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SULTAN SALAHUDDIN ABDUL AZIZ SHAH

ENGINEERING MATHEMATICS BOOK

EXPONENTS and LOGARITHMS

Discussing the fundamental

Aliza Md Atan
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Halimaton Sa'adiah Sa'don

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Exponent and Logarithm

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PREFACE

Exponent and Logarithm has been developed to meet the requirements of the **ENGINEERING MATHEMATICS 2 (DBM20023)** polytechnic course syllabus. This topic written by the lecturers from the Department of Mathematics, Science and Computer, Polytechnic Sultan Salahuddin Abdul Aziz Shah (PSA). We have put in all the necessary effort and passion into this project. We hope this module is easy to understand and relatable to polytechnic's student.

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EXPONENTS

1.0 Exponents

INTRODUCTION

Exponents are a convenient tool in mathematics to compactly denote the process of taking a power is simply a case of repeated multiplication of a number with itself while taking a root is just equivalent to taking a fractional power of the number. Therefore it is important to clearly understand the understand the concept as well as the laws of exponent to be able to apply them later in important applications.

We will first understand the formal notation for writing a number with an index, followed by the laws governing it.

Exponent numbers of index

$$a^n$$

a is base and n is exponents or index or power

In the expression

$$3^2$$

the index or exponent is 2. The base is 3

1.1 Rules of exponent

These rules provide useful techniques for simplifying algebraic expression.

Name	Rule	Explanation	Examples
Product Rule	$x^a \bullet x^b = x^{a+b}$	add the exponents	$x^2 \bullet x^3 = x^5$
Power of a Power Rule	$(x^a)^b = x^{a \bullet b}$	multiply the exponents	$(x^2)^3 = x^6$
Power of a Product Rule	$(ax)^b = a^b \bullet x^b$	each base is to the exponent	$(2x)^3 = 2^3 \bullet x^3$ $= 8x^3$
Quotient Rule	$\frac{x^a}{x^b} = x^{a-b}$	subtract the exponents	$\frac{x^5}{x^3} = x^2$
Negative Exponent Rule	$x^{-a} = \frac{1}{x^a}$	flip the term in a fraction and change sign of exponent	$\frac{1}{x^{-6}} = x^6$ $x^{-8} = \frac{1}{x^8}$
Zero Exponent Rule	$x^0 = 1$	anything to the zero equals 1	$7x^0 = 7(1) = 7$
Fractional Exponent Rule	$\sqrt[b]{x^a} = x^{\frac{a}{b}}$	inside exponent goes on top, outside number goes on bottom	$\sqrt[9]{x^4} = x^{\frac{4}{9}}$ $\sqrt{x} = x^{\frac{1}{2}}$

1.2 Simplify index by using rules of exponent

Solve the following equations

$$3^x = 3^{x+1} - 6$$

Solution :

$$3^x = 3^{x+1} - 6$$

$$3^x = 3^x \bullet 3^1 - 6 \quad if \quad 3^x = q$$

$$q = 3q - 6$$

$$q - 3q = -6$$

$$-2q = -6$$

$$q = \frac{-6}{-2}$$

$$q = 3$$

$$\therefore \quad 3^x = q$$

$$3^x = 3$$

$$3^x = 3^1$$

$$\therefore \quad x = 1$$

1.2 Simplify index by using rules of exponent

Simplifying algebraic expression involving exponent below:

$$\frac{3^5 x \ 3^6}{3^4}$$

Solution :

$$\frac{3^5 x \ 3^6}{3^4}$$

$$= \frac{3^{5+6}}{3^4}$$

$$= \frac{3^{11}}{3^4}$$

$$= 3^{11-4}$$

$$= 3^7$$

Remember this formula!!!

Product Rule : $x^a \bullet x^b = x^{a+b}$

Quotient Rule : $\frac{x^a}{x^b} = x^{a-b}$

1.2 Simplify index by using rules of exponent

Simplifying algebraic expression involving exponent below:

$$3^{n+2} \times 9^{n} \div 27^{n}$$

Solution :

$$3^{n+2} \times 9^{n} \div 27^{n}$$

$$= 3^{n+2} \times \left(3^{2}\right)^{n} \div \left(3^{3}\right)^{n}$$

$$= 3^{n+2} \times 3^{2n} \div 3^{3n}$$

$$= 3^{n+2+2n-3n}$$

$$= 3^{0+2}$$

$$= 3^{2}$$

$$= 9$$

changing base

use algebraic functions

1.2 Simplify index by using rules of exponent

Simplifying algebraic expression involving exponent below:

