Bahria College Zafar Campus
E-8 Islamabad

Class: 9th

Unit # 03

Logarithm

MEMORIZE THEM!!!

Exponential Reasoning

[1] $\log_a 1 = 0$ $\quad a^0 = 1$

[2] $\log_a a = 1$ $\quad a^1 = a$

[3] $\log_a a^x = x$ $\quad a^x = a^x$

Logarithmic Properties

Product Rule	$\log_a(xy) = \log_a x + \log_a y$
Quotient Rule	$\log_a\left(\frac{x}{y}\right) = \log_a x - \log_a y$
Power Rule	$\log_a x^p = p \log_a x$
Change of Base Rule	$\log_a x = \frac{\log_b x}{\log_b a}$
Equality Rule	If $\log_a x = \log_a y$ then $x = y$

Exercise 3.3:

Q1. Write the following into sum or difference.

(i) $\log(A \times B)$

By 1st law of logarithm:

$$\log(A \times B) = \log A + \log B =$$

(ii) $\log \frac{15.2}{30.5}$

By 2nd law of logarithm:

$$\log \frac{15.2}{30.5} = \log 15.2 - \log 30.5$$

(iii) $\log \frac{21 \times 5}{8}$

By 2nd law of logarithm:

$$\log \frac{21 \times 5}{8} = \log(21 \times 5) - \log 8$$

By 1st law of logarithm:

$$\log \frac{21 \times 5}{8} = \log 21 + \log 5 - \log 8$$

(iv) $\log \sqrt[3]{\frac{7}{15}}$

$$= \log\left(\frac{7}{15}\right)^{1/3}$$

By 3rd law of logarithm:

$$= \frac{1}{3}\log\frac{\mathbf{7}}{\mathbf{15}}$$

By 2nd law of logarithm:

$$= \frac{1}{3}\log 7 - \frac{1}{3}\log 15$$

(v) $\mathbf{\log\frac{22^{\frac{1}{3}}}{5^3}}$

By 2nd law of logarithm:

$$= \log 22^{\frac{1}{3}} - \log 5^3$$

By 3rd law of logarithm:

$$= \frac{1}{3}\log 22 - 3\log 5$$

(vi) $\mathbf{\log\frac{25\times47}{29}}$

By 2nd law of logarithm:

$$= \log(25 \times 47) - \log 29$$

By 1st law of logarithm:

$$= \log 25 + \log 47 - \log 29$$

Q3. Write the following in the form of a single logarithm.

(i) $\log 21 + \log 5$

$= \log(21 \times 5)$

$= \log 105$

(ii) $\log 25 + 2\log 3$

$= \log 25 + \log 3^2$

$= \log 25 + \log 9$

$= \log(25 \times 9)$

$= \log 225$

(iii) $2\log x - 3\log y$

$= \log x^2 - \log y^3$

$= \log \frac{x^2}{y^3}$

(iv) $\log 5 + \log 6 - \log 2$

$= \log \frac{5 \times 6}{2}$

$= \log 15$

Q2. Express $\log x - 2\log x + 3\log(x+1) - \log(x^2-1)$ as a single logarithm.

By re arranging

$$= \log x + 3\log(x+1) - \log(x^2-1) - 2\log x$$

$$= \log x + 3\log(x+1) - \{\log(x^2-1) + 2\log x\}$$

By 3rd law:

$$= \log x + \log(x+1)^3 - \{\log(x^2-1) + \log x^2\}$$

By 1st law:

$$= \log x(x+1)^3 - \{\log x^2(x^2-1)\}$$

By 2nd law:

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

Simplifying

$$= \log \frac{(x+1)^3}{x(x-1)(x+1)}$$

$$= \log \frac{(x+1)^2}{x(x-1)}$$

Q4. Calculate the following:

(i) $\log_3 2 \times \log_2 81$

***by 4th law*:**

$$= \frac{\log 2}{\log 3} \times \frac{\log 81}{\log 2}$$

simplifing

$$= \frac{\log 3^4}{\log 3}$$

by 1st law:

$$= \frac{4 \log 3}{\log 3}$$

$$= 4$$

(ii) $\log_5 3 \times \log_3 25$

***by 4th law*:**

$$= \frac{\log 3}{\log 5} \times \frac{\log 25}{\log 3}$$

simplifing

$$= \frac{\log 5^2}{\log 5}$$

by 1st law:

$$= \frac{2 \log 5}{\log 5}$$

$$= 2$$

Q.5 If $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 5 = 0.6990$, then find the values of the following.

i) $\log 32$ ii) $\log 24$

iii) $\log \sqrt{3\frac{1}{3}}$ iv) $\log \frac{8}{3}$

v) $\log 30$

Solution

i) $\log 32$

$\log_3 32$

$= \log (2 \times 2 \times 2 \times 2 \times 2)$

$= 5 \log 2^5$

$= 5 \log 2$

$= 5 (0.3010) = 1.5050$

ii) $\log 24$

$\log 24$

$= \log 8 \times 3$

$= \log 8 + \log 3$

$= \log 2^3 + \log 3$

$= 3 \log_2 + \log 3$

$= 3(0.3010) + 0.4771$

$= 0.9030 + 0.4771$

$= 1.3801$

iii) $\log \sqrt{3\frac{1}{3}}$

$= \log \left(\frac{10}{3}\right)^{\frac{1}{2}}$

$= \frac{1}{2} \log \frac{2 \times 5}{3}$

$= \frac{1}{2}[\log 2 + \log 5 - \log 3]$

$$= [0.3010 + 0.6990 - 0.4771]$$

$$= \frac{1}{2}[0.5230] = 0.2615$$

iv) $\log \frac{8}{3}$

$$\log \frac{2^3}{3}$$

$$= \log 2^3 \times \log 3$$

$$= 3 \log 2 - \log 3$$

$$= 3\,(0.3010) - 0.4771$$

$$= 0.9030 - 0.4771$$

$$= 0.4259$$

v) $\log 30$

$$\log (2 \times 3 \times 5)$$

$$= \log 2 + \log 3 + \log 5$$

$$= 0.3010 + 0.4771 + 0.6990$$

$$= 1.4771$$