Mr. Ward Answer Key

Exponential Functions: Growth and Decay

The first thing we need to do before we begin is look at the formula for an exponential function. What does it look like?

$f(x) = ab^x$ where "a" is the starting value, "b" is the base and "x" is the exponent.

Put a big circle or box around that equation. IT IS VERY IMPORTANT!!!

Tables of Values:

Let's look at a very standard exponential function: $y = 3^x$

If we were to create a table with domain and range values it would look like this:

x	y
0	1
1	3
2	9
3	27
4	81

Something very important happens with this table of values, specifically the y-values. Fill in the blanks below to see what this is.

$\frac{3}{1} = \frac{3}{\_\_}$ $\frac{9}{3} = \frac{3}{\_\_}$ $\frac{27}{9} = \frac{3}{\_\_}$ $\frac{81}{27} = \frac{3}{\_\_}$

What did you notice? they are all 3.

Notice how that 3 comes up in our original equation? Look back at it if you don't. This will happen with **all** exponential functions. They will either increase or decrease by a consistent rate.

Practice Problem: Given the following table, write an exponential function.

x	y
0	1
1	½
2	¼
3	1/8

$\frac{1/2}{1} = 1/2$ $\frac{1/4}{1/2} = 1/2$ $\frac{1/8}{1/4} = 1/2$

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

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

Sometimes we will have exponential growth and other times exponential decay.

Read on to the next page to learn the difference between these two.

Exponential Growth:

When you see the graph of an exponential growth function, the graph will rise as the x-values increase. (Exactly what you would expect.) As far as our parent function goes, "b" (which stood for the base) will be greater than one (b>1).

Examples: $y = 2^x$, $y = 1.5^x$, $y = 5(4)^x$

Notice with that 3rd example the starting value (the "a") is 5 instead of 1.

Exponential Decay:

When we have the graph of an exponential decay function, the graph will fall as the x-values increase. (Again, exactly what you would expect.) When we look at the parent function now, "b" will be between 0 and 1 (0<b<1).

Examples: $y = .5^x$, $y = \left(\frac{1}{3}\right)^x$, $y = 2\left(\frac{3}{4}\right)^x$

Again with that 3rd example, the starting value is 2. This would affect what the graph of this function looks like.

Applications:

One of the ways we use exponential functions in everyday life and problems is modeled through the following equation: $A(t) = a(1 \pm r)^t$

"A(t)" = final amount
"a" = initial amount
"r" = rate
"t" = time

When the equation is (1+r) we will have exponential growth.
When the equation is (1-r) we will have exponential decay.

Practice Problem: You put $2500 in the bank at 4% annual interest. How much will you have after 50 years?

$A(t) = 2500(1 + 0.04)^{50}$

$= 2500(1.04)^{50}$

$A(t) = 17,766.71$

Answer: $17,766.71

Assignment: Worksheet + pg 493 #2-10, 15, 17, 21

Name Mr. Ward Date _____ Class _____

LESSON 7-1

Practice B

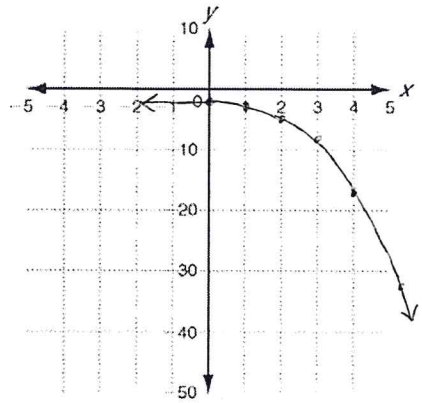
Exponential Functions, Growth, and Decay

Tell whether the function shows growth or decay. Then graph.

