BE - Alg. 2 | Monday 4-19-10

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~~ NOT WRITE AS:

$\log_{25^5} = \frac{1}{2}$

THIS SHOULD NOT LOOK LIKE AN EXPONENT OF 25

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

TIP: USE PARENTHESES!

② ⓐ $\boxed{6^3 = 216}$ ⓑ $\boxed{25^{\frac{1}{2}} = 5}$

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 <u>same</u> <u>base</u> so watch out, don't try to use LR's with different bases!

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

$\uparrow$ $\uparrow$

ADDING EXPONENTS $\Rightarrow$ MULTIPLYING POWERS WITH SAME BASE

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

TRUE?

$$3 + 4 = \log_2(128) = 7 \checkmark$$

(Since $2^7 = 128$)

AR $\Rightarrow$ WHEN ADDING logarithms WITH THE SAME base, multiply the powers

$$\boxed{\log_b M + \log_b N = \log_b MN}$$

Ex $\log_3 8 + \log_3 6 = ?$

$$\boxed{\log_3 48}$$

Ex $\log_5 XY = ?$

$$\boxed{\log_5 X + \log_5 Y}$$

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

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

$$\therefore \quad \underset{\substack{\uparrow \\ 4}}{\log_2 16} - \underset{\substack{\uparrow \\ 3}}{\log_2 8} = \log_2\left(\frac{16}{8}\right)$$

$$\stackrel{?}{=} \log_2 2$$

$$2^x = 2 \quad \boxed{x = 1} \checkmark$$

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

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

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

TOP

Bottom

$\sim -.6309$ ck $3^{-.6309} \cong .5 \checkmark$

Ex $\quad \log_4 \frac{X}{Y} = ?$

$$\boxed{\log_4 X - \log_4 Y}$$

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)

$$\boxed{N \log_b m = \log_b m^N}$$

EX $2 \log_3 6 = ?$

$\log_3(6^2) = \boxed{\log_3(36)}$

EX $\log_5 x^y = ?$

$\boxed{y \log_5 x}$ THE Biggie! Very USEFUL!!

Summary of 3 Logarithm Rules

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

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

MRL $\Rightarrow$ $N \log_b M = \log_b M^N$

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

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

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

$$\therefore \frac{X^3}{4} = 16$$

$$X^3 = 64$$

$$\boxed{X = 4}$$

(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

$+2 \quad -8$

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

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

Can't get a negative number to base 4^x no matter what x is

$\therefore -2$ cannot be a solution (Extraneous)

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

$\log_4 16 = 2$ ✓

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