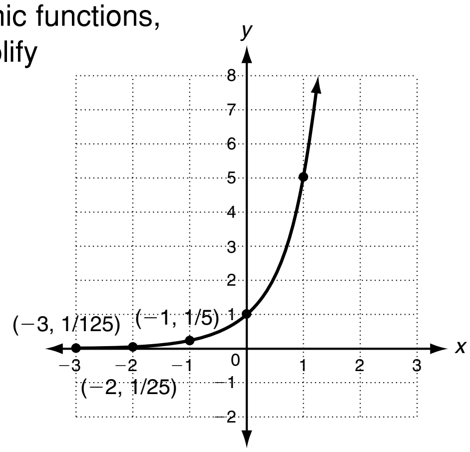
Date ______________

Dear Family,

In Chapter 7, your child will study exponential and logarithmic functions, and use the properties of exponents and logarithms to simplify expressions and solve equations.



A parent **exponential function** has the form $f(x) = b^x$.

The defining features of an exponential function are that the **base** b is a constant and the exponent x is a variable.

An exponential function will have an **asymptote**, or a line that the graph approaches but never reaches. In the graph of $y = 5^x$ at right, as x continues in the negative direction, the value of y gets smaller and smaller, approaching zero. So, the x-axis, or the line $y = 0$, is a horizontal asymptote for $y = 5^x$.

Two of the most common applications of exponential functions are **exponential growth** and **exponential decay**. Topics such as the interest on a savings account, the depreciation of an automobile, or the growth of a population can all be modeled by an exponential function in the form:

Initial amount

Final amount after t time periods

$$A(t) = a(1 + r)^t$$

Rate of growth (negative for decay)

Relations that "undo" each other are called **inverse relations**. When both relations happen to be functions, you have **inverse functions**. The inverse function of $f(x)$ is written as $\boldsymbol{f^{-1}(x)}$. (*Note:* The superscript -1 means "inverse"; it does not mean an exponent of -1.) For example, the functions below are inverses because they "switch" input and output values.

$\boldsymbol{f(x) = 2x - 8}$		inverse functions	$\boldsymbol{f^{-1}(x) = \frac{1}{2}x + 4}$	
x (input)	***y*** (output)	$\longleftrightarrow$	***x*** (input)	***y*** (output)
2	-4	inputs and	-4	2
10	12	outputs	12	6
0	-8	switch	-8	0

An exponential equation gives you the amount that results from raising a base to an exponent. The inverse, a **logarithm**, gives you the exponent to which a base must be raised to result in a given amount.

exponent: $5^2 = 25$

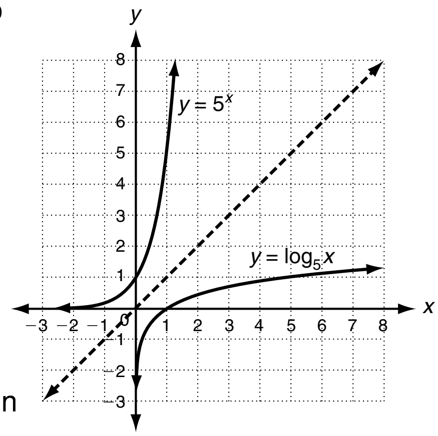
Think: What is 5 raised to an exponent of 2?

logarithm: $\log_5 25 = 2$

Think: To what exponent do you raise 5 to get 25?

A logarithm with base 10 is called a **common logarithm**. If no base is written on a logarithm, it is assumed to be 10. For example, log 1000 means the same thing as $\log_{10} 1000$.

Another special logarithm is a **natural logarithm**, which has the irrational number $e \approx 2.718\ldots$ as a base. Natural logarithms are abbreviated "ln" rather than "log."



Because a logarithm is the inverse of an exponent, a **logarithmic function** is the inverse of an exponential function. For example, $f(x) = 5^x$ and $f^{-1}(x) = \log_5 x$ are inverses of each other. Because inverse functions switch input/output values, the graph of $f^{-1}(x) = \log_5 x$ is a reflection of $f(x) = 5^x$ across the line $y = x$.

You may recall from Chapter 1 that there are several special properties for exponents. Similarly, there are special properties for logarithms:

Product Property	$\log_b (m \cdot n) = \log_b m + \log_b n$
Quotient Property	$\log_b \frac{m}{n} = \log_b m - \log_b n$
Power Property	$\log_b a^p = p \cdot \log_b a$
Inverse Properties	$\log_b b^x = x$ and $b^{\log_b x} = x$
Change of Base Formula	$\log_b x = \frac{\log_a x}{\log_a b}$

By applying the properties of exponents and logarithms, your child will learn to solve a variety of exponential and logarithmic equations. These types of equations have many applications. Exponents or logarithms are necessary to determine the age of fossils (carbon dating), to determine whether a substance is an acid or base (the pH scale), to measure perceived loudness (decibels), and to rate earthquakes (the Richter scale).

You may also recall from earlier chapters that parent functions can be transformed by translations (left, right, up, or down), stretches, compressions, and reflections. These same transformations will now be applied to exponential and logarithmic functions.

The chapter concludes with a section on **exponential regression** and **logarithmic regression**. By using a graphing calculator, your child will be able to fit an exponential or logarithmic model to a set of real-world data, and use the model to make future predictions.

For additional resources, visit go.hrw.com and enter the keyword MB7 Parent.