1. $g(x) = -(2)^x$

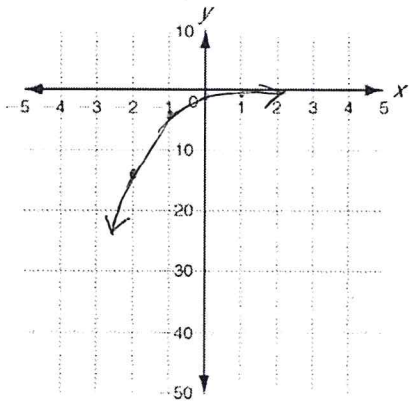
Growth

X	Y
0	-1
1	-2
2	-4
3	-8
4	-16
5	-32



2. $h(x) = -0.5(0.2)^x$

Decay

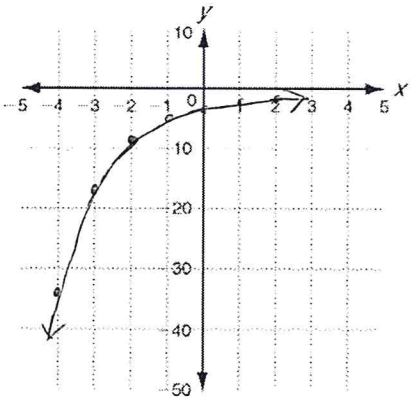


X	Y
-2	-12.5
-1	-2.5
0	-0.5
1	-0.1

3. $j(x) = -2(0.5)^x$

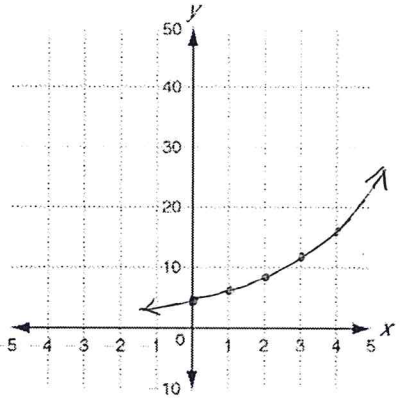
Decay

X	Y
	-2
	-1
2	-0.5
3	-0.25
-1	-4
-2	-8
-3	-16
-4	-32



4. $p(x) = 4(1.4)^x$

Growth



X	Y
0	4
1	5.6
2	7.84
3	10.98
4	15.37

Solve.

5. A certain car depreciates about 15% each year.

   a. Write a function to model the depreciation in value for a car valued at $20,000.

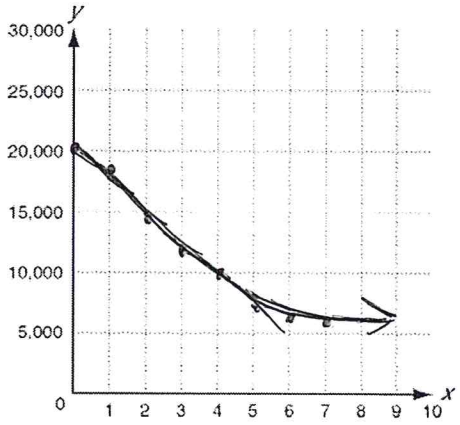
   $A(t) = 20{,}000(1 - 0.15)^t$

   b. Graph the function.

   c. Suppose the car was worth $20,000 in 2005. What is the first year that the value of this car will be worth less than half of that value?

