Decay (Choose one)

6.

x	-5	-1	2	3
y	32	2	.25	0.125

Function Rule:

b =

Exponential Growth/Decay (Choose one)

What is the value of x when f(x)=4096?

Exponential Growth & Decay

7. How does the value of b in an exponential equation affect the growth/decay of a function?

8. The Johnson Company calculated the value of its stock for the past 4 years.

Years	1	2	3	4
Stock value (\$)	117.60	115.25	112.94	110.68

A. Write an exponential equation that models this data.

$$y = 120(0.98)^x$$

B. What is the initial stock value? $x=0$

\$120

C. What is the growth or decay factor?

0.98

decay

D. What is the estimated stock value in 10 years? $x=10$

\$98.04

E. Would you invest money into the Johnson Company? Justify your answer.

;)

NORMAL FLOAT AUTO REAL RADIAN HP

ExpReg

$y = a \cdot b^x$

$a = 120.0033068$

$b = .9799845606$

Algebra I Unit 9 Exponential Functions

Student Practice – Writing Functions of Exponential Growth and Decay

Name _____ Date _____ Period _____

Use an exponential regression to write the function rule for each. Determine if the equation models a growth or decay and answer the following questions. Round to the nearest hundredth.

1.

x	1	2	3	4
y	2	1	0.5	0.25

Function Rule: _____

Exponential Growth/Decay (Choose one)

- A. What is the value of y when x is -3 ?
- B. What is the value of x when y is $32,768$?

2.

x	2	3	4	5
y	0.85	0.25	0.08	0.02

Function Rule: _____

Exponential Growth/Decay (Choose one)

- A. Evaluate $f(-5)$.
- B. What is the value of x when y is 123.56 ?

3.

x	-1	1	3	4
y	0.71	22.4	702.46	3933.8

Function Rule: _____

Exponential Growth/Decay (Choose one)

- A. What is the y -intercept of the function?
- B. Evaluate $f(-2)$.

4.

x	-5	-4	-3	-2
y	1024	256	64	16

Function Rule: _____

Exponential Growth/Decay (Choose one)

- A. Evaluate $f(-8)$.
- B. What is the value of x when y is 1 ? What is another name for this point?

5.

x	-1	1	2	3
y	8	18	27	40.5

Function Rule: _____

Exponential Growth/Decay (Choose one)

- A. Evaluate $f(3)$.
- B. What is the value of x when y is 205.03 ?

6. The following table represents the population growth since 2000.

Years since 2000	4	8	12	16
Population	336	5,376	86,016	1,376,256

Function Rule: _____

Exponential Growth/Decay (Choose one)

- A. What was the initial population in 2000?
- B. What was the population in 2013?

Algebra I Unit 9 Exponential Functions

7. The following table demonstrates the value of a car after its purchase.

Years since purchase	1	2	3	4
Value (\$)	22,080	20,314	18,689	17,193

- A. Use an exponential regression to calculate the function rule. Is it a growth or decay model?
- B. What is the initial value of the car?
- C. After how many years is the car first worth less than \$15,000?

8. The data below show the length of a Gila monster during the beginning of its life.

# of weeks since birth	1	2	3	4
Length (cm)	19.2	23.04	27.65	33.8

- A. Use an exponential regression to calculate the function rule. Is it a growth or decay model?
- B. Predict the length of the Gila Monster after 2 months.

9. Every hour that Ibuprofen is in your system, the medicine dissolves exponentially.

Time (hr)	1	2	3	4
Medicine in body (mg)	600	450	337.50	253.13

- A. Write a function that models the amount of Ibuprofen remaining in your body.
- B. What is the initial dosage taken?
- C. It is safe to retake medicine when there is less than 200 mg left in the body. How long before you can take more medicine?

HW Help: Exponential Growth & Decay

No Work = No Credit = No Kidding!

1. $y = 4(0.5)^x$ Since $b < 1$, this is a DECAY (the numbers are decreasing in your table).
 - A. 32. Use your table and find $x = -3$
 - B. -13. Use your table and find $y = 32,768$. You have to go backwards!
3. $y = 3.99(5.6)^x$. This is a GROWTH (the numbers are increasing in your table)
 - A. Y-intercept is where $x = 0$!
 - B. $f(-2)$ means find Y when X is -2!
5. You try! Remember, x's go in L1 and y's go in L2!
7. A. $y = 24000(0.92)^x$. This is a decay model - the value of the car is decreasing.
 - B. The initial value is when $x = 0$...find it in your table!
 - C. Scroll through your table. When is y less than 15,000?
9. You try!

Need help or a calculator? Drop by tutorials!