$$\frac{\left(4m^2 n^6\right)^{\frac{1}{2}}}{\sqrt[4]{m^4 n^8}}$$

Solution :

$$\frac{\left(4m^2 n^6\right)^{\frac{1}{2}}}{\sqrt[4]{m^4 n^8}}$$

$$= \frac{4^{\frac{1}{2}} m^{2\left(\frac{1}{2}\right)} n^{6\left(\frac{1}{2}\right)}}{m^{4\left(\frac{1}{4}\right)} n^{8\left(\frac{1}{4}\right)}}$$

$$= \frac{2m^1 n^3}{m^1 n^2}$$

$$= 2\,m^{1-1} n^{3-2}$$

$$= 2m^0 n^1$$

zero exponent

$$= 2(1)n^1$$

$$= 2n$$

Remember this formula!!!

Product Rule : $x^a \bullet x^b = x^{a+b}$

Quotient Rule : $\frac{x^a}{x^b} = x^{a-b}$

1.2 Simplify index by using rules of exponent

Simplifying algebraic expression involving exponent below:

$$\frac{\sqrt[3]{a^2b^4}}{\sqrt[3]{a^4b^2}}$$

Solution :

$$\frac{\sqrt[3]{a^2b^4}}{\sqrt[3]{a^4b^2}}$$

$$=\frac{\left(a^2b^4\right)^{\frac{1}{3}}}{\left(a^4b^2\right)^{\frac{1}{3}}}$$

fractional exponent rule

$$=\frac{a^{\frac{2}{3}}n^{\frac{4}{3}}}{a^{\frac{4}{3}}b^{\frac{2}{3}}}$$

$$=a^{\frac{2}{3}-\frac{4}{3}}b^{\frac{4}{3}-\frac{2}{3}}$$

$$=a^{-\frac{2}{3}}b^{\frac{2}{3}}$$

$$=\frac{b^{\frac{2}{3}}}{a^{\frac{2}{3}}}$$

$$=\sqrt[2]{\left(\frac{b}{a}\right)^3}$$

1.2 Simplify index by using rules of exponent

Simplifying algebraic expression involving exponent below:

$$\frac{\left(6m^9n^4\right)^0\left(4mn^2\right)^{-2}}{-2\left(8m^3\right)\left(m^{-2}\right)}$$

Solution :

zero exponent rule

$$\frac{\left(6m^9n^4\right)^0\left(4mn^2\right)^{-2}}{-2\left(8m^3\right)\left(m^{-2}\right)}$$

$$=\frac{(1)\left(\left(4^{-2}\right)\left(m^{-2}\right)\left(\left(n^2\right)^{-2}\right)\right)}{-2(8)\left(m^3\right)\left(n^{-2}\right)}$$

$$=\frac{4^{-2}m^{-2}n^{-4}}{-16m^3n^{-2}}$$

$$=\frac{4^{-2}m^{-2}n^{-4}}{-4^2m^3n^{-2}}$$

$$=-4^{-2-2}m^{-2-3}n^{-4-(-2)}$$

$$=-4^{-4}m^{-5}n^{-2}$$

$$=-\frac{1}{4^4m^5n^2}$$

Remember this formula!!!

Product Rule : $x^a \bullet x^b = x^{a+b}$

Quotient Rule : $\frac{x^a}{x^b} = x^{a-b}$

1.2 Simplify index by using rules of exponent

Use laws of exponent to simplify this expression:

$$k^{\frac{3}{2}} \div k^{4} \times k^{-1}$$

Solution :

$$k^{\frac{3}{2}} \div k^{4} \times k^{-1}$$

$$= k^{\frac{3}{2}-4+(-1)}$$

$$= k^{\frac{3}{2}-\frac{8}{2}-\frac{2}{2}}$$

$$= k^{-\frac{7}{2}}$$

$$= \frac{1}{k^{\frac{7}{2}}}$$

Remember this formula!!!

Product Rule : $x^{a} \cdot x^{b} = x^{a+b}$

Quotient Rule : $\frac{x^{a}}{x^{b}} = x^{a-b}$

More Information of Exponent

MORE INFO CLICK HERE

Exponent Equation

Exponent Function

LOGARITHMS

2.0 Logarithm

INTRODUCTION :

Logarithms were introduced by John Napier in the early 17th century as a means to simplify calculations. There were rapidly adopted by navigators, scientist, engineer, and others to perform computation more easil, using slide rules and logarithm tables. Tedious multi-digit multiplication steps can be replaced by table look-ups and simpler addition because of the fact - important in its own right.

