GUIDED NOTES – 6.5 LOGARITHMIC PROPERTIES

LEARNING OBJECTIVES

In this section, you will:

- Use the product rule for logarithms.
- Use the quotient rule for logarithms.
- Use the power rule for logarithms.
- Expand logarithmic expressions.
- Condense logarithmic expressions.
- Use the change of base formula for logarithms.

USING THE PRODUCT RULE FOR LOGARITHMS

- Recall that the logarithmic and exponential functions "undo" each other. This means they have similar properties. Some important properties are:

  - $\log_b(1) =$ _____
  - $\log_b(b) =$ _____
  - Inverse property:

    $\log_b(b^x) =$ _____ and $b^{\log_b(x)} =$ _____, $x > 0$

  - One-to-One property:

    $\log_b M = \log_b N$ if and only if $M = N$

Study the box in your textbook section titled "the product rule for logarithms".

- The _____ for logarithms can be used to simplify a logarithm of a product by rewriting it as a _____ of individual logarithms.

  $\log_b(MN) =$ _____ for $b > 0$

- Write out the 2 step process for using the product rule of logarithms to write an equivalent sum of individual logarithms, given the logarithm of a product.

    1.

    2.

Try It: Read Example 1 in the text, then answer the following.

Expand $\log_b(8k)$.

USING THE QUOTIENT RULE FOR LOGARITHMS

Study the box in your textbook section titled "the product rule for logarithms."

- The _____ for logarithms can be used to simplify a logarithm of a product by rewriting it as a _____ of individual logarithms.

$$\log_b\left(\frac{M}{N}\right) = \_\_\_\_\_$$

- Write out the 3 step process for using the quotient rule of logarithms to write an equivalent difference of individual logarithms, given the logarithm of a quotient.

    1.

    2.

    3.

Try It: Read Example 2 in the text, then answer the following.

Expand $\log_3\left(\frac{7x^2+21x}{7x(x-1)(x-2)}\right)$.

USING THE POWER RULE FOR LOGARITHMS

Study the box in your textbook section titled "the power rule for logarithms".

- The _____ for logarithms can be used to simplify a logarithm of a power by rewriting it as the _____ of the exponent times the logarithm of the _____.

$$\log_b(M^n) = \_\_\_\_\_$$

- Write out the 2 step process for using the power rule of logarithms to write an equivalent product of a factor and a logarithm, given the logarithm of a power.

1.

2.

Try It: Read Example 3 in the text, then answer the following.

Expand $\ln(x^2)$.

Try It: Read Example 4 in the text, then answer the following.

Expand $\ln\left(\frac{1}{x^2}\right)$.

Try It: Read Example 5 in the text, then answer the following.

Rewrite $2\log_3(4)$ using the power rule for logs to a single logarithm with a leading coefficient of 1.

EXPANDING LOGARITHMIC EXPRESSIONS

Try It: Read Example 6 in the text, then answer the following.

Expand $\log\left(\frac{x^2y^3}{z^4}\right)$.

Try It: Read Example 7 in the text, then answer the following.

Expand $\ln\left(\sqrt[3]{x^2}\right)$.

Try It: Read Example 8 in the text, then answer the following.

Expand $\ln\left(\frac{\sqrt{(x-1)(2x+1)^2}}{x^2-9}\right)$.

CONDENSING LOGARITHMIC EXPRESSIONS

- Write out the 3 step process for writing an equivalent expression as a single logarithm, given a sum, difference, or product of a logarithm with the same base.

    1.

    2.

    3.

Try It: Read Example 9 in the text, then answer the following.

Condense $\log(3) - \log(4) + \log(5) - \log(6)$.

Try It: Read Example 10 in the text, then answer the following.

Rewrite $\log(5) + 0.5\log(x) - \log(7x - 1) + 3\log(x - 1)$ as a single logarithm.

Try It: Read Example 11 in the text, then answer the following.

Condense $4(3\log(x) + \log(x + 5) - \log(2x + 3))$.

Try It: Read Example 12 in the text, then answer the following.

Use **Example 12** to answer this question. How does the pH change when the concentration of positive hydrogen ions is decreased by half?

USING THE CHANGE-OF-BASE FORMULA FOR LOGARITHMS

Study the box in your textbook section titled "the change-of-base formula."

- The change-of-base formula can be used to evaluate a logarithm with any _____. For any positive real numbers M, b, and n, where $n \neq 1$ and $b \neq 1$,

$$\log_b M = \_\_\_\_\_$$

- Write out the 2 step process for using the change-of-base formula to rewrite a logarithm as a quotient of logs with any positive base n, where $n \neq 1$, given a logarithm with the form $\log_b(M)$.

1.

2.

a.

b.

Try It: Read Example 13 in the text, then answer the following.

Change $\log_{0.5}(8)$ to a quotient of natural logarithms.

Try It: Read Example 14 in the text, then answer the following.

Evaluate $\log_5(100)$ using the change-of-base formula.