U3A Maths

12-Nov-2024 Term 4 / Week 5

Logarithms- Usage

- The "common" logarithms table which are used for calculations was published by Henry Briggs in 1617.

- Briggs table used a base of 10. Hence, $\log_{10} 1 = 0 \Rightarrow 10^0 = 1$
  $\log_{10} 10 = 1 \Rightarrow 10^1 = 10$

Recall,
if $y = a^x$ then $x = \log_a(y)$
where "a" is the base (=10),
y - Given number & x - logarithm

- Note that for a base value of 10;
  * range of given numbers from 1 to 10 is adequate, since values greater than 10 can be represented as below:

For Ex: $251.52 = 2.5152 \times 10^2$
$0.052 = 5.2 \times 10^{-2}$
etc.

  * of course, the number of (y) values in the table depends on the required precision. For a 4 digit precision the values range from 1.000 to 9.999

* Assuming an increment of 0.001, the table will have approx 10,000 values.

* The above precision is adequate for most engineering design calculations in practice.

* of course, higher precision requires more number of values! Briggs table had a 14 digit precision.

* Finally, the logarithm (x) values range from 0.0000 to 0.9999 for a 4 digit precision.

- Even though anti-logarithm values [ie, to find the number (y) for given logarithm (x)], can be found from the logarithm table, however, in practice it is common to provide a separate anti-logarithm table.

- Let us now practice the use of logarithms & anti-logarithms, using the table provided to you.

Ex.1

Find the $\log_{10}(2)$

While refering to the table, the value of "20" refers to "2.0".
By convention, the decimal point is "assumed"!

$\therefore \log_{10}(2.0) = 0.3010$

NOTE: The value given in the table is "3010"; the decimal point is "assumed", since the range of logarithm is from 0 to 1.

Note that, the 'y' values (given numbers) range from 1.0 to 10.0

& 'x' values (logarithms) range from 0.0 to 1.0

Ex.2

$\log_{10}(3.0) = 0.4771$

Ex.3

Calculate 2×3 $(= 6)$

$$\begin{aligned} \log_{10}(2) &= 0.3010 \\ + \log_{10}(3) &= 0.4771 \\ \hline & 0.7781 \end{aligned}$$

Now, find the anti-logarithm of 0.7781

From the anti-log table:

0.7781

Get value from "Main" table

Get value from "Difference" table

$$\begin{array}{r} 5998 \\ 1 \\ \hline 5999. \end{array} \Rightarrow 5.999$$

Note that the table lists the value as "5998", we have to provide the decimal point!!

Ex.4

Find $\log_{10}(2.5)$

From the table look for "25"

$\therefore \log_{10}(2.5) = 0.3979$

Ex 5 Find $\log_{10}(25.7)$

we have $25.7 = 2.57 \times 10^1$

$$\begin{aligned} \therefore \log_{10}(25.7) &= \log(2.57) + \log_{10}(10^1) \\ &= \log(2.57) + 1 . \log_{10}(10) \\ &= 0.4099 + 1 \\ &= 1.4099 \end{aligned}$$

Mantissa

Ex.6 Find antilog of 1.4099

Find antilog of 0.4099 from table
= 2.569

Mantissa

then multiply by 10^1

$\therefore$ The answer is 25.69