In Mathematic, the logarithm is the inverse function to exponentiatio. That means the logarithm of a given number x is the exponent to which another fixed number, the base b must be raised, to produce that number x

Expressed mathematically:

$$b^x = n$$

x is the logarithm of to n the base b .

In which case one writes

$$x = \log_b n$$

EXAMPLE :

$$2^3 = 8$$

Therefore, 3 is the logarithm of 8 to base 2, or

$$3 = \log_2 8$$

Expressed mathematically:

$$6^1 = 6$$

1 is the logarithm of to 6 the base 6 .

In which case one writes

$$1 = \log_6 6$$

EXAMPLE :

$$4^3 = 81$$

Therefore, read as "the logarithm of 81 to the base 3 is 4

$$3 = \log_4 81$$

Expressed mathematically:

$$3^2 = 9$$

2 is the logarithm of to
9 the base 3 .

In which case one writes

$$2 = \log_3 9$$

2.1 Rules of logarithm

Rule 1: $\log_b(M \cdot N) = \log_b M + \log_b N$

Rule 2: $\log_b\left(\frac{M}{N}\right) = \log_b M - \log_b N$

Rule 3: $\log_b\left(M^k\right) = k \cdot \log_b M$

Rule 4: $\log_b(1) = 0$

Rule 5: $\log_b(b) = 1$

Rule 6: $\log_b\left(b^k\right) = k$

Rule 7: $b^{\log_b(k)} = k$

Where:

$b > 0$ but $b \neq 1$, and M, N, and k are real numbers but M and N must be positive!

2.2 Simplify index by using rule of logarithm

Use laws of logarithm to simplify this expression:

$$\frac{1}{2}-8\log_a x-6\log_a y$$

Solution :

$$\frac{1}{2}-8\log_a x-6\log_a y$$

$$=\frac{1}{2}\log_a a-8\log_a x-6\log_a y$$

$$=\log_a a^{\frac{1}{2}}-\log_a x^8-\log_a y^6$$

$$=\log_a\left(\frac{a^{\frac{1}{2}}}{x^8}\right)-\log_a y^6$$

$$=\log_a\left(\frac{\sqrt{a}}{x^8}\div y^6\right)$$

$$=\log_a\left(\frac{\sqrt{a}}{x^8 y^6}\right)$$

note :

That if we have logarithm expression that have the same base, we can simplify it into a single logarithm by applying laws of logarithms that we have learn previously

2.2 Simplify index by using rule of logarithm

Use laws of logarithm to simplify this expression:

$$4\log_8 2 + \log_8 32 - \log_8 128$$

Solution :

$$4\log_8 2 + \log_8 32 - \log_8 128$$
$$= \log_8 2^4 + \log_8 32 - \log_8 128$$
$$= \log_8 \left(2^4 \times 32\right) - \log_8 128$$
$$= \log_8 512 - \log_8 128$$
$$= \log_8 \left(\frac{512}{128}\right)$$
$$= \log_8 4$$

Remember this formula :

Rule 1: $\log_b (M \cdot N) = \log_b M + \log_b N$

Rule 2: $\log_b \left(\frac{M}{N}\right) = \log_b M - \log_b N$

2.2 Simplify index by using rule of logarithm

a. $Given \log 2 = 0.301 \ and \log 6 = 0.778. Find \log 12.$

Solution :

$$
\begin{aligned}
\log 12 &= \log(2 \times 6) \\
&= \log 2 + \log 6 \\
&= 0.301 + 0.778 \\
&= 1.079
\end{aligned}
$$

b. $Given \ \log_2 3 = 1.585 \ \ and \log_2 5 = 2.322$. Without using a calculator, find the value of $\log_2 9$.

Solution :

$$
\begin{aligned}
\log_2 9 &= \log_2(3 \times 3) \\
&= \log_2 3 + \log_2 3 \\
&= 1.585 + 1.585 \\
&= 3.17
\end{aligned}
$$

2.2 Simplify index by using rule of logarithm

Find the values of a :

a. $3 = \log_a 125$

Solution :

$$3 = \log_a 125$$
$$3\log_a a = \log_a 125$$
$$\log_a a^3 = \log_a 125$$
$$a^3 = 125$$
$$a^3 = 5^3$$
$$a = 5$$

b. $-2 = \log_a\left(\frac{1}{25}\right)$

Solution :

$$-2 = \log_a\left(\frac{1}{25}\right)$$
$$-2\ \log_a a = \log_a\left(\frac{1}{25}\right)$$
$$a^{-2} = \left(\frac{1}{25}\right)$$
$$\frac{1}{a^2} = \frac{1}{25}$$
$$\frac{1}{a^2} = \frac{1}{5^2}$$
$$a = 5$$

