3- Logarithmic & 4- Exponential Functions :-

In mathematics, the logarithmic is the inverse function to exponential. i.e the logarithm of a number x to the base b is the exponent to which b must be raised to produce x.

Ex 1)

$$\log_b x = y \quad = \quad b^y = x$$

base — logarithmic form fun — exponential form fun

Ex 2)

$$\log_{10} 1000 = 3 \quad = \quad 10^3 = 1000$$

* **Common logarithm :-**
It is the logarithm with base 10.

Evaluate logarithmic Function :-

Ex)

1- $\log_2 4 = 2$

2- $\log_2 8 = 3$

3- $\log_3 9 = 2$

4- $\log_3 27 = 3$

5- $\log_4 16 = 2$

6- $\log_2 32 = 5$

7- $\log_3 1 = 0$

8- $\log_{10} 10 = 1$

ملاحظة: في حالة لم يتم ذكر اساس (base) اللوغاريتم هنا يعتبر 10

9- $\log_{10} 100 = 2$

10- $\log 10000 = 4$

11- $\log(0.1) = -1$

12- $\log(0.01) = -2$

13- $\log(-5) = DNE$ "does not exist"

14- $\log(0) = DNE$

15- $\log_4(16) = 2$

16- $\log_4(\frac{1}{16}) = -2$

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Note:

$$\log_a b = \frac{\log b}{\log a}$$

Ex:

$\log_4 16 = 2 = \frac{\log 16}{\log 4} = 2$

$\log_2 8 = 3 = \frac{\log 8}{\log 2} = 3$

Natural logarithm :-

$\log_e x = \ln x$; $(\ln 1 = 0 , \ln e = 1$

Properities of logarithms :-

① $\log(xy) = \log(x) + \log(y)$

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

③ $\log x^n = n \log(x)$

Ex:

① Re-write the Following log expression into a single log $\log(x) + \log(y) - \log(z)$

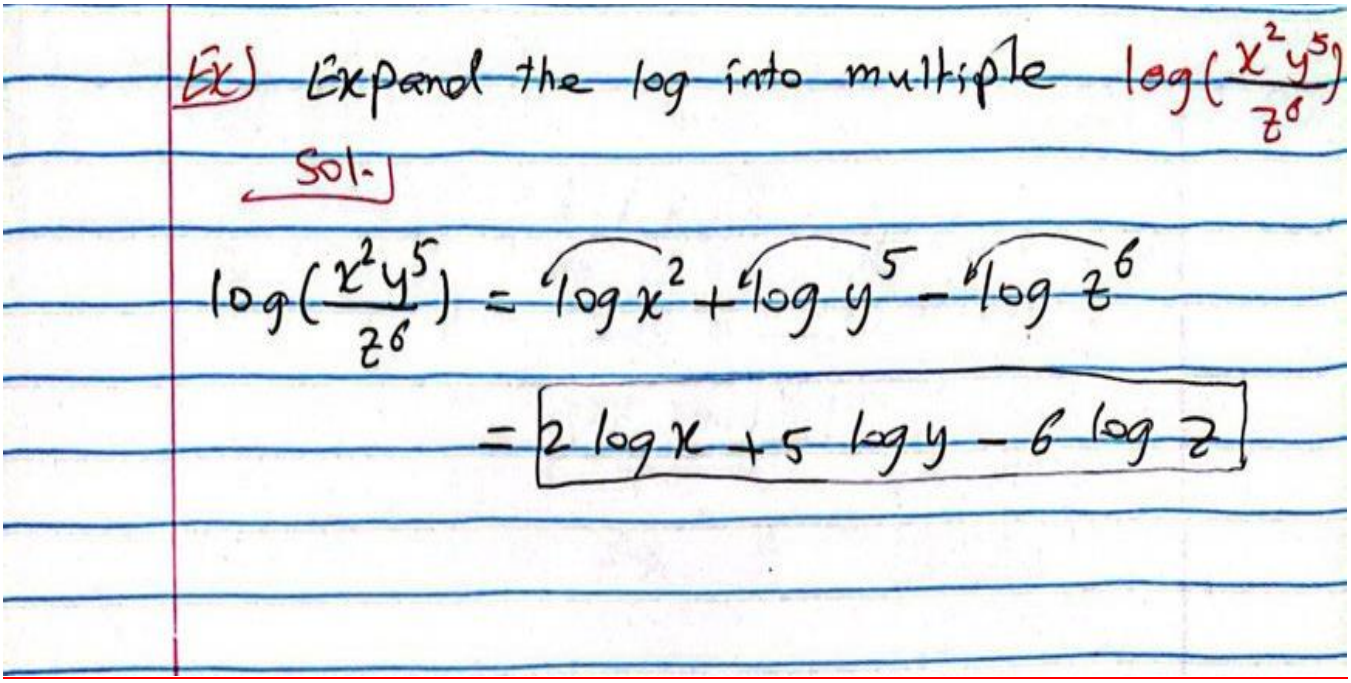
Sol:

$\log(x) + \log(y) - \log(z) = \boxed{\log\left(\frac{xy}{z}\right)}$

② $\log x - \log y + \log z - \log R = \boxed{\log\left(\frac{xz}{yR}\right)}$

③ $2\log x + 3\log y - 4\log z = \log x^2 + \log y^3 - \log z^4$

$= \boxed{\log \frac{x^2 y^3}{z^4}}$


Ex) Expand the log into multiple $\log\left(\frac{x^2y^5}{z^6}\right)$
Sol.
$\log\left(\frac{x^2y^5}{z^6}\right) = \log x^2 + \log y^5 - \log z^6$
$= 2\log x + 5\log y - 6\log z$