2.0 NUMERICAL PROCESSES (2) THEORY OF LOGARITHMS & INDICES

OBJECTIVES

1. Express statements given in index form (such as 81 = 3^4) as an equivalent logrithms statement (log 3 81 = 4).
2. Evaluate expression given in logarithms form.
3. Note the equivalence between the laws of indices and the law of logarithms
4. Recall and use the law of logarithms to simplify and/or evaluate given expression without the use of logarithm table.

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5. Use logarithms table for the purpose of calculation.

2.1 LAW OF LOGARITHMS & INDICES

The three fundamental law of indices can be stated in their equivalent logarithms form;

1. In indices: Y^a x Y^b = Y^a+b (Note ^ means Raise to power)

* In Logarithms: Log(MN) = Log M + Log N

2. In indices: Y^a ÷ Y^b = Y^a-b (Note ^ means Raise to power)

* In Logarithms: Log(M/N) = Log M - Log N

3. In indices: (X^a)^b = X^ab (Note ^ means Raise to power)

* In Logarithms: Log(M^p) = p log M

Theory Of Logarithms And Indices

Example 1: Simplify Log 8 + Log 5

solution;
Log 8 + Log 5 = Log(8x5)
Ans = Log 40

Example 2: Simplify Log 9 ÷ Log 3

solution;
Log 9 ÷ Log 3 = Log 9/Log 3

= Log 3^2 / Log 3^1 (Note / means All over)
= 2 Log 3 / 1 Log 3 (Log 3 will cancel Log 3)
= Log 2/1
Ans = Log 2

Example 3: Given that Log 2 = 0.30103; Calculate Log 5 without using table

solution;
Log 5 = Log 10/2
= Log 10 - Log 2 (Note: Log 10 = 1)
= 1 - 0.30103
Ans = 0.69897

Example 4: Evaluate Log base3(6.84) to 2 d.p

Theory Of Logarithms And Indices 2

solution;
Log3 (6.84)
= Let Log3 (6.84) = x
then 3^x = 6.84
= log(3^x) = log(6.84)
x = log(6.84) / log(3)
x = 0.8351 / 0.4771
Ans = 1.75

2.2 CALCULATIONS USING LOGARITHM TABLE

Example 1: Evaluate 82.47 x 24.85 / 209.3

solution;
Draw a table form with "No & Log"

No 82.47 = log 1.9163 (No means Number)
No 24.85 = log 1.3954
Add together = 3.3117

No 209.3 = log -2.2307 (from log table)
Deduct -2.2307 from 3.3117

= 3.3117 - 2.2307
Ans = 0.9910

2.3 LAW OF INDICES

The following laws of indices are true for all non-zero value a, b and x

1. X^a x X^b = X^a+b (Note ^ means Raise to power)

2. X^a ÷ X^b = X^a-b (Note ^ means Raise to power)

3. X^0 = 1

4. X^-1 = 1 / X^a (Note / means All over)

5. (X^a)^b = X^ab

6. X^1/a = a√x (Note √ means Square root)

7. X^a/b = b√x^a or (b√x)^a

Theory Of Logarithms And Indices 3

2.3.1 WORKED EXAMPLES

Example 1: Simplify 25^1/2

solution;
25^1/2 = √25
Ans = 5

Example 2: 4^3 ÷ 4^5

solution;
4^3 ÷ 4^5 = 4^3-5
= 4^2
= 1 / 4^2
Ans = 1/16

Theory Of Logarithms And Indices 4

REVISION EXERCISE

[1] Simplify 3^8 x 3^3
[2] Simplify 5^3 x 5^-1
[3] Express Log 3 + Log 4
[4] Evaluate 3Log2 + Log20 - Log1.6

[5] Simplify Log 8 - Log 4
[6] Simplify Log 8 ÷ Log 4
[7] Simplify Log 4 / Log 2
[8] Simplify (27/48)^3/2
[9] Simplify 3^6 ÷ 3^2
[10] Simplify (4/25)^-1/2 x (2^4) ÷ (15/2)^-2

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