   the 5th year

X	Y
0	20,000
1	17,000
2	14,450
3	12,282
4	10,440
5	8,874
6	7,542
7	



Mr. Ward Homework Key

pg 493

2. Exponential Decay
See Graph

3. Exponential Growth
See Graph

4. Exponential Decay
See Graph

5. a) $f(x) = 150(2)^x$

b) See Graph

c) 614,400

6. a) $f(x) = 25\left(\frac{2}{5}\right)^x$

b) See Graph

c) After 4 bounces

7. Exponential Decay
See Graph

8. Exponential Growth
See Graph

9. Exponential Growth
See Graph

10. a) $A(t) = 580(1 + 0.0232)^t$

$A(t) = 580(1.0232)^t$

b) See Graph

c) Year 24 $(t = 24)$

15. 2008
-1626
382 years

$A(t) = 24(1 + 0.035)^{382}$

$A(t) = 24(1.035)^{382}$

$A(t) = 12,229,955.10$

17. $A(t) = 2765(1 - 0.3)^x$

$350 = 2765(1 - 0.3)^x$

$\frac{350}{2765} = \frac{2765(0.7)^x}{2765}$

$0.12658 = (0.7)^x$

$x \approx 5.8$ years

21. a) $A(t) = 12,000(1 - 0.2)^6$

$A(t) = 12,000(0.8)^6$

$A(t) = 3146$ beanbag animals

b) $A(t) = 12,000(0.8)^x$

$1000 = 12,000(0.8)^x$

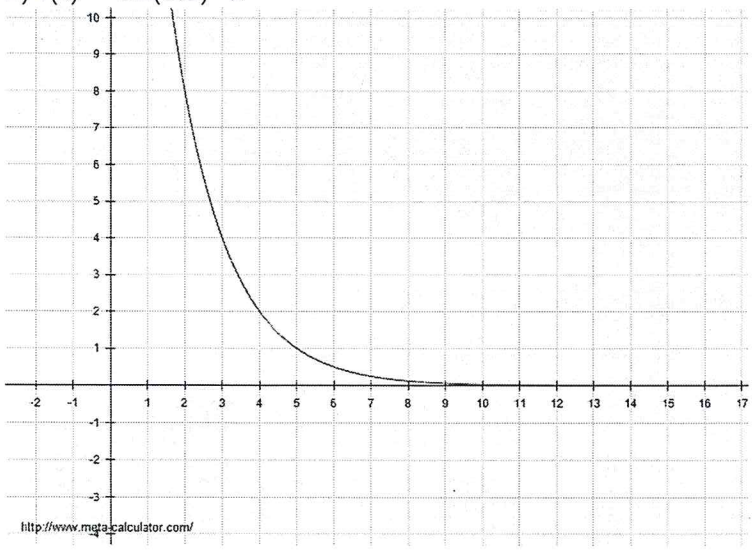
$0.08\overline{3} = (0.8)^x$

$x \approx 12^{th}$ month (11.23)

