Warm-Up 1-10

1. Define a linear function.

2. Define an exponential function.

3. Note some differences and similarities between exponential and linear functions.

Warm-Up 1-10

1. Define a linear function.
- a function that is a line
- it function that has a constant rate of change (difference)

2. Define an exponential function.
- a function that increases using multiplication/division
- it function that has a changing rate of change (common ratio)
- starts slowly and then changes a lot

3. Note some differences and similarities between exponential and linear functions.

Differences
- One is a line and the other is curved
- linear grows by a constant rate and exponential is changing
- linear grows by adding or subtracting and exponential by multiplying/ dividing

Similarities
- they are both functions
- they can be discrete or continuous
- they can increase or decrease
- they both can be graphed

Compare Linear and Exponential Functions

Name ______________________ Date ______________

Sara has been asked to babysit for a neighbor. She is offered two payment options. With the first plan, she is paid $5.00 per hour. With the second plan, she is paid $0.25 for one hour, $0.50 for two hours, $1.00 for three hours, and so on, as shown in both the graph and the table.

Hours	Plan 1	Plan 2
1	5.00	0.25
2	10.00	0.50
3	15.00	1.00
4	20.00	2.00
5	25.00	4.00
6	30.00	8.00
7	35.00	16.00
8	40.00	32.00
9	45.00	64.00
10	50.00	128.00

1. What type of function is represented by Plan 1? Linear

2. What type of function is represented by Plan 2? Exponential

3. How are the plans alike? Explain.

   paid per hour   paid in $ start $0 for 0 hours
   both increasing

4. How are the plans different? Explain.

   one adds $5   one doubles   one is Linear other exponential
   starts $5   other $0.25

5. Sara asks you which plan she should choose if she was going to babysit for four hours. What would you tell her? Justify your answer.

   Plan #1 : pays more at 4 hours

6. When should Sara choose Plan 2? Why?

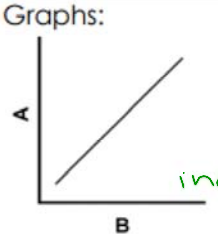
   At 9 or more hours because she will start earning more $.

Quiz

EXPLORING EXPONENTIAL FUNCTION GROWTH & DECAY (DAY 3)

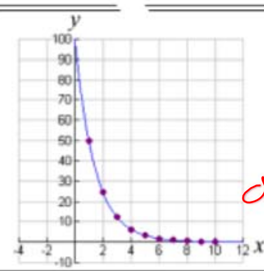
Linear Functions		Exponential Functions	
General Equation $y = ax + b$ $y = mx + b$	**Function Notation** $f(x) = ax + b$ $f(x) = mx + b$	**General Equation** $y = ab^x$	**Function Notation** $f(x) = ab^x$
		(recall: variable is the exponent for an exponential function)	
a = slope **b =** y-intercept		**a =** initial value (starting amount) **b =** rate of growth or decay **x =** usually time	
		Exponential Function are able to have both a positive or negative rate of change • Positive Rate of Change is called an exponential growth **To Get b# R.O.C:** $(1 + r)$ • Negative Rate of Change is called an exponential decay **To Get b# R.O.C:** $(1 - r)$	

Graphs:



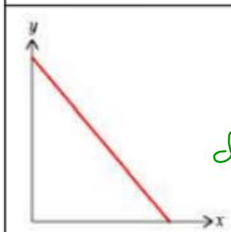
This is a graph of a positive line (slope)

increasing from left to right



This is a graph of an exponential decay

decreasing from left to right

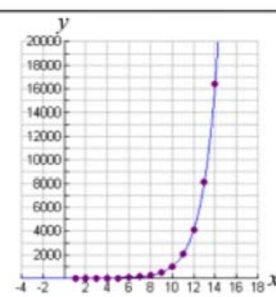


This is a graph of a negative line (slope)

decreasing from left to right

This is a graph of an exponential growth

increasing from left to right



Exponential Growth & Decay

Any quantity that grows or decays by a fixed percent at regular intervals is said to possess **exponential growth** or **exponential decay.**

Exponential Function General Equation:

$-\log_{10}(h+)$

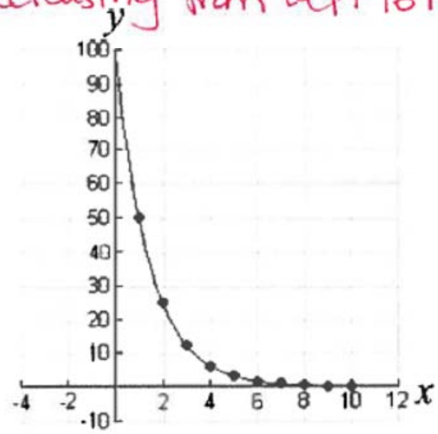
$$y = ab^x$$

x: Time Period ex: #years

a: Starting amount or Initial Value

b: Rate: Change % to decimal
Growth: (1 + decimal) b>1
Decay: (1 − decimal) b<1

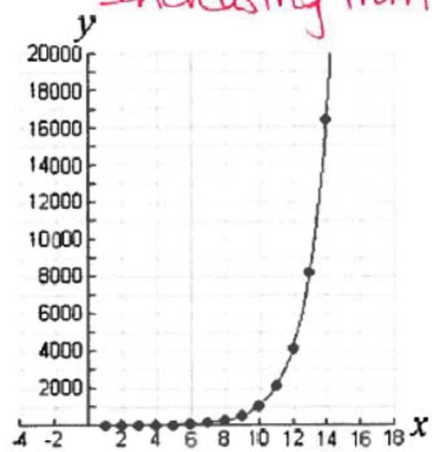
Decreasing from Left to Right



This situation is called an exponential Decay.

