Warm Up

11/17

What type of relationship does the data in each table below represent? **Provide evidence!**

x	y
3	4
4	3
6	2
12	1

x: +1, +2, +6

y: -1, -1, -1

y: $\times\frac{3}{4}$, $\times\frac{2}{3}$, $\times\frac{1}{2}$

x	y
3	5
5	-1
9	-13
10	-16

x: +2, +4, +1

y: -6, -12, -3

x	y
1	4
2	8
3	16
4	32

x: +1, +1, +1

y: +4, +8, +16

y: ×2, ×2, ×2

$\frac{\Delta y}{\Delta x} = \frac{-1}{1} \neq \frac{-1}{2} \neq \frac{-1}{6}$

Not Linear

No constant growth factor

$\boxed{\text{UNKNOWN}}$

$\frac{\Delta y}{\Delta x} = \frac{-6}{2} = \frac{-12}{4} = \frac{-3}{1}$

$= -3$

$\boxed{\text{LINEAR}}$

$\frac{\Delta y}{\Delta x} = \frac{4}{1} \neq \frac{8}{1} \neq \frac{16}{1}$

Not Linear

Constant Growth Factor = 2

$\boxed{\text{EXPONENTIAL}}$

Homework Questions?

Page 19, #'s 15, 17-21, 51

Recognizing Exponential Relationships Practice

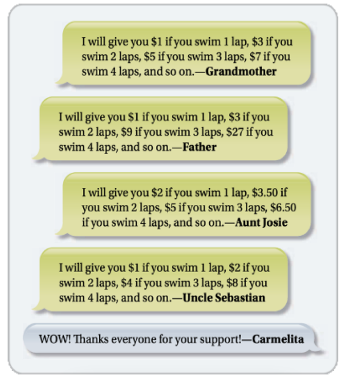
(These are ACE questions. The number from the book is included so you can check your answers.)

15. Carmelita is planning to swim in a charity swim-a-thon. Several relatives said they would sponsor her.

a. Decide whether each donation pattern is an exponential function, linear function, or neither. Filling in more of the table will help you recognize the pattern.

b. For each relative, write an equation.

c. For each plan, tell how much money Carmelita will raise if she swims 20 laps.



# of Laps	Grandmother	Father	Aunt Josie	Uncle Sebastian
1	1 (+2)	1 (×3)	2 (+1.5)	1 (×2)
2	3 (+2)	3 (×3)	3.50 (+1.5)	2 (×2)
3	5 (+2)	9 (×3)	5 (+1.5)	4 (×2)
4	7 (+2)	27 (×3)	6.5 (+1.5)	8 (×2)
5	9 (+2)	81 (×3)	8 (+1.5)	16 (×2)
6	11 (+2)	243 (×3)	9.5 (+1.5)	32 (×2)
7	13	729	11	64
a. Type of relationship (Circle one)	Linear / Exponential / Neither	Linear / Exponential / Neither	Linear / Exponential / Neither	Linear / Exponential / Neither
b. Equation (if there is one)	$y=2x-1$	$y=\frac{3^x}{3}$	$y=1.5x+0.5$	$y=\frac{2^x}{2}$
c. How much will she make for 20 laps?	$y=2(20)-1$ \$39	$y=\frac{3^{20}}{3}$ \$1,162,261,467	$y=1.5(20)+0.5$ \$30.50	$y=\frac{2^{20}}{2}$ \$524,288

For Exercises 17-21, study the pattern in each table.

a. Tell whether the relationship between *x* and *y* is linear, exponential, or neither.

b. If the relationship is linear or exponential, write its equation. ***Make sure to test your equation with one or more values from your table.***

17.

x	0	1	2	3	4	5
y	10	12.5	15	17.5	20	22.5

+1 +1 +1 +1 +1

+2.5 +2.5 +2.5 +2.5 +2.5

Linear - constant slope

$\frac{\Delta y}{\Delta x} = 2.5$

$\boxed{y = 2.5x + 10}$

18.

x	0	1	2	3	4
y	1	6	36	216	1,296

+1 +1 +1 +1

×6 ×6 ×6 ×6

Exponential - constant growth factor = 6

$\boxed{y = 6^x}$

19.

x	0	1	2	3	4	5	6	7	8
y	1	5	3	7	5	8	6	10	8

+1 +1 +1 +1 +1 +1 +1 +1

+4 −2 +4 −2 +4 −2 +4 −2

Neither

No constant slope or growth factor

20.

x	0	1	2	3	4	5	6	7	8
y	2	4	8	16	32	64	128	256	512

+1 +1 +1 +1 +1 +1 +1 +1

×2 ×2 ×2 ×2 ×2 ×2 ×2 ×2

2 4 8

$y = 2 \cdot 2^x$ $\quad y = 2(2^x)$

Exponential - constant growth factor = 2

$\boxed{y = 2(2^x)}$

21.

x	0	1	2	3	4	5
y	0	1	4	9	16	25

+1 +1 +1 +1 +1

+1 +3 +5 +7 +9

$\frac{\Delta y}{\Delta x} = \frac{1}{1} \neq \frac{1}{3} \neq \frac{1}{5} \neq \frac{1}{7} \neq \frac{1}{9}$

Neither

No constant slope or growth factor

51. The king tried to figure out the **total** number of rubas the peasant would receive under Plan 1.

> Remember, for Problem 1 we were just calculating how many rubas went on **each square**, not the total number that were on the chess board!

a. Fill the table up to square 10.

