Week 10
MTH-1320 – PreCalculus

Hello and Welcome to the weekly resources for MTH-1320 – PreCalculus!

This week is Week 10 of class, and typically in this week of the semester. your professors are covering these topics below. If you do not see the topics your particular section of class is learning this week, please take a look at other weekly resources listed on our website for additional topics throughout of the semester.

We also invite you to **look at the group tutoring chart on our website to see if this course has a group tutoring session offered this semester**.

If you have any questions about these study guides, group tutoring sessions, private 30 minute tutoring appointments, the Baylor Tutoring YouTube channel or any tutoring services we offer, please visit our website www.baylor.edu/tutoring or call our drop in center during open business hours. M-Th 9am-8pm on class days 254-710-4135.

Key Words: Log properties, Exponential and Logarithmic Equations

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Topic of the Week: Log Properties

The following table summarizes both exponential and logarithmic properties (since logs and exponentials are inverses their properties also look inverted)

Property	Exponential	Logarithm
	$b^0 = 1$	$\log_b 1 = 0$
	$b^1 = 1 = b$	$\log_b b = 1$
Inverse Property	$b^{\log_b x} = x\ (x > 0)$	$\log_b b^x = x$
One-to-One Property	$b^x = b^y$ only if x = y	$\log_b(M) = \log_b(N)$ only if M = N
Product Rule	$b^x b^y = b^{x+y}$	$\log_b(MN) = \log_b(M) + \log_b(N)$
Quotient Rule	$\frac{b^x}{b^y} = b^{x-y}$	$\log_b(\frac{M}{N}) = \log_b(M) - \log_b(N)$
Power rule	$(b^x)^y = b^{xy}$	$\log_b(M^n) = n\log_b(M)$

Highlight #1: Expanding and Condensing Logarithmic Expressions

- To expand a logarithmic expansion, use the 1) quotient rule 2) product rule 3) power rule in this order

- To condense a logarithmic expansion, use the 1) power rule 2) product rule 3) quotient rule in this order

Note! A ratio of products can be written as a sum of the numerator and difference of denominators

$$\log_b = \frac{M_1 * M_2 * \ldots * M_M}{N_1 * N_2 * \ldots * N_M} =$$

$$\log_b(M_1) + \log_b(M_2) + \ldots + \log_b(M_M) - \log_b(N_1) - \log_b(N_1) - \cdots - \log_b(N_N)$$

Highlight #2: Change of base formula

Often we need to transform existing logarithms into logarithms with a different base. We can do so by using the change of base formula, which states

$$\log_b(M) = \log_n(M) \log_n(b)$$

Where n is the new base we want to use.

Highlight #3: Exponential and Logarithmic Equations

We are finally at the point where we can use the tools we acquired so far to solve exponential and logarithmic equations

Here are some useful things to remember as we approach problems:

- A positive base raised to a power cannot yield a negative number
  - This is significant because we might get extraneous solutions, which are solutions that work algebraically but do not satisfy the conditions of the original equation
- If two exponentials are equal and their base is the same, the exponents are also the same
- If two bases seem different, we can often rewrite one of the bases as a power of the other

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Highlight #4: Using Logarithms

Here are a few things to remember when using logarithms in equations

- Equality is maintained if we take the same logarithm on both sides of the equation
- Logarithmic equations might have extraneous solutions as well
- Just how we can take the log of both sides, we can use exponential functions on both sides
- If two logarithms are equal, we can set the arguments (the part in parenthesis) equal to each other

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Things you might struggle with:

- Memorizing the logarithm properties can be confusing
    - Try to make sense of them rather than memorizing them
- Expanding logarithms can be tricky if you don't follow the order quotient, power, product

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Check Your Learning

1. Expand the equation: $\log(\frac{\sqrt{(x+2)(x+3)^2}}{(x-5)})$

2. Solve $5^x = 2^{x+3}$

3. Solve ln(x + 3) = ln(1)

Thanks for checking out these weekly resources!
Don't forget to check out our website for group tutoring times, video tutorials and lots of other resources: www.baylor.edu/tutoring ! Answers to check your learning questions are below!

Answers to Check Your Learning

Example 1

$$\log\left(\frac{\sqrt{(x+2)(x+3)^2}}{(x-5)}\right) =$$

Let's start by using the quotient rule:

$$\log(\sqrt{(x+2)(x+3)^2}) - \log(x-5)$$

Let's treat the square root like an exponent

$$\log\left((x+2)^{\frac{1}{2}}(x+3)^{2^{1/2}}\right. - \log(x-5)$$

Let's use the power rule for exponents in the first logarithm

$$\log\left((x+2)^{\frac{1}{2}}(x+3)^1\right) - \log(x-5)$$

Let's use the product rule to expand the first logarithm

$$\log((x+2)^{\frac{1}{2}} + \log(x+3) - \log\,(x-5)$$

Let's use the power rule on the first logarithm

$$\frac{1}{2}\log(x+2) + \log(x+3) - \log\,(x-5)$$

Example 2

$$5^x = 2^{x+3}$$

First, let's natural log both sides (remember, equality is preserved if we do something to both sides)

$$\ln(5^x) = \ln(\,2^{x+3})$$

Let's use the power rule now

$$x * \ln(5) = (x+3) * \ln(2)$$

Let's distribute the coefficients

$$x * \ln(5) = x * \ln(2) + 3 * \ln(2)$$

Let's isolate the x's

$$x * \ln(5) - x * \ln(2) = 3 * \ln(2)$$

Let's factor out the x's

$$x(\ln(5) - \ln(2)) = 3 * \ln(2)$$

Let's solve for x

$$x = \frac{3*\ln(2)}{\ln(5)-\ln(2)}$$

Example 3

$$\ln(x + 3) = \ln(1)$$

Remember the rule that if we have the same log on both sides we can set the arguments equal to each other

$$x + 3 = 1$$
$$x = -2$$