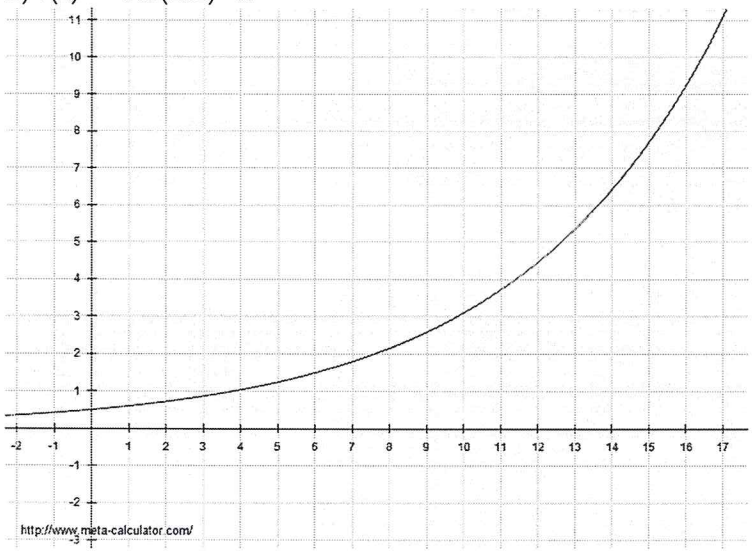
7-1 Graphs

Pg 493 # 2-10

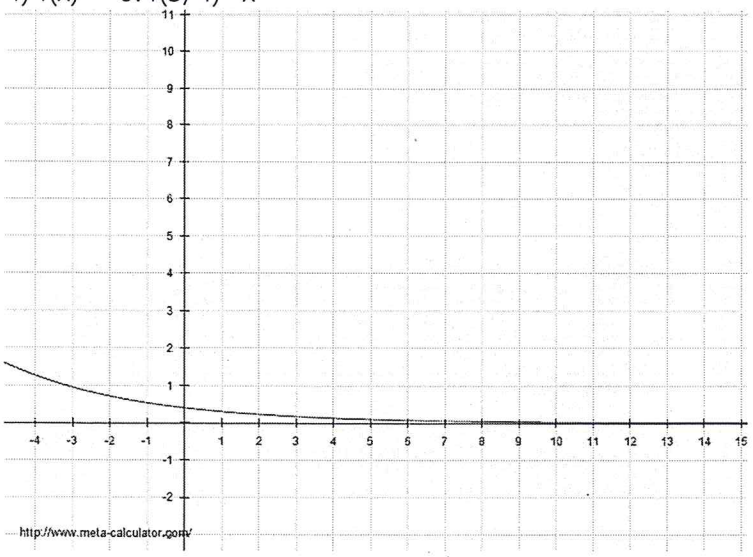
2) f(x) = 32(0.5)^x



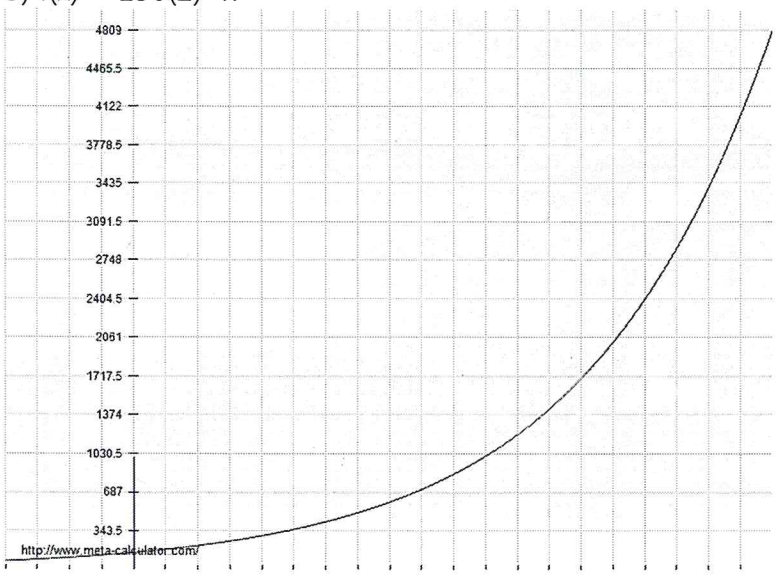
3) f(x) = 0.5(1.2)^x



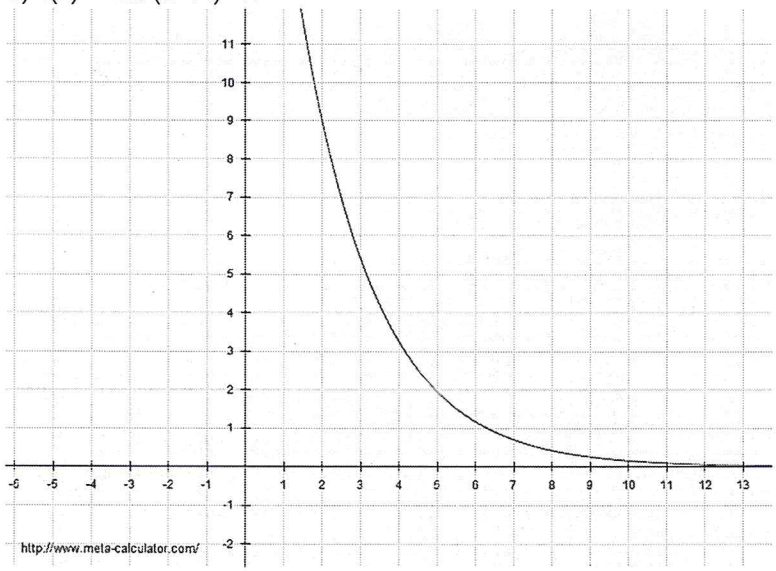
4) f(x) = 0.4(3/4)^x



