2.3 Laws of Logarithms

Laws of Exponents:

Multiplication: $a^x * a^y = a^{x+y}$

Division: $a^x \div a^y = a^{x-y}$

Power: $\left(a^m\right)^n = a^{mn}$

Power of Product: $(ab)^n = a^n b^n$

Power of a Quotient: $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$

Laws of Logarithms:

Multiplication: $\log_a xy = \log_a x + \log_a y$

Division: $\log_a \frac{x}{y} = \log_a x - \log_a y$

Powers: $\log_a x^n = n \log_a x$

Root: $\log_a \sqrt[n]{x} = \frac{1}{n} \log_a x$

$\log_a x^{\frac{1}{n}}$

***Note: The bases of the logarithms MUST be the same just like in laws of exponents.**

Simplify each of the following and write as a single log.

a) $\log_{10} 8 + \log_{10} 125$

$\log 8 \cdot 125$

$\log_{10} 1000$

3

b) $\log_2 5 - \log_2 20$

$\log_2 \frac{5}{20}$

$\log_2 \frac{1}{4}$

c) $\log_3 40 + \log_4 75$

$\log_4 40 + \log_4 75$

$\log_4 40 \cdot 75$

$\log_4 3000$

Write log 6 as a sum and difference of logs

$\log \underset{(2)\cdot(3)}{6} = \log 2 + \log 3$

$\log \underset{\left(\frac{12}{2}\right)}{6} = \log 12 - \log 2$

Solve the equation $2^x = 10$

$2^3 \overset{?}{\longleftrightarrow} 2^4$

* Remove the "x" from the exponent.

$\log 2^x = \log 10$

$x \cdot \log 2 = \log 10$

$x = \frac{\log 10}{\log 2} \doteq 3.32$

Solve the equation $250 = 132 \times 1.01^n$

$\frac{250}{132} = 1.01^n$

$\log \frac{250}{132} = \log 1.01^n$

$\log 250 - \log 132 = n \cdot \log 1.01$

$\frac{(\log 250 - \log 132)}{\log 1.01} = n$

$n = 64.18$

Determine the value of $\log_4 20$

$\log_4 20 = x$

* If you $\underline{\text{cannot}}$ evaluate a log convert it to exponential form.

$4^x = 20$

$\log 4^x = \log 20$

$x \log 4 = \log 20$

$x = \frac{\log 20}{\log 4} \doteq 2.16$

Express 9 as a power of 2:

$9 = 2^x$

$\log 9 = x \log 2$

$\frac{\log 9}{\log 2} = x$

$x = 3.17$

Write $\log(100ab^2)$ in terms of "a" and "b"

Break this log into parts that have a value or a or b.

$\log 100 + \log a + \log b^2$

$2 + \log a + 2 \log b$

Write as a single log

a) log a + log b – log c

$\log(ab) - \log c$

$\log\left(\frac{ab}{c}\right)$

b) 2loga – 1/3logb + log c

$\log a^2 - \log\sqrt[3]{b} + \log c$

$\log\left(\frac{a^2}{\sqrt[3]{b}}\right) + \log\frac{c}{1}$

$\log\frac{a^2c}{\sqrt[3]{b}}$

Pg. 84
6, 7 odds
9–11 odds
17, 18