2.2 Simplify index by using rule of logarithm

Write the following expression as addition or subtraction of logarithms.

a. $\log \frac{1}{100b^2}$

Solution :

Rule 1 and 3

$$\begin{aligned}
&\log \frac{1}{100b^2} \\
&= \log 1 - \left(\log 10 = \log b^2\right) \\
&= 0 - \log 100 - 2\log b \\
&= -\left(\log 100 + 2\log b\right) \\
&= -2\left(1 + \log b\right)
\end{aligned}$$

b. $\log \sqrt{\frac{ab^3}{c}}$

Solution :

$$\begin{aligned}
&\log \sqrt{\frac{ab^3}{c}} \\
&= \log\left(\frac{ab^3}{c}\right)^{1/2} \\
&= 1/2\left(\log ab^3 - \log c\right) \\
&= 1/2 \log ab^3 - 1/2 \log c \\
&= 1/2 \log a + 1/2 \log b^3 - 1/2 \log c \\
&= 1/2 \log a + \frac{3}{2} \log b - 1/2 \log c
\end{aligned}$$

2.2 Simplify index by using rule of logarithm

Solve the following equations:

a. $7^x = 12$

Solution :

$$7^x = 12$$
$$\log \textit{both side},$$
$$x\log 7 = \log 12$$
$$x = \frac{\log 12}{\log 7}$$
$$= \frac{1.079}{0.845}$$
$$= 1.2769$$

b. $\log_2 0.5$

Solution :

$$\log_2 0.5$$
$$\textit{Assume} \log_2 0.5 = x$$
$$\log_2 0.5 = x$$
$$0.5 = 2^x, \textit{where}\ \ 0.5 = \frac{1}{2}$$
$$\frac{1}{2} = 2^x$$
$$2^{-1} = 2^x$$
$$-1 = x$$

2.2 Simplify index by using rule of logarithm

Given that $\log_2 3 = 1.5850$ and $\log_2 5 = 2.3219$, without using calculator, find the following value.

a. $\log_2 270$

Solution :

$$= \log_2(27 \times 10)$$
$$= \log_2 27 + \log_2 10$$
$$= \log_2 3^2 + \log_2 5$$
$$= 3\log_2 3 + \log_2 5$$
$$= 3(1.5850) + 2.3219$$
$$= 6.9069$$

b. $\log_2(3)^3 + \log_2(5 \times 2)$

Solution :

$$\log_2(3)^3 + \log_2(5 \times 2)$$
$$= 3\log_2 3 + \log_2 5 + \log_2 2$$
$$= 3(1.5850) + 2.3219 + 1$$
$$= 8.0769$$

2.2 Simplify index by using rule of logarithm

Solve the following equations:

a. $2\log_2 5 - \log_2 100 + 3\log_2 4$

Solution :

$$
\begin{aligned}
&2\log_2 5 - \log_2 100 + 3\log_2 4 \\
&= 2\log_2 5 - \log_2 100 + 3\log_2 4 \\
&= \log_2 5^2 - \log_2 100 + \log_2 4^3 \\
&= \log_2\left(\frac{25\times 64}{100}\right) \\
&= \log_2 16
\end{aligned}
$$

b. $\log_3 \frac{1}{9}$

Solution :

$$
\begin{aligned}
&\log_3 \frac{1}{9} \\
&= \log_3 9^{-1} \\
&= \log_3 \left(3^2\right)^{-1} \\
&= \log_3 3^{-2} \\
&= -2\log_3 3 \\
&= -2(1) \\
&= -2
\end{aligned}
$$

More Information of Logarithm

Logarithm Trick

Common Logarithm

CHANGING THE BASE OF LOGARITHMS

3.0 Changing The Base of Logarithms

Logarithms to base 10 are called Common Logarithms. Common Logarithms can be evaluated using a scientific calculator. However, we cannot use scientific calculator in order to find the values of logarithms besides base 10. This problem can be solved by using the formula below :

Changing Base of Log

a. $\log_a b = \dfrac{\log_c b}{\log_c a}$

b. $\log_a b = \dfrac{1}{\log_b a}$

formula to remember!!!

