8.5 Write & Graph Exponential Growth Functions

Exponential Function

A function of the form: $y = ab^x$ $y=mx+b$
where $a \neq 0$, $b > 0$, and $b \neq 1$
It is a nonlinear function.

Exponential Growth (8.5)
$y = ab^x$ where $a>0$ and $b>1$
(rises from left to right)

Exponential Decay (8.6)
$y = ab^x$ where $a>0$, and $0<b<1$
(falls from left to right)

Exponential Model– Activity

1. Take 1 yard of yarn which would be 1 unit in length. Fold and cut in half where you have 2 pieces which are each ½ in length.
2. Fold, repeat, and fill out the table.

Stage	# of pieces	Length -each piece
1	2	1/2 yd
2	4	1/4 yd
3	8	1/8 yd
4	16	1/16 yd
5	32	1/32 yd

Exponential Model– Activity Cont.

3. Write a function that models the # of pieces of yarn at stage x $y=2^x$ growth
4. Use the function to find the # of pieces at stage 10 $y=2^{10}$ $y=1024$
5. Write a function that models the length of each new piece of yarn at stage x $y=\frac{1}{2}^x$ decay
6. Use the function to find the length of each new piece of yarn at stage 10

$y=\left(\frac{1}{2}\right)^{10}=\frac{1^{10}}{2^{10}}=\frac{1}{1024}$

Linear VS. Exponential

Linear: $y = 3x + 2$ m b

x	-2	-1	0	1	2
y	-4	-1	2	5	8

+1 +1 +1 +1

+3 +3 +3 +3

**Change in both x and y are addition (could be subtraction).

$\frac{2}{3}\cdot\frac{1}{3}=\frac{2}{9}$

Exponential: $y = (2) * 3^x$ y-int

x	-2	-1	0	1	2
y	2/9	2/3	2	6	18

x3 x3 x3 x3

**Change in y is multiplication (could be division).

Note: $y = (a) * b^x$ where a is "0" term and b is the change

Write a Rule

$y=a\cdot b^x$ (a: y-int, b: slope)

7.

x	-2	-1	0	1	2
y	1/81	1/27	1/9	1/3	1

x3 x3 x3 x3

$\frac{1}{3}\cdot\frac{3}{1}=1$

Change:
$a = \frac{1}{9}$
$b = 3$

So. . . $y = \frac{1}{9}\cdot 3^x$

Try On Your Own :)

Write a Rule Cont.

8.

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

Change: 125

a = 125

b = 5

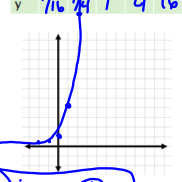
So. . . $y = 125 \cdot 5^x$

Graph the function; identify its domain and range

9. $y = 4^x$

x	-2	-1	0	1	2
y	1/16	1/4	1	4	16

$4^{-2} = 1/16$
$4^{-1} = 1/4$
$4^0 = 1$
$4^1 = 4$
$4^2 = 16$

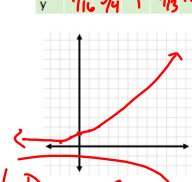


D: $x = \mathbb{R}$
R: $y > 0$

10. $y = (4/3)^x$

x	-2	-1	0	1	2
y	9/16	3/4	1	4/3	16/9

$(\frac{4}{3})^0 = 1$
$(\frac{4}{3})^1 = \frac{4}{3}$
$(\frac{4}{3})^2 = \frac{16}{9}$
$(\frac{4}{3})^{-1} = \frac{3}{4}$
$(\frac{4}{3})^{-2} = \frac{9}{16}$

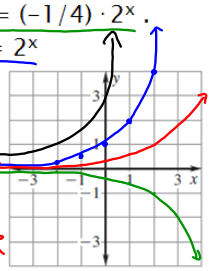


D: $x = \mathbb{R}$
R: $y > 0$

Multiple Graphs

11. Graph $y = (1/4) \cdot 2^x$ and $y = (-1/4) \cdot 2^x$. Compare with the graph of $y = 2^x$

x	-2	-1	0	1	2
$y = 2^x$	1/4	1/2	1	2	4
$y = (1/4) \cdot 2^x$	1/16	1/8	1/4	1/2	1
$y = (-1/4) \cdot 2^x$	-1/16	-1/8	-1/4	-1/2	-1



a < 1 - grows at slower rate

a is - decays

Vertical shrink

Vertical shrink & reflected over the x-axis

$y < 0$

Exponential Growth Model

$y = a(1+r)^t$ where a=initial amount, r=growth rate, t=time

decimal

12. One Computer Industry expert reported that there were about 600 million computers in use worldwide in 2001 and that the number was increasing at an annual rate of about 10%
    a. Write a function that models the number of computers in use over time.
    b. Use the function to predict the number of computers used worldwide in 2009.

1286,153,306

$y = a(1+r)^t$
$y = 600(1+.1)^x$
$y = 600(1+.1)^8$
$y = 600(1.1)^8$
$y = 600(2.14358888)$
$y = 1286.1533$ million

Compound Interest

Interest on an investment and the previously earned interest; use the exponential growth model

$y = a(1+r)^t$ where a=initial investment, r=annual rate, t=# years invested

13. You put $500 in a savings account that earns 5% annual interest compounded yearly. You do not make any deposits or withdrawals. How much will your investment be worth in 4 years?

$y = 500(1+.05)^4$
$y = 500(1.05)^4$
$y = \$607.75$