b<1 (decimal)

Increasing from Left to Ri



This situation is called an exponential Growth.

b>1

6

1. Identify the following equation as either linear or exponential.

a) $f(x) = 3^x + 2$ b) $2y = -5x + 1$ c) $y = 7$ d) $C(x) = 16,332(1.052)^x$

Exp. Linear Linear Exp.

For questions #2 – 5:

a. State whether the function is a growth or decay.

b. State the initial value.

ab^x

2. $c(t) = 100(.75)^t$ 3. $p(n) = 40(1.80)^n$ 4. $t(x) = 10,000(1.02)^x$ 5. $f(n) = 50(.1)^n$

a "initial value" b rate of decay growth growth decay

Steps for writing and solving Functions:

- Identify the type of function (Linear: $y = ax + b$ or Exponential: $y = ab^x$)
- If Exponential:
  - Determine a# - initial amount (start #)
  - Determine b#:
    - Exponential Growth: 1+rate (%)
    - Exponential Decay: 1 – rate (%)

a ½, 0.5 b

6. A tennis tournament has 128 competitors. Half of the competitors are eliminated each round. Write a function to represent the number of competitors that will be left after "x" rounds. Then determine how many players will be left after 5 rounds.

$128(1-0.5)^x = 128(0.5)^x$ $128(0.5)^5 = 4$ players

a

7. A three-bedroom house in Burbville was purchased for $190,000. If housing prices are expected to increase by 1.8% annually in that town, write a function that models the price of the house in *t* years. Find the price of the house in 6 years. ab^x

$1.8\% = 0.018$ $190,000(1+0.018)^x = 190,000(1.018)^x$

$190000(1.018)^6 \approx \$211,465.86$

grow Linear

8. Jonathan makes a weekly allowance of $25. He also makes $9.50 an hour at his job. Write a function for the amount of money he makes each week based on the amount of hours, h, he works. How much will he make if he works 25 hours?

~~$25(1+9.5)^x$~~ ~~25 – a, 9.5 – b~~

$y = 25 + 9.50h$

$25 + 9.50(25) = \$262.50$

6

EXPONENTIAL APPLICATION WORD PROBLEMS (DAY 4)

1. In 1995, there were 85 rabbits in Central Park. The population increased by 12% each year. How many rabbits were in Central Park in 2005?

2. There are 500 rabbits in Lancaster on February 1st. If the amount of rabbits triples every month, write a function that represents the number of rabbits in Lancaster after "m" months. How many rabbits are there in Lancaster on August 1st?

3. The value of an early American coin increases in value at the rate of 6.5% annually. If the purchase price of the coin this year is $1,950, what is the value to the nearest dollar in 15 years?

4. In 1985, there were 285 cell phone subscribers in the small town of Centerville. The number of subscribers increased by 75% per year after 1985. How many cell phone subscribers were in Centerville in 1994?

5. The cost of Bob's house in 2005 was $220,000. If his house appreciates in value at a rate of 3.5% every year, what will the price of his house be in 2015?

6. Kelli's mom takes a 400 mg dose of aspirin. Each hour, the amount of aspirin in a person's system decreases by about 29%. To the nearest tenth of a milligram, how much aspirin is left in her system after 6 hours?

7. Ryan bought a new computer for $2,100. The value of the computer decreases by 50% each year. After what year will the value drop below $300?

8. Malik bought a new car for $15,000. His best friend, Will, told him that the car's value will drop by 15% every year. What will the car's value be after 5 years, according to Will?

9. In the 2000-2001 school year, the average cost for one year at a four-year college was$16, 332, which was an increase of 5.2% from the previous year. If this trend were to continue, the equation $C(x) = 16,332(1.052)^x$ could be used to model the cost, $C(x)$, of a college education x years from 2000.

   a) Find C(4). What does this number represent?

   b) If this trend continues, how much would parents expect to pay for their new born baby's first year of college? (Assume the child would enter college in 18 years.)

10. In 1993, the population of New Zealand was 3,424,000, with an average annual growth rate of 1.3%. Suppose that this growth rate were to continue.

   a) Express the population P as a function of n, the number of years after 1993.

   b) Estimate New Zealand's population in the year 2010.

Project

Infection Disease or Zombie Apocalypse

https://www.khanacademy.org/math/algebra/introduction-to-exponential-functions/exponential-functions-from-tables-and-graphs/v/constructing-linear-and-exponential-functions-from-data

Homework

Exponential equations
worksheet