3.0 Changing The Base of Logarithms

Example:

a.

$$\log_3 45 = \frac{\log_{10} 45}{\log_{10} 3}$$
$$= \frac{1.6532}{0.4771}$$
$$= 3.465$$

b.

$$\log_2 0.096 = \frac{\log_{10} 0.096}{\log_{10} 2}$$
$$= \frac{-1.0177}{0.3010}$$
$$= -3.381$$

changing the base

c.

$$\log_2 x = \log_x 16$$
$$\log_2 x = \frac{\log_2 16}{\log_2 x}$$
$$(\log_2 x)^2 = \log_2 16$$
$$(\log_2 x)^2 = 4$$
$$(\log_2 x) = \pm 2$$
$$\log_2 x = 2 \quad or \quad \log_2 x = -2$$
$$x = 2^2 \quad or \quad x = 2^{-2}$$
$$x = 4 \quad or \quad x = \tfrac{1}{4}$$

3.0 Changing The Base of Logarithms

Example:

Given $2\log_3 p - 2 = \log_9 q$. Express ***q*** in the term of ***p*** :

$$2\log_3 p - 2 = \log_9 q$$

$$2\log_3 p - \log_9 q = 2$$

changing the base

$$\log_3 p^2 - \left(\frac{\log_3 q}{\log_3 9}\right) = 2$$

$$\log_3 p^2 - \left(\frac{\log_3 q}{\log_3 3^2}\right) = 2$$

$$\log_3 p^2 - \left(\frac{\log_3 q}{2\log_3 3}\right) = 2$$

$$\log_3 p^2 - \left(\frac{\log_3 q}{2(1)}\right) = 2$$

$$2\log_3 p^2 - (\log_3 q) = 4$$

$$\log_3 (p^2)^2 - (\log_3 q) = 4$$

$$\log_3 \left(\frac{p^4}{q}\right) = 4$$

$$\log_3 \left(\frac{p^4}{q}\right) = 4\log_3 3$$

$$\log_3 \left(\frac{p^4}{q}\right) = \log_3 3^4$$

$$\left(\frac{p^4}{q}\right) = 3^4$$

$$\frac{p^4}{q} = 81$$

$$\therefore \quad q = \frac{p^4}{81}$$

3.0 Changing The Base of Logarithms

Given $\log_2 = 1.585 \; and \; \log_2 5 = 2.322$. Without using a calculator, find the value of $\log_6 1.5$

changing the base

$$\log_6 1.5 = \frac{\log_2 1.5}{\log_2 6}$$

$$= \frac{\log_2 \left(\frac{3}{2}\right)}{\log_2 (3(2))}$$

$$= \frac{\log_2 3 - \log_2 2}{\log_2 3 + \log_2 2}$$

$$= \frac{\log_2 3 - (1)}{\log_2 3 + (1)}$$

$$= \frac{1.585 - 1}{1.585 + 1}$$

$$= \frac{0.585}{2.585} = 0.226$$

3.0 Changing The Base of Logarithms

Solve $\log_6 64$

a method : Exponent

$$
\begin{aligned}
\log_6 64 &= m \\
2^m &= 64 \\
2^m &= 2^6 \\
\therefore \quad m &= 6
\end{aligned}
$$

b method : Changing base

$$
\begin{aligned}
\log_6 64 &= \frac{\log_{10} 64}{\log_{10} 2} \\
&= \frac{1.806}{0.301} \\
&= 6
\end{aligned}
$$

$$
\begin{aligned}
\log_6 64 &= \log_2 2^6 \\
&= 6\log_2 2 \\
&= 6(1) \\
&= 6
\end{aligned}
$$

c method : Changing base

EXPONENT AND LOGARITHMIC EQUATIONS

4.0 Exponent and Logarithmic Equations

Equations involving exponent and logarithmic can be solved using the following properties:

$$a^x = a^y \longrightarrow x = y$$
$$\text{and} \quad \log_a x = \log_a y \longrightarrow x = y$$

formula to remember!!!

$$3^{x+1} = 15$$
$$\log 3^{x+1} = \log 15$$
$$(x+1)\log 3 = \log 15$$
$$(x+1) = \frac{\log 15}{\log 3}$$
$$(x+1) = 2.465$$
$$x = 1.465$$

4.0 Exponent and Logarithmic Equations

Equations involving exponent and logarithmic can be solved using the following properties:

$$a^x = a^y \longrightarrow x = y$$

$$\text{and} \quad \log_a x = \log_a y \longrightarrow x = y$$

formula to remember!!!

