BE-Alg. 2 | Monday 4-18-11

① Write in logarithmic form:

Ⓐ $5^3 = 125$ Ⓑ $3^{-4} = \frac{1}{81}$

② Write in Exponential form:

Ⓐ $\log_6 216 = 3$ Ⓑ $\log_{25} 5 = \frac{1}{2}$

③ Simplify and name the exponent rule:

Ⓐ $x^5 \cdot x^{14} = ?$

Ⓑ $\frac{x^{14}}{x^5} = ?$

Ⓒ $(x^{14})^5 = ?$

NOTE HOW THIS IS WRITTEN

DO NOT WRITE AS: $\log_{25} 5 = \frac{1}{2}$

THIS SHOULD NOT LOOK LIKE AN EXPONENT OF 25

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① Ⓐ $\log_5 125 = 3$ Ⓑ $\log_3 \left(\frac{1}{81}\right) = -4$

TIP: USE PARENTHESES

② Ⓐ $6^3 = 216$ Ⓑ $25^{\frac{1}{2}} = 5$

③ Ⓐ x^{19}, Mult. Rule ⇒ ADD EXPONENTS.

Ⓑ x^9, Division Rule ⇒ Subtract EXPONENTS

Ⓒ x^{70}, Power-Power Rule ⇒ MULTIPLY EXPONENTS

Q: WHAT IS A LOGARITHM?

Ch. 10-3, Properties of Logarithms (Rules)

Covers 3 "logarithm rules" — these are a direct result of the 3 "exponent rules" (MR, DR, PP) we covered in the bell exercise.

This is reasonable, the logarithmic function is the inverse of the exponential function.

So you can think of these 3 LR's (logarithmic rules) as "going backward" from the ER's (exponential rules).

Remember ⇒ the ER's assume same base so watch out, don't try to use LR's with different bases!

$$\log_2 8 + \log_2 16 = ?$$

ADDING EXPONENTS ⇒ MULTIPLYING POWERS WITH SAME BASE

$\therefore$ $\log_2 8 + \log_2 16 = \log_2 (8 \cdot 16)$

TRUE? $3 + 4 = \log_2 (128) = 7$ ✓

(SINCE $2^7 = 128$)

AK ⇒ WHEN ADDING LOGARITHMS WITH THE SAME BASE, MULTIPLY THE POWERS

$$\log_b M + \log_b N = \log_b MN$$

(EX) $\log_3 8 + \log_3 6 = ?$

$\log_3 48$

(EX) $\log_5 XY = ?$

$\log_5 X + \log_5 Y$

What about $\log_2 16 - \log_2 8 = ?$

Subtracting exponents $\Rightarrow$ dividing powers with the same base

$\therefore \log_2 16 - \log_2 8 = \log_2 \left(\frac{16}{8}\right)$

$4 - 3 \stackrel{?}{=} \log_2 2$

$2^x = 2 \quad \boxed{x = 1}$ ✓

SR $\Rightarrow$ when subtracting logarithms with the same base, divide the powers.

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

(Ex) $\log_3 8 - \log_3 16 = \log_3 \left(\frac{8}{16}\right) = \boxed{\log_3 \left(\frac{1}{2}\right)}$

Recall: to find $\log_3 \left(\frac{1}{2}\right)$ on your calculator

$\log_3 \left(\frac{1}{2}\right) =$ (top) $\frac{\log\left(\frac{1}{2}\right)}{\log 3}$ or $\frac{\ln\left(\frac{1}{2}\right)}{\ln 3}$ (bottom)

$\sim -.6309$ CK $3^{-.6309} \approx .5$ ✓

(Ex) $\log_4 \frac{x}{y} = ?$

$\boxed{\log_4 x - \log_4 y}$

FINALLY, look at $4 \log_2 8 = ?$

MULTIPLYING EXPONENTS ⇒ RAISING A power to a power

$\therefore (4)(\log_2 8) = \log_2(8^4)$ NOT $(\log_2 8)^4 = 81$

$4 \cdot 3 \stackrel{?}{=} \log_2(4096) = 12$ ✓

SINCE $2^{12} = 4096$

MR for log

WHEN MULTIPLYING A logarithm, raise the power by the term doing the multiplication (the multiplier)

$$N \log_b m = \log_b m^N$$

(EX) $2 \log_3 6 = ?$

$\log_3(6^2) = \log_3(36)$

(EX) $\log_5 x^y = ?$

$y \log_5 x$ The Biggie!! Very useful!!

Summary of 3 Logarithm Rules

ARL ⇒ $\log_b M + \log_b N = \log_b (MN)$

SRL ⇒ $\log_b M - \log_b N = \log_b \left(\frac{M}{N}\right)$

MRL ⇒ $N \log_b M = \log_b M^N$

Solving Equations using Logarithm Rules:

Ex 5 Pg 543 (A) $3\log_5 x - \log_5 4 = \log_5 16$

Since all the logs are base 5, start simplifying use LR's

$\log_5 x^3 - \log_5 4 = \log_5 16$

$\log_5 \left(\frac{x^3}{4}\right) = \log_5 (16)$

$\therefore \quad \frac{x^3}{4} = 16$

$x^3 = 64$

$\boxed{x = 4}$

(b) $\log_4 x + \log_4 (x-6) = 2$

$\log_4 (x)(x-6) = 2$

$\log_4 (x^2 - 6x) = 2$

$4^2 = x^2 - 6x$

$x^2 - 6x - 16 = 0$

Sum ⇒ -6
Prod ⇒ -16
$+2 \quad -8$

$(x+2)(x-8) = 0 \quad \therefore x = -2, 8$

CK $x=-2$ $\log_4(-2) + \ldots$

↑ CAN'T get A NEGATIVE NUMBER to base 4^x NO MATTER WHAT X is

$\therefore -2$ CANNOT be a solution (EXTRANEOUS)

CK $x=8$ $\log_4 8 + \log_4 (8-6) = 2$

$\log_4 16 = 2$ ✓

Homework: ① Memorize 3 LR's
② Pg 544 #7-10