5.1.3 What is a Logarithm?

This activity is designed to help you find out what the *LOG* key on your calculator does. Logarithms can be set to any base. The *LOG* key represents $\log_{10}$, which is known as the "common logarithm." Record the results in the space provided and retain this page for later reference. The first example is done for you.

Logarithm	Value
Log 100 = <u>2</u>	$10^2 = 100$
Log 10	
Log 1000	
Log 0.01 =	
Log 0.0001 =	
Log $\sqrt{10}$ =	
Log $\sqrt{10\,000}$	
Log $\sqrt{0.001}$	
Log 0	
Log -3	
Log -31	
Log 6.74	
Log 67.4	
Log 6740	
Log 20	
Log 2000	
Log 53	
Log 471	
Log 5	

When you have completed the table, compare your results with that of a partner. With your partner, determine the relationship between log x and x. Record your conclusions and answer the following question.

Which word best describes a logarithm? Explain your answer.

Test your theory with the following:

If $\log_3 9 = 2$, what is the corresponding power?

If $\log_2 32 = 5$, what is the corresponding power?

5.1.3A Home Activity: Exponential and Logarithmic Functions

1. Convert the following from exponential to logarithmic form and logarithmic to exponential form, depending on what is provided.

   a) $27 = 3^3$ becomes ________________ in logarithmic form.
   b) $4 = \log_3 81$ becomes ______________ in exponential form.
   c) $3 = \log_{10} 1000$ becomes ______________ in exponential form.
   d) $49^{\frac{1}{2}} = \sqrt{49}$ becomes ___________________ in logarithmic form.
   e) $-2 = \log_3 \frac{1}{9}$ becomes __________________ in exponential form.
   f) $64^{-\frac{1}{2}} = \frac{1}{8}$ becomes __________________ in logarithmic form.

2. Express in exponential form.

   a) $\log_6 36 = 2$
   b) $\log_9 1 = 0$
   c) $\log_2 0.25 = -2$
   d) $\log_4 256 = 4$
   e) $\log_3 9 = 2$
   f) $\log_2 8 = 3$

3. Express in logarithmic form.

   a) $5^2 = 25$
   b) $512^{\frac{1}{3}} = 8$
   c) $144^{-\frac{1}{2}} = \frac{1}{12}$
   d) $10^5 = 100\ 000$
   e) $\sqrt{16} = 4$
   f) $27^{-\frac{1}{3}} = \frac{1}{3}$

4. Evaluate.

   a) $\log_{10} 1$
   b) $\log_4 256 - \log_{10} 100$
   c) $\log_6 6$
   d) $\log_4 64$
   e) $\log_2 128 - \log_2 32$
   f) $\log_5 1$
   f) $\log_8 \sqrt{8}$
   g) $\log_2 16 + \log_3 81$
   h) $\log_{25} 5$

Answers:

1 a) $\log_3 27 = 3$ b) $3^4 = 81$ c) $10^3 = 1000$ d) $\log_{49} \sqrt{49} = \frac{1}{2}$ e) $3^{-2} = \frac{1}{9}$ f) $\log_{64} \frac{1}{8} = -\frac{1}{2}$

2. a) $6^2 = 36$ b) $9^0 = 1$ c) $2^{-2} = 0.25$ d) $4^4 = 256$ e) $3^2 = 9$ f) $2^3 = 8$

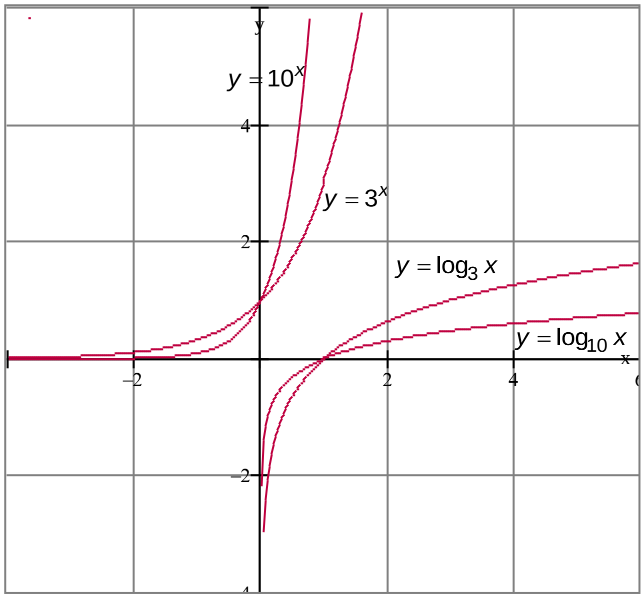
3. a) $\log_5 25 = 2$ b) $\log_8 512 = \frac{1}{3}$ c) $\log_{144} \frac{1}{12} = -\frac{1}{2}$

d) $\log_{10} 100000 = 5$ e) $\log_{16} 4 = \frac{1}{2}$ f) $\log_{27} \frac{1}{3} = -\frac{1}{3}$

4.a) 0 b) 2 c) 1 d) 3 e) 2 f) 0 g) $\frac{1}{2}$ h) 8 h) $\frac{1}{2}$

5.1.4 Features of Logarithmic Functions

Consider the graphs below and record key features in the table provided:



	Function			
Feature	$y = \log_3 x$	$y = \log_{10} x$	$y = 3^x$	$y = 10^x$
Function Type				
Domain				
Range				
x-intercept				
y-intercept				
Asymptotes				

1. What do you notice about the graphs of $y = 10^x$ and $y = \log_{10} x$?
2. What do you notice about the graphs of $y = 3^x$ and $y = \log_3 x$?
3. What would you expect to see in a graph comparing $y = a^x$ and $y = \log_a x$?
4. What test can you make to see if your theory is correct?