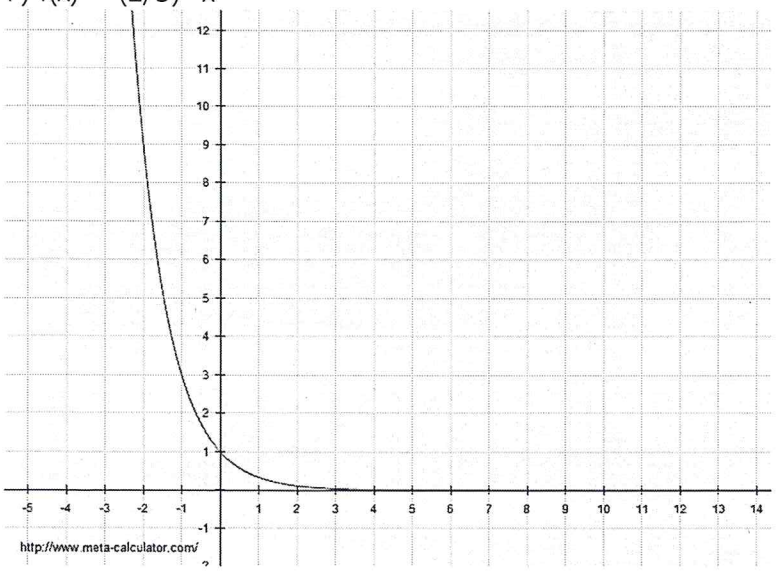
5) f(x) = 150(2)^x



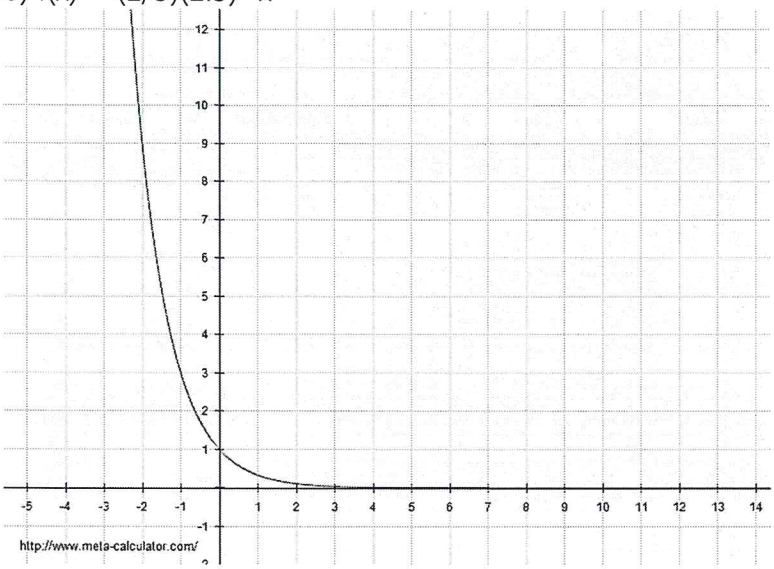
6) f(x) = 25(1-.4)^x



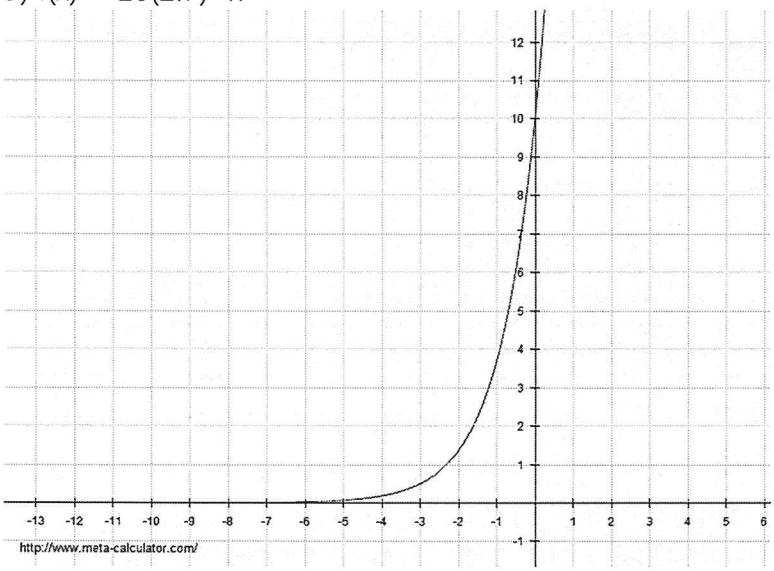
7) f(x) = (1/3)^x



8) f(x) = (1/3)(1.3)^x



9) f(x) = 10(2.7)^x



10) f(x) = 580(1.0232)^x