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

Square Number	Number of Rubas on the square	Total Number of Rubas on the board
1	1	1
2	2	3
3	4	7
4	8	15
5	16	31
6	32	63
7	64	127
8	128	255
9	256	511
10	512	1023

$\times 3$, $\times \frac{7}{3}$, $\times \frac{15}{7}$

It is clear that there is no constant growth factor, so this cannot be exponential.

$= (512)2 - 1$

$\left(\frac{2^{10}}{2}\right)2 - 1$

$\frac{2^{10}}{2}$

b. We know that the relationship between the square number and the number of rubas on the square is exponential.
Is the relationship between the square number and the **total number of rubas** on the board exponential? Explain.

the relationship between square number and total number of rubas is NOT exponential. See above, there is no constant growth factor.

c. We know the equation for the Number of Rubas on a square (look back at Problem 1.2). Use that equation to come up with a new one that will calculate the **total** number of rubas on the board.

Did you notice?

5	16	31
6	32	63
7	64	127
8	128	255
9	256	511

-1

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

Try with x=7

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

$y = \frac{2^7}{2} - 1$

$= 63$ ← We are expecting $y = 127$

$\boxed{y = 2^x - 1}$

Play around with it a bit, and you will get

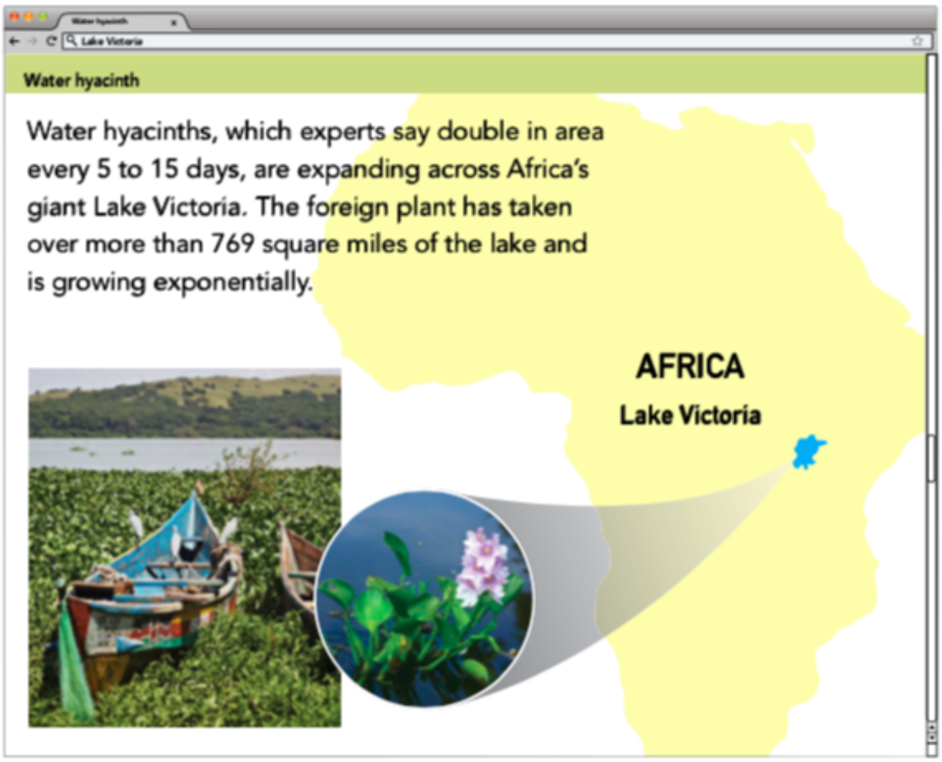
e. Suppose the king gave the peasant the reward she requested. How many Rubas would she receive?
(A chessboard has 64 squares!)

$y = 2^{64} - 1 \sim 1.8 \times 10^{19}$ Rubas

2.1 Killer Plant Strikes Lake Victoria

y-Intercepts Other Than 1

Exponential functions occur in many real-life situations. For example, consider this story:



Little progress has been made to reverse the effects of the water hyacinths. Plants like the water hyacinth that grow and spread rapidly can affect native plants and fish. This in turn can affect the livelihood of fishermen. It can also impede rescue operations in case of a water disaster. To understand how such plants grow, you will look at a similar situation.

Problem 2.1

Ghost Lake is a popular site for fishermen, campers, and boaters. In recent years, a certain water plant has been growing on the lake at an alarming rate. The surface area of Ghost Lake is 25,000,000 square feet. At present, the plant covers 1,000 square feet of the lake. The Department of Natural Resources estimates that the area covered by the water plant is doubling every month.

A 1. Write an equation that represents the growth pattern of the plant.

2. Explain what information the variables and numbers in your equation represent. x: # of months y: Area of plant (ft^2)

3. Compare this equation to the equations in Investigation 1.

B 1. Make a graph of the equation.

2. How does this graph compare to the graphs of the exponential functions in Investigation 1?

3. ~~Recall that a function is a relationship between two variables where, for each value of the independent variable, there is exactly one corresponding value of the dependent variable. Is the plant growth relationship a function? Justify your answer using a table, graph, or equation.~~

# of months	Area
0	1000
1	
2	
⋮	
8	

C 1. How much of the lake's surface will be covered at the end of a year by the plant?

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

$y = 2^x \cdot 1000$

$y = (2^x)1000$

$y = 1000(2^x)$

# of months	Area of plants (ft^2)
0	1000
1	2000
2	4000
3	8000
4	16,000
5	32,000
6	64,000
7	128,000
8	256,000

Homework

Page 32, #'s 1 and 2