Exponentials and Logarithms

A logarithmic function is the inverse of an exponential function. More specifically a logarithm is the exponent to which a specified base is raised. To better understand this let's look at the two equations below and see how they relate to each other.

Exponential Equation	Logarithmic Equation
$b^x = a$	$\log_b a = x$

Look carefully at where the "a", "b", and the "x" all move to when we switch between exponents and logarithms. **You need to be good at doing this switching!**

Example #1 Write the exponential equation in logarithmic form.

$4^3 = 64$

First thing we do is identify which numbers are a, b, and x. Then we simply convert it over to logarithmic form.

What is a? 64 What is b? 4 What is x? 3

Write out your answer in logarithmic form. $\log_4 64 = 3$

You should have gotten $\log_4 64 = 3$.

Example #2 Write the logarithmic equation in exponential form.

$\log_6 36 = 2$

Again identify which numbers are a, b, and x.

What is a? 36 What is b? 6 What is x? 2

Write out your answer in exponential form. $6^2 = 36$

Hopefully you got $6^2 = 36$. If not raise your hand and get some help!

You need to get to the point where you can switch between exponents and logarithms in your head, WITHOUT identifying what "a", "b", and "x" are.

Special Case: Logarithm of 1

$\log_b 1 = 0 \rightarrow b^0 = 1$ (Remember, anything to the 0 power is 1.)

Graphing Logarithms

Calculators can't graph logarithmic functions. We get around this by graphing their inverses, exponential functions (*This is why we did the things we've done the past two days!!*). To do this we look at the table of values of a logarithmic function and just flip the table of values. Here's what a question like this will look like.

Example #1 Use the given x-values to graph the function $f(x) = 3^x$; x = -2, -1, 0, 1, 2. Then graph it's inverse.

Step 1: Create a table of values using the given x-values.

Step 2: Plug in the different x-values and solve for the y-values. **Then graph!**

Original

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

Step 3: Switch the x and y coordinates. (This gives us the inverse. Remember?!)

Inverse

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

Step 4: Graph the logarithmic function (which is the inverse of the exponential function) using the new table of values. You should now have two different functions on your graph paper.

Assignment: Practice B WS + pg 509 #2-15

Mr. Ward Answer Key

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2. $\log_{2.4} 1 = 0$ 3. $\log_4 8 = 1.5$ 4. $\log_{10} 0.01 = -2$

5. $\log_3 243 = x$ 6. $4^{-2} = 0.0625$ 7. $x^3 = -16$

8. $0.9^2 = 0.81$ 9. $6^3 = x$ 10. $7^x = 243$
$= 3$

11. $3^x = \frac{1}{9}$
$= -2$

12. $0.5^x = 0.25$
$= 2$

13. $1.2^x = 1.44$
$= 2$

14.

Original

x	y
-2	1/25
-1	1/5
0	1
1	5
1.5	11.2

Inverse

x	y
1/25	-2
1/5	-1
1	0
5	1
11.2	1.5

See Graph

15.

Original

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

Inverse

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

See Graph

Name Mr. Ward Date _____ Class _____

LESSON 7-3

Practice B

Logarithmic Functions

Write each exponential equation in logarithmic form.

1. $3^7 = 2187$

$\log_3 2187 = 7$

2. $12^2 = 144$

$\log_{12} 144 = 2$

3. $5^3 = 125$

$\log_5 125 = 3$

Write each logarithmic equation in exponential form.

4. $\log_{10} 100{,}000 = 5$

$10^5 = 100{,}000$

5. $\log_4 1024 = 5$

$4^5 = 1024$

6. $\log_9 729 = 3$

$9^3 = 729$

Evaluate by using mental math.

7. log 1,000,000 $10^x = 1{,}000{,}000$

$= 6$

8. log 10

$= 1$

9. log 1

$= 0$

10. $\log_4 16$

$= 2$

11. $\log_8 1$

$= 0$

12. $\log_5 625$ $5^x = 625$

$= 4$

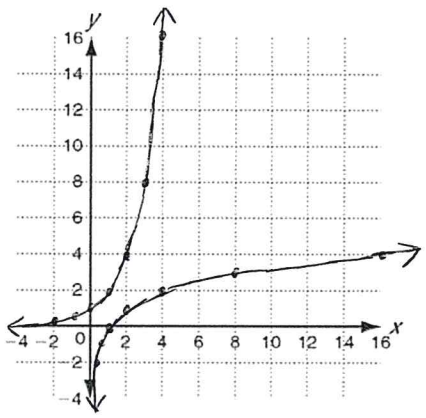
Use the given *x*-values to graph each function. Then graph its inverse. Describe the domain and range of the inverse function.

13. $f(x) = 2^x$; $x = -2, -1, 0, 1, 2, 3, 4$

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

⇒

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

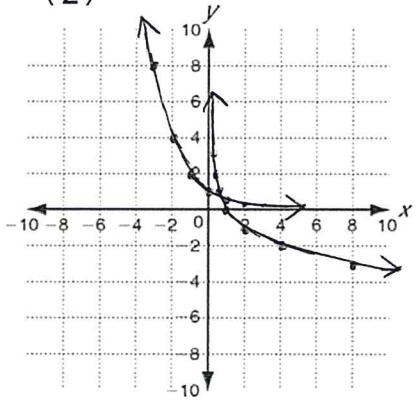


14. $f(x) = \left(\frac{1}{2}\right)^x$; $x = -3, -2, -1, 0, 1, 2, 3$

x	y
-3	8
-2	4
-1	2
0	1
1	1/2
2	1/4
3	1/8

⇒

x	y
8	-3
4	-2
2	-1
1	0
1/2	1
1/4	2
1/8	3



Solve.

15. The hydrogen ion concentration in moles per liter for a certain brand of tomato-vegetable juice is 0.000316.

a. Write a logarithmic equation for the pH of the juice.

b. What is the pH of the juice?