PreCalculus Name: Period: Date:

Warm Up 12/02

Lesson 4-2: Logarithmic Functions II

Objective

Students will…

- Be able to define natural logarithmic function.
- Be able to know and apply the properties of natural logarithms.
- Be able to use calculators to compute natural logarithms.

Natural Logarithms

We've learned that any logarithm with base 10 is known as the *common* logarithm, without the base written. In our previous section of exponential function, we learned about a very special number denoted, e. Naturally (no pun intended as we'll see), logarithms with base e is also considered special, and it is given a special name.

Natural Logarithm- The logarithm with base e is called the **natural logarithm** and is denoted by **ln**:

$$\ln x = log_e x$$

The Inverse of Exponential Function

Like all other exponential and logarithmic functions, the natural logarithmic function $y = \ln x$ is the inverse function of the exponential function $y = e^x$. Hence, by definition we have

$$\ln x = y \leftrightarrow e^y = x$$

Example:

$$e^6 \approx 403.43 \quad \rightarrow \quad \ln 403.43 \approx 6$$
$$\ln 8 \approx 2.08 \quad \rightarrow \quad e^{2.08} \approx 8$$

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Properties of Natural Logarithms

We have learned about some of the basic properties of logarithms. Always remember that, although it's given a special name, natural logarithms is still a logarithmic function! Thus, the properties of natural logarithm naturally (again, no pun intended ☺) follow the properties of logarithms. Simply replace a with e and log_a with ln.

Property	Reason
1. $\ln 1 = 0$	Anything raised to the zero power is 1
2. $\ln e = 1$	Anything raised to the 1st power is itself
3. $\ln e^x = x$	e raised to the x power is e^x
4. $e^{\ln x} = x$	$\ln x$ is the power to which e must be raised to get x

Examples

You try

Using a Calculator

For most logarithmic, as well as exponential functions, we've learned that having a calculator is a must. Computing natural logarithm on a calculator is easy. We simply need to find where the ln button is. Almost all calculators place e^x and ln together (usually "2nd" e^x).

Example:
To compute $\ln 5$, we would input "2nd" e^x, then "5".
The answer should read: $\ln 5 = 1.6094379124341$

In Closing
Compute the following natural logarithms using a calculator and check your answers with a partner.

1) $\ln 4 =$ 2) $2 \ln 9 =$ 3) $9 \ln 11 =$

Homework 12/02
TB pg. 349-350 #7, 8, 13, 14, 22a, 23b, 23c, 35, 36