Pre-Calculus CP 1 – Section 3.3 Notes Properties of Logarithms

Graph the following:

y=logx



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y = log(x+2)-3



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y=-log	$\left(\frac{1}{2}x\right)$
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$$y = log(-(x+1))-2$$



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Name:

Calculators only have two keys to evaluate logarithms:

- logarithm (LOG) which is base 10
- natural logarithm (LN) which is base "e"

What if you need to evaluate logarithms with other bases?

Change-of-Base Formula

Let a, b, and x be positive real numbers such that $a \neq 1$ and $b \neq 1$. The $\log_a x$ can be converted to a different base as follows:

Base b	Base 10	Base e	
$\log_{a} x = \frac{\log_{b} x}{\log_{b} a}$	$\log_a x = \frac{\log x}{\log a}$	$\log_a x = \frac{\ln x}{\ln a}$	

Ex 1: Rewrite each logarithm as a ratio of common logarithms and natural logarithms

a) $\log_7 4 =$ b) $\log_2 17 =$

try them in your calculator to ensure you did it right!

We already learned about how to rewrite logs in exponential form, so these inverse properties should make sense

- $\log_b b^x =$ _____
- $b^{\log_b x} =$ _____
- log_b b = _____
- log_b1 = _____

Properties of Logarithms

Ex 2: Use the properties above to evaluate the logarithmic expressions.

- a) $3\log_5 5 \log_5 25 =$
- b) $\log_4 16^2 + \log_4 8^4 =$
- c) $\log_4 2 + \log_4 32 =$

More Properties of Logarithms

Let a be positive real number such that $a \neq 1$ and let n be a real number. If u and v are positive real number, the following properties are true:

1)	$\log_{a}(u \cdot v) = \log_{a} u + \log_{a} v$ "the log of a product equals	"
2)	$\log_{a}\left(\frac{u}{v}\right) = \log_{a} u - \log_{a} v$ "the log of a quotient equals	"
3)	log _a u ⁿ = nlog _a u "the log of a number raised to a power equals	"

Ex 3: Expand each logarithmic expression:

a) $\log_4 xy =$

Properties of Logarithms

b)
$$\log_{3} x^{4} =$$

c)
$$\log_7 xy^3 =$$

d)
$$\log_8 \frac{\sqrt{2x+5}}{7} =$$

You try: Expand the logarithmic expression:

a)
$$\log_4 x^3 y^2 =$$

b)
$$\log_5 \sqrt{\frac{x}{y^5}} =$$

c)
$$\log_5 \sqrt[4]{y} =$$

Properties of Logarithms

d)
$$\log_7\left(\frac{x}{9}\right) =$$

Ex 4: Condense each logarithmic expression.

a) $3\log_3 x + \log_3 y =$

b) $2\log_4 x + \log_4 3 - \log_4 y =$