$$9^x + 20 = 3^{x+2}$$
$$\log 9^x + \log 20 = \log 3^{x+2}$$
$$x \log 9 + \log 20 = (x+2)\log 3$$
$$x \log 3^2 + \log 20 = (x+2)\log 3$$
$$2x[\log 3] - (x+2)[\log 3] = -\log 20$$
$$2x - x - 2[\log 3] = -\log 20$$
$$x - 2 = \frac{-\log 20}{\log 3}$$
$$x = \frac{-\log 20}{\log 3} + 2$$
$$= -0.726$$

4.0 Exponent and Logarithmic Equations

Find the value of ***x*** for :

$$2^{3x} = 15^{x-2}$$

$$\log_{10} 2^{3x} = \log_{10} 15^{x-2}$$

$$(3x)\log_{10} 2 = (x-2)\log_{10} 15$$

$$\frac{3x}{x-2} = \frac{\log 5}{\log 2}$$

$$\frac{3x}{x-2} = 2.32x - 4.64$$

$$3x - 2.32x = -4.64$$

$$x = -6.82$$

formula to remember!!!

$$a^x = a^y \longrightarrow x = y$$

$$and \quad \log_a x = \log_a y \longrightarrow x = y$$

4.0 Exponent and Logarithmic Equations

Find the value of ***y*** for :

$$\log(3-y)-\log(y+6)=2\log 5$$

$$\log\frac{(3-y)}{(y+6)}=\log 5^2$$

$$\therefore\frac{(3-y)}{(y+6)}=25$$

$$3-y=25y+150$$

$$26y=147$$

$$y=\frac{147}{-26}\quad or\quad -5.6538$$

formula to remember!!!

$$a^x=a^y \longrightarrow x=y$$

$$and\quad \log_a x=\log_a y \longrightarrow x=y$$

4.0 Exponent and Logarithmic Equations

Simplify the equation below :

$$\log 3 + \log 5 - 4\log 2 + 2\log\frac{3}{5}$$

$$= \log 3 + \log 5 - \log(2)^4 + \log\left(\frac{3}{5}\right)^2$$

$$= \log\left(\frac{3x5}{2^4} x \frac{3^2}{5^2}\right)$$

$$= \log\frac{27}{80}$$

formula to remember!!!

$$a^x = a^y \longrightarrow x = y$$

$$and \quad \log_a x = \log_a y \longrightarrow x = y$$

4.0 Exponent and Logarithmic Equations

Given $\log_2 3 = 0.1213$ *and* $\log_2 5 = 1.7172$. Determine the value of following without using calculator

a $\log_{27} 25$

changing the base

$$
\begin{aligned}
&\log_{27} 25 \\
&= \frac{\log_2 25}{\log_2 27} \\
&= \frac{\log_2 5^2}{\log_2 3^3} \\
&= \frac{2\log_2 5}{3\log_2 3} \\
&= \frac{2(1.7172)}{3(0.1213)} \\
&= \frac{3.4344}{0.3639} \\
&= 9.4378
\end{aligned}
$$

4.0 Exponent and Logarithmic Equations

Given $\log_2 3 = 0.1213 \quad and \quad \log_2 5 = 1.7172$. Determine the value of following without using calculator

b $\log_4 125$

$$\log_4 125$$

$$= \frac{\log_2 125}{\log_2 4}$$

$$= \frac{\log_2 5^3}{\log_2 2^2}$$

$$= \frac{3\log_2 5}{2\log_2 2}$$

$$= \frac{3(1.7172)}{2(1)}$$

$$= \frac{5.1516}{2}$$

$$= 2.5758$$

changing the base

References

Futher Engineering Mathematics,Programmes & Problemmes, K.A Stroud Second Edition, The Mac Millan Press Ltd. (1990)

James Steward (2012). Calculus (7th Edition). Brook/Cole. (ISBN : 978-0-538-49781-7)

Rozanna Sa'ari (2016). Engineering Mathematics 2 (DBM2013) Step By Step Module (1st Edition). Mathematic, Science and Computer Department, Polytechnic of Sultan Haji Ahmad Shah.

Bird, J. (2021). Higher Engineering Mathematics (9th Edition). New York : Rout ledge

Nariman, Diana, Husniyat, Lee Ten Ten, Nor Aishah, Siti Nurul Huda dan Kang Sian Lee. Engineering Mathematics 2 (2019). Politeknik Sultan Salahudin Abdul Aziz Shah : Muhibbah Publication.

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